UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	**)**	**Docket No. 52-011-ESP**
	)	
Southern Nuclear Operating Company	**)**	**ASLBP No. 07-850-01-ESP-BD01**
	)	
(Early Site Permit for Vogtle ESP Site)	**)**	**January 9, 2009**

SOUTHERN NUCLEAR OPERATING COMPANY'S TESTIMONY OF THOMAS MOORER CONCERNING EC 1.2

Q1. **Please state your name and address.**

A1. My name is Thomas Claibourne Moorer. My business address is: 42 Inverness Center Parkway, Birmingham, AL 35242-4809.

Q2. **Please state your employer, position, and current responsibilities.**

A2. I am currently employed by Southern Nuclear Operating Company ("SNC") as the Project Manager-Environmental. In that capacity, I am responsible for all environmental support activities for new plant and license renewal work for SNC. I was responsible for developing the Environmental Report filed by SNC as part of the Early Site Permit application for Vogtle Units 3 and 4 and all supporting activities. *See* Exhibit SNC000014 (Thomas C. Moorer Curriculum Vitae).

Q3. **Please summarize your education and professional qualifications.**

A3. I earned a Bachelor of Science degree in Environmental Science from Auburn University and a Bachelor of Science in Civil/Environmental Engineering from the University of Alabama. I have over 30 years of experience in the environmental field, including 18+ years of experience in environmental engineering, licensing, and regulatory compliance

in nuclear power. I have over 15 years of experience working in NEPA matters, including the development of Environmental Reports for Environmental Impact Statements supporting NRC licensing actions. I am heavily involved in the work of various industry groups, including EPRI, EEI, and NEI, and have both authored and co-authored numerous technical publications in the environmental field.

Since 2005, I have been responsible for all environmental support for new plants and license renewals, including development of the Environmental Reports ("ERs") for the Vogtle Early Site Permit ("ESP"), Combined Construction and Operating License ("COL") and License Renewal applications to NRC. I am responsible for interface with NRC for review of the ERs and subsequent EIS development, site audits and public meetings and for coordination with state and Federal agencies regarding ESP, COL, and License Renewal activities. Prior to 2005, I worked as the SNC Environmental Services Supervisor for over 15 years and managed the technical and regulatory support for permitting and environmental compliance in the areas of water, air, solid/hazardous waste, mixed waste, chemistry and hazardous materials for all three SNC plants. I have extensive NEPA experience, including the management of environmental support for the Plant Farley and Plant Hatch license renewals, as well as EPRI and NEI work associated with development of the NEI License Renewal Guideline. I worked with NRC on the development of the Generic Environmental Impact Statement ("GEIS") for license renewal. I also provided project management for numerous major environmental projects including technical studies to resolve NPDES permitting issues, wetlands and endangered species work, US Army Corps of Engineers permitting, and studies related to license renewal.

Q4. **What is the purpose of your testimony?**

A4. I will testify regarding preparation of the ER, *see* SNC000001 (Environmental Report for Southern Nuclear Operating Company's Vogtle Early Site Permit Application), as part of the ESP application for Vogtle Units 3 and 4 and regarding the analysis of aquatic impacts in the ER and the EIS. I am also providing separate testimony with respect to EC 1.3 and EC 6.0.

Q5. **What was your role in the preparation of the ESP Application?**

A5. I was responsible for the preparation of the Environmental Report (ER) and coordination of the environmental review process with the NRC staff. The ER was prepared at my direction and under my supervision by a contractor, Tetra-Tech, located in Aiken, South Carolina and a number of sub-contractors employed by Tetra-Tech to provide expertise in various disciplines. I reviewed the requirements identified in NRC guidance and in consultation with my staff and the contractor, assigned responsibility for development of draft sections of the ER in accordance with NRC requirements and guidance. Each of these draft sections was reviewed by me and by the Tetra-Tech project manager. After completion of all required sections, a draft ER was assembled and reviewed by me, my staff, and industry peers, and final comments were developed. A final version was produced, merged with the ESP application, and reviewed again for form and content prior to submittal.

I was also responsible for preparing responses to Requests for Additional Information (RAIs) from NRC, coordination of NRC and NRC contractor, and other regulatory agency site visits, public meetings, and development of comments on the draft Environmental Impact Statement (DEIS).

Q6. Describe the NRC requirements and guidance for preparation of an ER.

A6. NRC regulation 10 CFR 52.17(a)(2) specifies the contents of an environmental report for an ESP application and Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations (Revision 2, July 1976; RG 4.2) provides guidance to applicants preparing environmental reports for nuclear power stations. The NRC's Standard Review Plans for Environmental Reviews for Nuclear Power Plants (1999; NUREG-1555) provides guidance for NRC staff to use when conducting environmental reviews of applications related to nuclear power plants. RG 4.2 is over 30 years old (July 1976) and NUREG-1555 is relatively new. Based on discussion with NRC staff and industry peers, SNC selected to rely primarily on NUREG – 1555 (ESRP) for guidance in establishing the format and content of its environmental report. SNC provided additional information and organization in the material presented, as deemed appropriate, when applying lessons learned from the first three ESP applicants. SNC also consulted NRC's Generic Environmental Impact Statement for License Renewal of Nuclear Plants (1996; NUREG-1437) for input in assessing the impacts of the new nuclear units on the VEGP site. SNC concluded that NUREG-1437 environmental issues, significance determination criteria, and significance conclusions could be relevant to the ESP environmental review. SNC indicated in its ER where it has applied NUREG-1437 to supplement assessment of VEGP environmental impacts.

Q7. **Do you agree with the assertion that the ER/EIS fails to identify and adequately consider the impacts of the proposed cooling system intake and discharge structures on aquatic resources?**

A7. No. The ER and subsequent information collected during site visits and through responses to the Staff's RAIs provide a clear assessment of the direct, indirect, and cumulative impacts associated with the proposed intake and discharge systems for Vogtle Units 3 and 4. The Vogtle ER and responses to RAIs provided more than a hundred references describing the baseline conditions of the Savannah River in the area near Vogtle. In addition, the Final Environmental Impact Statement (FEIS) and supporting documentation for Vogtle Units 1 and 2 (NUREG – 1085 issued by NRC in 1985) and used as a reference, provide valuable information about the baseline conditions of the aquatic community near Vogtle. The collection of data, studies performed, and SNC's submissions have ensured that the direct, indirect and cumulative impacts were appropriately addressed in the ER. The Staff's FEIS relied on the ER, consultation with regulatory agencies, and its own independent analysis in reaching the conclusion that aquatic impacts were SMALL. Both the ER and FEIS contain thorough discussions of aquatic impacts.

In preparing the ER, SNC considered and referenced the conclusions from studies conducted on once-through intakes at the Savannah River Site (SRS) relative to impingement and entrainment. These studies are very relevant to the Vogtle intake impacts analysis since the SRS intakes are located very near to the Vogtle intakes. The SRS studies concluded that at intake flows many times larger than those proposed for Vogtle, impingement and entrainment impacts remain small and do not result in any quantifiable impact to the fishery or the general aquatic community. Use of this data coupled with years of additional data on the background aquatic community near the site was an appropriate and bounding surrogate for individual site specific studies conducted

on the actual Vogtle Unit 1 and 2 intake. This approach used by SNC in the ER and subsequently by the Staff in its FEIS was appropriate and consistent with NUREG-1555. This is sufficient evidence to tell me, as a trained and experienced environmental professional, what the category of impingement and entrainment impacts would be. Moreover, this is a common approach to estimating impacts and consistent with the NEPA process.

Additionally, in order to confirm the assessment and conclusions in the ER, in 2008, SNC conducted site specific impingement and entrainment studies of the existing Vogtle intake. These studies, the results of which are attached to the joint testimony of Tony Dodd and Matt Montz, completely confirm the conclusions stated in the ER and FEIS relative to the impacts of impingement and entrainment for Vogtle Units 3 and 4 – that impacts were adequately considered and are SMALL.

Q8. **In your view, was the baseline aquatic data used to estimate impacts adequate?**

A8. Yes, the ER and subsequent responses to RAIs and material collected during site visits provide a clear, well documented assessment of the baseline aquatic community in the vicinity of plant Vogtle. The Savannah River, especially in the area near the SRS is one of the most frequently studied rivers in the southeastern United States. In addition to the Academy of Natural Sciences studies that began in the late 1950s and continue today, there are many other relevant studies cited in the ER and provided in response to RAIs that contribute to the wealth of information available for the Savannah River aquatic community. In turn, the Staff verified and used this information in assessing impacts in the FEIS. In my experience, the volume and quality of information available to establish the baseline of aquatic resources was more than adequate.

Q9. **In your opinion, was consideration of the ANSP studies for determining the aquatic baseline appropriate?**

A9. Yes, we relied on these studies because they represent an ongoing annual study with a fifty-plus year look at the area near the site performed by an extremely reputable organization of scientists. The ANSP studies began in the 1950s to assess the impacts of the Savannah River Site on the Savannah River. The ANSP studies included several sample sites proximate to the Vogtle site, including one that essentially coincides with the proposed location of the Unit 3 and 4 intake structure.

Notably, the ANSP studies were just one set of information SNC considered to create a comprehensive picture of the baseline aquatic conditions on the Savannah River near Vogtle. SNC provided over 125 reference documents as part of the ER submittal and more than one hundred references in response to RAIs. *See* SNC000015 (List of references submitted in response to RAIs). SNC also referenced the FEIS prepared for Vogtle Units 1 and 2. When coupled with the large body of additional information provided in the ER and FEIS the ANSP studies provide a conclusive, contemporary assessment of the baseline aquatic community near the Vogtle site. Additionally, NEPA encourages the use of available data to evaluate the effect of the proposed action on the environs near the site. There is no question that use of the consideration of ANSP data was appropriate. In fact, it would not have been credible for the ER to ignore it.

Moreover, the NRC and state agencies concluded for Vogtle Units 1 and 2 that the operation of the intake did not produce a significant adverse environmental effect on the Savannah River and that no confirmatory studies were required. Recently, SNC conducted site specific impingement and entrainment studies on the Vogtle Unit 1 and 2

intakes to provide supplemental data for this proceeding. These studies confirm that very little impingement occurs and that entrainment is also comparably small, which is consistent with the conclusions from the Unit 1 and 2 FEIS. The ER for Vogtle Units 3 and 4 and the Unit 3 and 4 FEIS also reached this same conclusion.

Q10. **In determining impacts from entrainment and thermal discharges, explain the use of the uniform drift distribution.**

A10. In the ER and in subsequent responses to RAIs, SNC provides a discussion of the body of relevant data on the "drift" community near the Vogtle site. The drift community is characterized by free floating life stages of certain aquatic organisms such as eggs and larval fish. There are a number of species that inhabit the Savannah River and there is significant variance in their spawning behavior and characteristics of eggs and larval fish. For example, the diadromous striped bass, as well as the shad and herring species are prolific in the amount of eggs they produce and their eggs are released from spawning locations directly to the water column. Many of these eggs are lost due to predation and other natural phenomena and, because they float freely in the water column, they are potentially subject to the impacts of entrainment or the thermal plume. However, the large number of eggs produced ensures adequate reproduction rates. On the other hand, eggs of most game species such as bass and bream, and catfish are deposited in discrete "nests or beds" where they remain until they hatch. These eggs are also not normally found in the water column and are not normally subject to entrainment by water intakes. Sturgeon eggs are laid in the water column but are adhesive and demersal, meaning that they sink to the bottom and adhere to bottom substrate. Sturgeon are known to seek out certain types of substrate for their spawning, typically rock cobble bottom. The spawning

sites are well known and none occur near the Vogtle intakes. In order to provide a clear, conservative assessment of the entrainment impacts of Vogtle 3 and 4 on the Savannah River drift community, Southern Nuclear chose to assume that the "drift" was uniformly distributed throughout the water column and thus the drift from all species would be entrained equally. This assumption reasonably estimates the impacts of Vogtle Units 3 and 4 water withdrawal on those species that release their eggs, and larvae develop, in the water column. The assumption significantly overstates the impact to those species described above whose eggs and larvae are not normally present in the water column.

Basically, the assumption of a uniform drift community means that it is assumed these eggs are evenly spread out in the water column such that any x% of the water will contain x% of the drift community within it. The ER and FEIS also presume that all organisms entrained are killed. As such, the entrainment loss is assumed to be the percentage of river flow withdrawn by the Vogtle units. This assumption therefore has an additional conservatism related to the timing of fish spawn and the Savannah River flow regime. The large majority of spawning occurs between March and July when river flows are normally higher. The percentage of water withdrawn compared to river flow is normally lower during this period than the withdrawal (and entrainment) rate estimated in the ER, which was based on lower late summer/fall flows.

It is true that drift within the water column can vary and that it is influenced by channel morphology, flow, and other variables which can affect habitat or spawning locations. It is also true that a typical intake design impacts only a small part of the river channel, not the entire channel. The Vogtle intake is located in a relatively straight section of the river channel and is not near any creek, slough, or other morphological

feature. As such, no significant fish habitat exists within the area of influence of the intake structure. In addition, the bottom structure in the area has been characterized as a relatively sterile mixture of graded sand and is not well suited for spawning habitat for species which law eggs in nests or beds. Therefore, due to the lack of spawning habitat for species which produce eggs into the water column, no significant concentration of drift is anticipated and the uniform distribution assumption remains conservative. There is no entrainment impact on the federally endangered shortnose sturgeon since no spawning areas are proximate to the Vogtle site, and the eggs and larvae remain in the spawning areas

In a recent study conducted by SNC in 2008, using Acoustic Doppler technology, the area of influence in the Savannah River associated with the Vogtle Unit 1 and 2 intake is less than 10 percent of the channel volume. Since the study was done during a low flow period, the impact during normal flow periods would be even smaller. In consideration of this information along with the uniform distribution assumption, it is likely that the effect of the intake on entrainment is significantly overstated, making the assumption even more conservative.

Q11. **What river flows were used to determine impacts from impingement, entrainment and thermal discharges?**

A11. In the ER, impingement and entrainment effects are evaluated at the annual average flow of 8820 cfs, the 7Q10 flow of 3822 cfs and the Drought Level 3 flow of 3800 cfs. These represent the range of flows most likely to occur. *See* SNC000016 (USGS Charts depicting recent flows of Savannah River). Drought Level 4 Flow was not considered for two reasons. First, Drought Level 4 has never been experienced in the history of the

Savannah River system. Secondly, the Corps Drought Plan in place at the time the ER was submitted did not define a specific flow regime for Drought Level 4, but rather indicated that Drought Level 4 would consist of passing inflow from Lake Thurmond downstream. *See* SNC000017 (U.S. Army Corps of Engineers Savannah River Drought Contingency Plan (March 1989)). The Corps has indicated at that time that they were revising the Drought Level 4 triggers to more accurately define the Drought Level 4 flow regime. The recent draft of the Drought Plan released by the Corps defines the first step in Drought Level 4 as reducing discharge from Thurmond (Clarks Hill) Dam to 3600 cfs moving stepwise as the drought continued to a final position of passing inflow from Lake Thurmond (Clarks Hill). This flow regime is much more appropriate and will likely be adopted. Based on the USGS flow record, the lowest flows occur in late summer and fall. The low flow period typically does not coincide with the spawning period.

More conservatively, in the FEIS, NRC evaluates the annual average flow of 8820 cfs, the Drought Level 3 flow of 3800 cfs, and two additional flows of 3000 cfs and 2000 cfs Recently, the USACE proposed a revised Drought Plan to better define Drought Level 4. *See* SNC000018 (FONSI for Drought Contingency Plan Update (August 2006)). Drought Level 4 is designed to maintain a 3600 cfs release from Thurmond (Clarks Hill) Dam as long as reservoir storage can support, followed by a step-wise transition to a point where releases will match reservoir inflow. Review of the substantial flow record indicates that the frequency and duration of flow values below 3600 cfs is extremely low. *See* SNC000016 (USGS Charts depicting river flows of Savannah River). The 3800 cfs flow associated with Drought Level 3 corresponds essentially to the 7Q10 flow of 3822 cfs. Single day flows below 3600 cfs are extremely rare and no extended periods at or

below this flow are known to exist. NRC's choice of 3000 cfs to represent an extreme low flow event is appropriate based on the flow record and the USACE Drought Plan. The 2000 cfs scenario seems excessively conservative as it is not supported by existing flow data. Regardless, NRC's evaluation confirms that even at the lowest of these flows, the conclusion of SMALL reached in the FEIS does not change. This information further supports the conclusions reached in both the ER and the FEIS that impacts from impingement, entrainment, and the thermal discharge are SMALL.

Q12. **Do you agree with Joint Intervenors' presumption that combined withdrawals which may exceed 5% of river flow invalidate the Staff's impacts conclusions?**

A12 No. The Joint Intervenors are wrong for two reasons. First of all, the Joint Intervenors imply that a 5% withdrawal rate represents a "cutoff" that determines whether or not impacts to the river and to aquatic communities should be considered SMALL. The 5 % criteria comes from EPA's "316(b)" standards, which sets 5% withdrawal rates as a trigger for additional steps. However, that standard is specifically based on the annual average flow of the river, not the lowest drought flows. Accordingly, it is not at all relevant to apply the 5 % criteria to extremely rare and essentially "worst-case" flow events for the assessment of withdrawal impacts.

Second, the FEIS already includes combined withdrawals in excess of 5%. In fact, the FEIS already considers withdrawal rates and flow conditions that are more extreme than those the Joint Intervenors argue should have been considered. Whereas the Joint Intervenors, through their experts, assert that flow reduction could reach 7 to 7.9%, the FEIS evaluates withdrawals of 173 cfs at flows of 2000 cfs, FEIS 7- 4-6, which is a reduction of 8.7%. The FEIS includes the calculation of flow reduction based on

"consumptive use" in the text (*see* Table 7-2) and evaluates impacts at 6.5% reductions in flow. Although the Tables do not show the percentage flow reduction for withdrawal at the 3000 and 2000 cfs values, the 173 cfs maximum withdrawal value stated in Table 7-1 can be assessed at these values and the percent reduction in flow can be easily determined. For illustration purposes and in order to make an "apples to apples" comparison with Joint Intervenors example, I computed the values at 3000 and 2000 cfs and obtained a percent reduction in flow of 5.6 % and 8.7 %, respectively. The flow reduction of 7.9% stated by the JI, would be bounded by the 8.7 % value which are derived from information contained in the FEIS and is also bounded by the NRC conclusion of SMALL in the FEIS. Accordingly, by any measure, the FEIS already evaluates possible rare flow reductions in excess of 5% and in excess of the amounts suggested by the Joint Intervenors for both withdrawal and consumptive use, and the conclusion of SMALL impacts remains unchanged.

Q11. **Do you believe that the EIS adequately considers impacts from impingement and entrainment on aquatic resources?**

A11. Yes. The background information on the baseline aquatic community is comprehensive, conservative, and supported by contemporary data. The assumptions about uniform distribution of drift organisms also are conservative and well supported. The Vogtle intake design is considered Best Available Technology (BAT) to minimize the effects of impingement and entrainment. This information is confirmed by studies conducted in 2008 on the Vogtle Unit 1 and 2 intake.

Q12. **Do you believe that the EIS adequately considers impacts from thermal discharges on aquatic resources?**

A12. Yes. The thermal impact from all four Vogtle units will be extremely small. The CORMIX runs discussed in the ER and the NRC FEIS confirm that the thermal plume will not have any significant impact on drift organisms or the Savannah River fishery. This information is further supported by 2008 field verification performed by SNC, addressed in the joint testimony of Tony Dodd and Matt Montz.

With regard to the potential for harm to the drift community from contact with the thermal plume, two facts are important. First, the maximum temperature associated with the plume occurs at the point of discharge. Since the maximum blowdown temperature is estimated at 91 degrees F, this temperature would impact only a very small area until it decayed below the 90 degree F Georgia Water Quality Standard. *See* Ga. Comp. R. & Regs. 391-3-6-.03(5). This area was estimated in the FEIS as 3 feet downstream by 7 feet wide (21 square feet). Assuming a river flow at low flow conditions of 3800 cfs, the river velocity of 1.5 ft/sec associated with this flow would result in exposure to a drift organism in the Savannah River to the 90 Degree F temperature for no more than 2 seconds. Since this is a bounding case, actual exposure would be significantly less. Drift organisms are normally present in the Savannah River in the spring and early summer months. Maximum temperatures would not occur during this time, adding additional conservatism to the ER and FEIS conclusion. The allegation that harm would occur to drift organisms as a result of exposure to the thermal plume is unfounded. The conclusion reached in the ER and FEIS regarding thermal impacts associated with the Vogtle discharge is based on sound, conservative information and is firmly supported by the data and literature.

Q13. Are each of the exhibits referenced in this pre-filed written testimony true, accurate and correct copies, and do they accurately portray the facts they purport to portray?

A13. Yes.

Q14. Does this conclude your testimony?

A14. Yes.

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Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
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(Early Site Permit for Vogtle ESP Site)	)	January 9, 2009

AFFIDAVIT OF THOMAS C. MOORER CONCERNING SOUTHERN NUCLEAR'S PRE-FILED TESTIMONY ON ENVIRONMENTAL CONTENTION 1.2

I, Thomas C. Moorer, do hereby state as follows:

1. I am employed by Southern Nuclear Operating Company as the Project Manager for Environmental Support. A statement of my professional qualifications is attached to the SNC pre-filed testimony to be submitted on January 9, 2009, in response to hearing issues identified by the Board.

2. I have read the foregoing prepared testimony regarding environmental matters at the Plant Vogtle Site.

3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding. I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information and belief.

Thomas C. Moorer

Subscribed and sworn to before me
this 6th day of January, 2009.

Karen O. Fowler
Notary Public
My Commission expires
January 19, 2011