NRC Staff Responses to Licensing Board's Questions Regarding Environmental Matters

Question No. 1, FEIS Section 2.3.1.4, Page 2-10: *The Final Environmental Impact Statement (FEIS) indicates that the period between 1998 and 2002 was an "abnormally dry period in the southeast." How does this compare to the more recent dry period? If the most recent five years is worse, why was the most recent dry period not used as the basis for analysis?*

Response No. 1 (Rishel): Section 2.3.1.4 of the FEIS provides a discussion of atmospheric moisture at the site, including precipitation. The applicant submitted 5-years (1998-2002) of onsite meteorological data; the selection and use of this period meets criteria set forth in Regulatory Guide (RG) 1.23, Rev. 1, for an early site permit:

> The minimum amount of onsite meteorological data to be provided at the time of application … for an early site permit … is a consecutive 24-month period of data that is defendable, representative and complete, but not older than 10 years from the date of the application. However, 3 or more years of data are preferable and, if available, should be submitted with the application.

Following guidance in ESRP Section 2.7, NRC staff compared the onsite meteorological data to other nearby measurement sites to establish a context for evaluating the data's representativeness and validity. For perspective, the staff noted in the FEIS that the selected 5-year period was an "abnormally dry period in the southeast", especially when compared to long-term (30-year) precipitation records. For example, at the Augusta, Georgia National Weather Service (NWS) measurement site, the annual average precipitation amount during this 5-year period was 39.35 inches, compared to a normal (1971-2000) annual average of 44.58 inches (FEIS Section 2.3.1.4). As shown in Figure 1 below, the most recent 5-year period (2003-2007) at Augusta is wetter than the 5-year

period discussed in the FEIS (1998-2002), with an annual average of 43.29 inches of precipitation. It is important to note that although the 1998-2002 period was drier than average, the staff did not use these precipitation data elsewhere within the FEIS to draw impact conclusions. Sections 4.3.2 and 5.3.2 of the FEIS discuss surface water usage for construction and operation, respectively, of VEGP Units 3 & 4. Analyses in these sections rely on historical stream flow records from river gauges, not the 5-year onsite precipitation data discussed in Section 2.3.1.4 of the FEIS.

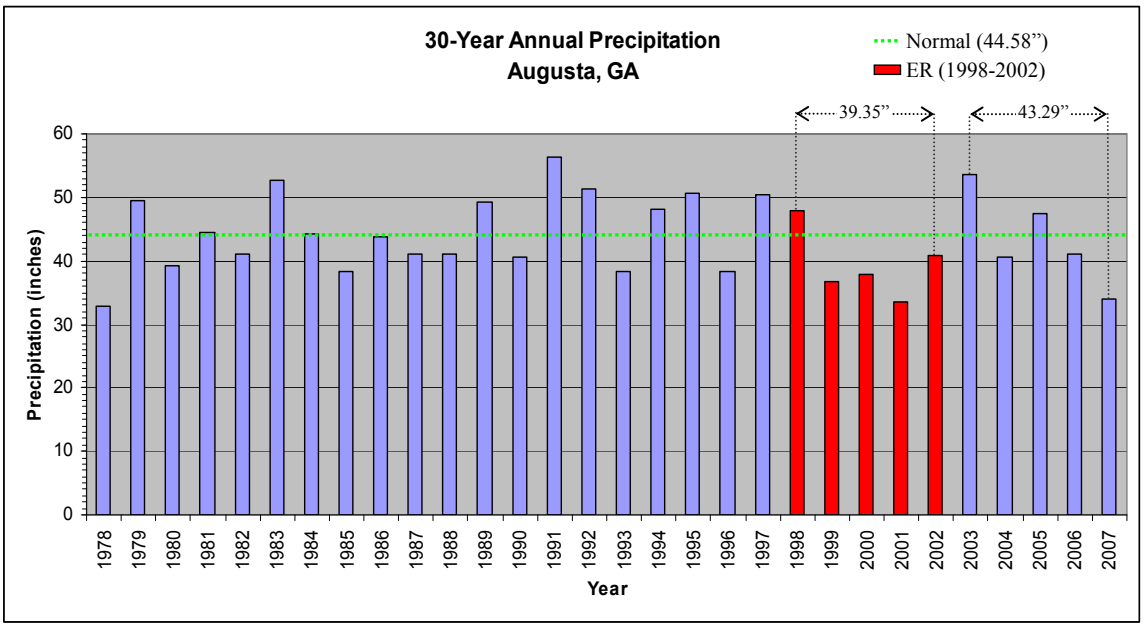


Figure 1. Thirty-year precipitation data for Augusta, Georgia (NCDC 2008).

References:

National Climatological Data Center (NCDC). 2008. *2007 Local Climatological Data Annual Summary with Comparative Data – Augusta, Georgia*. Asheville, North Carolina.

Question No. 2, FEIS Section 2.3.3, Page 2-13: *The FEIS indicates "[m]eteorological data for the period of January 1, 1998, to December 31, 2002, were used to generate atmospheric dispersion factors (X/Q values) to estimate radiological impacts in the areas surrounding the [Vogtle Electric Generating Plant (VEGP)] site." Why was the data limited to this period? What about the last six years?*

Response No. 2 (Rishel): As stated in Section 2.3.3 of the FEIS, the applicant provided onsite meteorological data for the five-year period spanning 1998-2002 in support of its ESP application. These data were used to generate atmospheric dispersion factors (X/Q values) to estimate radiological impacts in the areas surrounding the VEGP site. The use of these data exceeds the meteorological data criteria set forth in Regulatory Guide (RG) 1.23, Rev. 1, for an early site permit:

> The minimum amount of onsite meteorological data to be provided at the time of application … for an early site permit … is a consecutive 24-month period of data that is defendable, representative and complete, but not older than 10 years from the date of the application. However, 3 or more years of data are preferable and, if available, should be submitted with the application.

As noted above, the applicant provided five continuous years (60 months) of meteorological data, exceeding the 24-month (minimum) and 36-month (preferred) consecutive month periods specified in guidance. In addition, the data spanned the years 1998-2002, which is within the 10-year window of the VEGP ESP application date of August 14, 2006. The staff examined the measured data following guidance in ESRP Section 2.7 and evaluated the onsite monitoring program using guidance in ESRP Section 6.4. The staff found the data to be complete and representative of the site. Therefore, the staff concluded the applicant's data was acceptable for generating atmospheric dispersion factors for the site.

Lastly, atmospheric dispersion factors for environmental reviews are evaluated using realistic (i.e., 50th percentile) meteorological conditions. Although more recent meteorological data could have been used, year-to-year variations in the 50th percentile meteorology are sufficiently small that it is unlikely that additional data would appreciably change the resulting atmospheric dispersion factors and the staff's conclusions related to environmental impacts. As a result, the staff determined that little would be gained by requiring the applicant to provide additional or more recent meteorological data.

Question No. 3, FEIS Section 2.3.3, Page 2-13: *ANSI/ANS-3.11 indicates that meteorological instruments should be located at a distance at least ten times the height of an obstruction. Applicant Southern Nuclear Operating Company (SNC) indicated in its environmental report (ER) that it performed an analysis to verify the acceptability of the meteorological tower being only 3000 feet (ft.) from the 600 ft. high cooling towers. How did the staff confirm the SNC ER analysis?*

Response No. 3 (Rishel): NRC staff meteorologists reviewed the Vogtle meteorological monitoring system during the environmental site audit on October 17, 2006. Using guidance in ESRP Section 6.4, the meteorologists evaluated the pre-application monitoring program, including tower siting and instrument exposure. As part of this evaluation, wind modifications that could be caused by existing terrain, vegetation, and building obstructions were examined. The cooling towers for existing VEGP Units 1 and 2 are approximately 550 feet tall and located over one mile northeast of the meteorological monitoring site; this distance is greater than the ten-times obstruction height distance recommended by ANSI/ANS-3.11 and so the VEGP Units 1 and 2 cooling tower structures were not evaluated further. No other existing obstructions

were identified and NRC staff concluded that the measured data were acceptable for use in the ER and FEIS.

During the environmental site audit, instrument siting for operational monitoring of proposed VEGP Units 3 and 4 was also evaluated. Potential future obstructions include two 600-foot cooling towers associated with VEGP Units 3 and 4. According to Section 2.3.3.3 of the ER, the cooling tower for Unit 3 will be the closer of the two structures to the meteorological tower and will be located approximately 3025 feet due north of the meteorological monitoring site. This distance is within the ten-times obstruction height distance recommended by ANSI/ANS-3.11. Although NRC staff notes that SNC performed an analysis to verify the acceptability of the proposed cooling tower locations with respect to the meteorological tower, the calculations were not independently confirmed by the staff. Instead, NRC staff based its evaluation of the tower locations' acceptability on professional judgment and onsite factors, including:

a. The cooling towers will subtend only a small angle when viewed from the instrumentation. Therefore the cooling towers would affect measurements only for a small range of wind directions.

b. As noted in Section 2.3.1.1 of the FEIS, the prevailing wind direction at the site is from the west-southwest at both the 10- and 60-m levels. The proposed cooling towers will be located due north, not in the direction of the prevailing wind.

c. The effect of the cooling towers on wind measurements at a distance of 3025 feet would be a possible slight reduction in wind speed and a slight increase in turbulence. It is highly unlikely that the cooling tower would affect wind direction at that distance. It is also unlikely that either the wind speed reduction or increase in turbulence would be discernable without extensive supplemental measurements.

d. With respect to dose estimates, the reduction in wind speed and increase in turbulence would tend to offset one another, since dose is inversely proportional to the product of wind speed and turbulence.

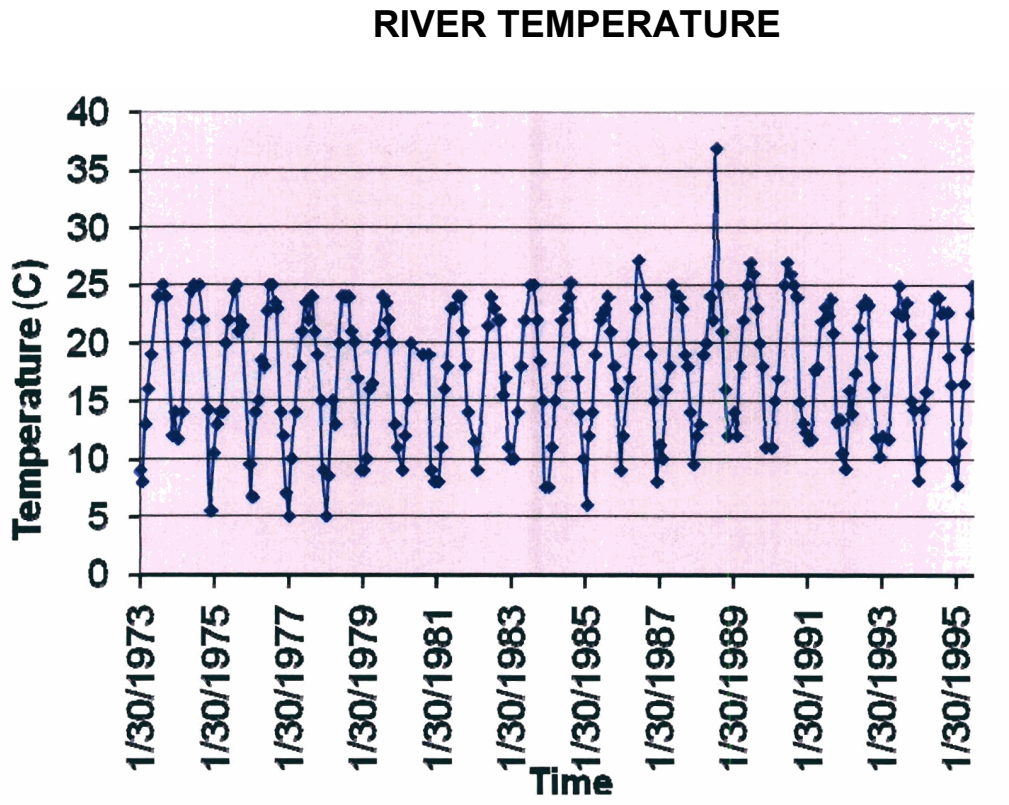
e. Staff considered other locations for the meteorological measurements. No other location on or near the site was identified that would be better.

Finally, guidance in ESRP Section 6.4 states that “for towers located more than five obstruction heights from major obstructions, the influence should be minimal”. The new units will be located slightly beyond this lower obstruction height distance. Based on these factors, the staff concluded that there was no compelling reason to believe that operational meteorological monitoring will be affected by the proposed cooling towers for Units 3 and 4.

Question No. 4, FEIS Section 2.6.1.1, Page 2-20: *In connection with the Savannah River water temperature data from 1973 to 1996 referenced on this FEIS page, is there any indication that there is an increasing temperature trend?*

Response No. 4 (Vail): No. Although the staff did not attempt to perform a detailed statistical trend analysis in its FEIS assessment, the staff did perform a visual inspection of the data collected from a nearby stream location. That inspection does not suggest a trend to either cooler or warmer temperatures. The following figure displays the 262 temperature measurements recorded by the Georgia Department of Natural Resources (GADNR) and mentioned in the FEIS on page 2-20. The variability is dominated by annual seasonal patterns. Operation of the reservoirs also confounds any trend analysis of the stream temperature data. The magnitude and temperature of releases from Thurmond Dam, the local meteorological conditions, thermal discharges to the Savannah River between Thurmond Dam and VEGP, and tributary and groundwater inflows all impact the temperature of the Savannah River at the VEGP site. Lower flows tend to increase the influence of local meteorological conditions in controlling the stream temperature. The staff did not investigate the pedigree of the 37 degree C outlier shown in the figure below because, based on the anomalous high reading, the staff expects that

it is either a sampling or measurement error. Therefore, the staff did not consider it further. Regardless, a single outlier does not suggest a trend. In summary, the staff's analysis, based on a visual inspection of the limited time-series data, did not suggest a temperature trend for the period of record or provide any evidence that a trend exists.



References:

Southern Nuclear Operating Company, Inc. Cooling Water Blowdown Thermal Discharge Analysis for Plant Vogtle Early Site Permit Facility. Southern Nuclear Operating Company, Birmingham, Alabama. July 7, 2006. Accession No. ML063000221.

Question No. 5, FEIS Sections 2.6.1.2 and 5.9.2, Pages 2-28 and 5-67: *The FEIS presents key hydraulic properties for the Water Table, Tertiary, and Cretaceous aquifers. How are these properties used in calculating the liquid effluent pathway radiation doses to the maximally exposed individual (MEI) and nearby populations? How did the staff assure itself the parameters used in the dose calculations had adequate conservatism to account for the uncertainties in the measured data on which they are based?*

Response No. 5 (Smith): The staff used the dose assessment approach specified in Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," and the LADTAP II program (NUREG/CR-4013, "LADTAP II—Technical Reference and User Guide," April 1986) to estimate doses to the maximally exposed individual and population from the liquid effluent pathway of the proposed VEGP Units 3 and 4. This approach considers liquid discharge only to the Savannah River and does not consider unanticipated releases such as those to groundwater; therefore, these hydraulic parameters are not used in calculating the liquid effluent pathway radiation doses to the MEI and nearby populations. The referenced key hydraulic properties presented in the FEIS are provided as background information for calculations of drawdown and impacts on water resources. To calculate doses to the public from liquid effluents, the staff used a personal computer version of the LADTAP II code entitled NRCDOSE, Version 2.3.8. The staff used the annual radioactive effluent release reports for the years 2000–2006 to estimate doses to the maximally exposed individual and population from the existing units' liquid effluent releases. The staff used the source term from the AP1000 Design Control Document, Rev. 15 (Westinghouse 2005), to estimate doses to the maximally exposed individual and population from the proposed units' liquid effluent releases.

The staff analysis contained several conservative assumptions that tended to increase the predicted dose to account for uncertainties. First, the staff assumed that the maximally exposed individual withdraws drinking water from the Savannah River just downstream of the plant when, in fact, no such withdrawal exists within 100 miles downstream of the plant. Second, the staff assumed an unrealistic, but conservative, exposure scenario where the maximally exposed individual obtains all drinking water and fish for consumption from the Savannah River just downstream of the plant. Lastly, the staff did not take credit for the cooling tower blow-down flow to dilute the plants' effluent before discharge to the river. Accordingly, the staff believes that the dose calculations have adequate conservatism to account for uncertainties in data measurement.

Question No. 6, FEIS Section 2.6.1.2, Page 2-29: *The FEIS indicates that "[b]ased on potentiometric contour maps (Southern 2008a), groundwater movement from the VEGP site powerblock region appears to be toward Mallard Pond." What are the implications of this movement with respect to radiological monitoring?*

Response No. 6 (Smith & Kincaid): Under the guidance in ESRP (NUREG-1555) Section 6.2, "Radiological Monitoring," the staff reviews and evaluates the applicant's proposed radiological environmental monitoring program (REMP). The scope of the staff's review includes evaluation of the proposed program "to characterize the radiological environment of the biosphere in the vicinity of the site, to provide data on measureable levels of radiation and radioactive materials in the site environs, and to provide baseline data on surveillance of principal pathways of exposure to the public." ESRP Section 6.2 at 6.2-1.

As part of NRC requirements for operating a nuclear power plant, licensees must: (1) keep releases of radioactive material to unrestricted areas during normal operation as low as reasonably achievable (as described in the Commission's regulations in 10 CFR 50.36(a), and (2) comply with radiation dose limits for the public (10 CFR Part 20). In addition, NRC regulations require licensees to have various effluent and environmental monitoring programs to ensure that the impacts from plant operations are minimized. In cases where even minor leakage is discovered, NRC corrective action requirements (10 CFR Part 50, App. B, Sec. XVI [“Corrective Action”]) are applicable. Furthermore, the design of the plant and the NRC inspection program provide reasonable assurance that even in abnormal situations such as a spill or leak of liquid material, safety limits are met.

The NRC has developed guidance for implementing the monitoring requirements, including the following: Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants" (U.S. Atomic Energy Commission 1974), Regulatory Guide 4.1 "Programs for Monitoring of Nuclear Power Plants" ((U.S. Atomic Energy Commission 1975), Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) -- Effluent Streams and the Environment," (NRC 2007), NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors," and NUREG-1302, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors."

The NRC has no specific requirements for monitoring potential pathways of radioactive liquid releases to the subsurface environment that occur in an unplanned or unmonitored fashion. As such, the fact that a groundwater gradient is present from the proposed power block region toward Mallard Pond does not, in itself, require an applicant or licensee to establish groundwater monitoring in this region in the absence of an anticipated release.

Nevertheless, in its January 2007 response to Request for Additional Information (RAI) E6.2-1, Southern indicated that all SNC plants will participate in the Nuclear Energy Institute (NEI) Groundwater Protection Initiative. [Southern 2007a.] The NEI Initiative requires member companies "to develop and implement a site-specific/company groundwater protection program to assure timely and effective management of situations involving inadvertent releases of licensed material to groundwater and to implement voluntary communication programs." [NEI 2007.] In response, Southern developed the "Plant Alvin W. Vogtle Nuclear Generating Plant Groundwater Monitoring Plan for Radionuclides" for Units 1 and 2. [Southern 2007b.] That plan includes monitoring wells that surround the operating units and would detect releases moving toward Mallard Pond drainage as well as other potential receptor locations.

References:

Southern Nuclear Operating Company, Inc. (Southern). 2007a. Southern Nuclear Operating Company, Vogtle Early Site Permit Application, Response to Requests for Additional Information on the Environmental Report. Letter report from Southern Nuclear Operating Company (Birmingham, Alabama) to the U.S. Nuclear Regulatory Commission (Washington, D.C.). January 30, 2007. Southern Company, Birmingham, Alabama. ADAMS Accession No. ML070460323.

Southern Nuclear Operating Company (Southern). 2007b. Plant Alvin W. Vogtle Nuclear Generating Plant Groundwater Monitoring Plan for Radionuclides. Southern Company, Birmingham, Alabama. ADAMS Accession No. ML073240580

Nuclear Energy Institute (NEI). 2007. Industry Ground Water Protection Initiative - Final Guidance Document. Nuclear Energy Institute, Washington, D.C. ADAMS Accession No. ML072610036.

Question No. 7, FEIS Section 2.6.3.2, Page 2-42; *The FEIS states that "[t]he evidence indicates the primary pathway for tritium pollution of the Water Table aquifer is through recharge of the aquifer by atmospheric deposition of tritium released from the Savannah River Site." What is the evidence that supports this conclusion?*

Response No. 7 (Kincaid): After detection of tritium in the aquifer system at an elevated level (~600 pCi/L) in 1988, the Georgia Geologic Survey, U.S. Geological Survey (USGS), and U.S. Department of Energy undertook an investigation to evaluate whether Georgia aquifers had become polluted by tritium, the extent of the pollution, the potential threat to public health, and the pathways for tritium to enter the groundwater (Summerour et al 1998). The staff reviewed numerous reports produced by the participants in this overall study. The Georgia Geologic Survey issued Summerour et al (1994, 1998) and Summerour (1997). The USGS issued Clarke and West (1997, 1998) and Cherry (2006). These studies gathered field data and evaluated (1) the Savannah River Site (SRS) releases, (2) their possible movement and tritium contamination levels, including that for rainfall in the vicinity of the SRS and Burke County, (3) the vertical distribution of tritium contamination in the vadose zone and unconfined aquifer, and (4) the areal distribution and magnitude of tritium contamination in the surface water and groundwater of Burke County. In the Phase II report issued by the Georgia Geological Survey, Summerour et al (1998) concluded that all of these lines of reasoning, from the tritium source at the SRS to surface water and groundwater observations of tritium contamination in Burke County, suggest that the primary tritium pathway into the

unconfined aquifer in Burke County is through an airborne pathway and aquifer recharge by tritiated rainfall. The staff reviewed the data presented, the alternate hypothetical pathways evaluated, and the groundwater modeling results, and concluded that the investigation of source and alternate pathways by the participants in the studies was thorough and complete.

References:

Cherry, G.S. 2006. Simulation and Particle-Tracking Analysis of Ground-Water Flow near the Savannah River Site, Georgia and South Carolina, 2002, and for Selected Ground-Water Management Scenarios, 2002 and 2020. Scientific Investigations Report 2006-5195. U.S. Geological Survey. Web-only publication at http://pubs.usgs.gov/sir/2006/5195/.

Clarke, J.S. and C.T. West. 1997. Ground-Water Levels, Predevelopment Ground Water Flow, and Stream-Aquifer Relations in the Vicinity of the Savannah River Site, Georgia and South Carolina. Water-Resources Investigations Report 97-4197. US Geological Survey, Atlanta, Georgia.

Clarke, J.S. and C.T. West. 1998. Simulation of Ground-Water Flow and Stream-Aquifer Relations in the Vicinity of the Savannah River Site, Georgia and South Carolina, Predevelopment Through 1992. Water-Resources Investigations Report 98-4062. US Geological Survey, Atlanta, Georgia.

Summerour, J.H., E.A. Shapiro, J.A. Lineback, P.F. Huddlestun, and A.C. Hughes. 1994. An Investigation of Tritium in the Gordon and Other Aquifers in Burke County, Georgia. Information Circular 95. Georgia Department of Natural Resources, Environmental Protection Division, Georgia Geologic Survey, Atlanta, Georgia.

Summerour, J.H. 1997. Results of Annual Tritium Project Base Flow Studies Burke County, Georgia 1991-1995. Project Report 29. Georgia Department of Natural Resources, Environmental Protection Division, Georgia Geologic Survey, Atlanta, Georgia.

Summerour, J.H., E.A. Shapiro, and P.F. Huddlestun. 1998. An Investigation of Tritium in the Gordon and Other Aquifers in Burke County, Georgia, Phase II. Information Circular 102. Georgia Department of Natural Resources, Environmental Protection Division, Georgia Geologic Survey, Atlanta, Georgia.

Question No. 8, FEIS Sections 2.6.3.3 and 5.3.3.1, Pages 2-43 and 5-17: *The FEIS states that thermal monitoring of the VEGP Units 1 and 2 discharge is performed once every five years. Did this monitoring include temperature measurements in the Savannah River thermal plume? If so, were these measurements compared to the thermal plume calculations performed with the CORMIX code to check the accuracy of the calculations?*

Response No. 8 (Vail): No, the monitoring for the VEGP Units 1 and 2 discharge does not include temperature measurements in the Savannah River thermal plume. Temperature measurements required under Southern's NPDES permit for Units 1 and 2 are taken prior to discharge into the river. The location at which these measurements are taken is specified in the NPDES permit. Accordingly, the staff did not compare these measurements to the thermal plume calculations performed for the Units 3 and 4 impacts analysis.

Question No. 9, FEIS Section 2.8.2.6 and 2.8.2.7, Pages 2-109 to 112: *Please explain why the FEIS impact analysis regarding public services and education does not include South Carolina impacts.*

Response No. 9 (Cort): The socioeconomic impacts on all counties within a 50-mile region of the Vogtle site, including the 12 counties in South Carolina, are captured as regional impacts. The impacts on public services and education for South Carolina counties are expected to be SMALL (see FEIS Section 4.5, page 4-38). As explained in Section 2.8 of the FEIS, the staff focused the socioeconomic discussion primarily on Burke, Richmond, and Columbia Counties (in Georgia), and this focus is "guided by the

magnitude and nature of the expected impacts of construction, maintenance, and operation of the proposed project and by those site-specific community characteristics that can be expected to be affected by these impacts." As further explained in footnote (a) on page 2-95 of the FEIS, the criteria used to narrow the socioeconomic discussion included (1) the county in which the proposed plant would be located and (2) those specific portions of surrounding counties and urbanized areas from which the construction/operations workforce would be principally drawn, or that would receive stresses to community services from in-migrating construction/operations workers.

Chapter 2 of the FEIS further presents statistics on all of the surrounding counties (including those in SC) and specifically characterizes some of the relevant socioeconomic statistics in the closest counties (including Barnwell, Allendale, and Aiken counties in SC) to provide a further basis for this approach. Chapter 4 also elaborates on this discussion, explaining (on page 4-38) that while Barnwell County (in SC) borders the site on the east side of the Savannah River, this county is primarily occupied by the Savannah River Site, which has no permanent residents, and there are no bridges near the Vogtle site connecting these two counties.

Question No. 10, FEIS Section 5.3.2.2, Page 5-15: *The FEIS states that the hydraulic heads of the Cretaceous and Tertiary aquifers in the vicinity of the VEGP site are approximately 160 ft. and 120 ft. above mean sea level, respectively. It also states that pumping drawdown in the Cretaceous aquifer would be less than 40 ft., so that an upward gradient is maintained during pumping. What is a conservative estimate of the cumulative pumping drawdown? How confident is the staff of the conclusion that an upward gradient will always be maintained? How would a reversal of this gradient*

impact the staff's conclusions regarding potential contamination of the Cretaceous aquifer?

Response No. 10 (Kincaid): Based on the staff's review of data and information submitted by the applicant (SNC 2007) and completion of groundwater model simulations by the USGS (Cherry and Clarke 2007), the staff concludes that there has been 23 ft of drawdown in the deep confined Cretaceous aquifer between 1977 (pre-construction) and 2004, and that a conservative projection of additional drawdown during operation of the proposed two units using a regional groundwater model is an additional 10 ft. Therefore, based on regional model simulations, a conservative estimate of the cumulative drawdown, including all four (4) VEGP units, in comparison to pre-construction (i.e., prior to construction of Units 1 and 2) levels is approximately 33 ft at well MU-1, which is located approximately 1000 ft north of VEGP Units 1 and 2. Well MU-1 is the deep production well with the most complete data set and is representative of the site groundwater characteristics, especially the static hydraulic head of the Cretaceous aquifer.

The above projection is based on a regional groundwater model; however, another approach would be to use only the available field data. In the past 27 years, the static hydraulic head in the production wells has declined to a level of ~150 ft. At well MU-1, that equates to a drawdown of 23 ft. Upon doubling the long-term average production requirement, which is essentially what the operation of the proposed additional units would do, the aquifer could be projected to decline another 23 ft for a cumulative decline of approximately 46 ft and a future hydraulic head of ~127 ft.

When the position of well MU-1 is superimposed on the June 2005 piezometric contour map for the Tertiary aquifer (see Figure 2-8 of the EIS), the corresponding hydraulic head in the Tertiary aquifer above MU-1 is ~102 ft. Accordingly, an upward gradient would be maintained at well MU-1 (i.e., for a drawdown of either 33 ft or 46 ft). However, as is evident in the reported drawdown for the three existing production wells (SNC 2006), the aquifer system is heterogeneous, and the actual behavior of existing and future wells will vary. It is possible that drawdown to a static level of ~127 ft could be close to a neutral or zero-gradient situation at some locations within the VEGP site.

Therefore, taking into account field data and modeling results, the staff believes that the cumulative drawdown may be as much as 46 ft, but given the variability within the aquifer, it is plausible that the drawdown could be greater at specific locations. Accordingly, a flow reversal from the Tertiary aquifer to the Cretaceous aquifer could occur locally at the VEGP site, especially at the location of production wells. However, reversal of the gradient would not impact the staff's conclusions in the FEIS regarding potential contamination of the Cretaceous aquifer because there is no known significant contamination in the Tertiary aquifer, and none is expected from future VEGP operation, to be drawn through the confining zone and into the VEGP wells completed in the Cretaceous aquifer.

References:

Cherry, G.S. and J.S. Clarke. 2007. Simulation and Particle-Tracking Analysis of Selected Ground-Water Pumping Scenarios at Vogtle Electric Generating Plant, Burke County, Georgia. Open-File Report 2007-1363. U.S. Geological Survey. Web-only publication at http://pubs.usgs.gov/usgspubs/of/2007/1363/.

Southern Nuclear Operating Company, Inc., (SNC). December 2006. Executive Summary for Groundwater Drawdown Calculations included in Vogtle ESP ER Sections 4.2.2 and 5.2.2 Groundwater Use Impacts During Construction and Operations. ADAMS Accession Number ML063000223.

Southern Nuclear Operating Company, Inc., (SNC). January 2007. Southern Nuclear Operating Company, Vogtle Early Site Permit Application, Response to Requests for Additional Information on the Environmental Report, AR-07-0061. Birmingham, Alabama.

Question No. 11, FEIS Section 5.3.3.1, Pages 5-17 to 20: *Why were the CORMIX analyses described in this section limited to Drought Level 3 river flow rates? What would be the impact of lower flow rates?*

Response No. 11 (Vail): As discussed in the Errata to the FEIS, dated September 3, 2008 (ADAMS Accession No. ML0825500400), the staff performed CORMIX analyses at flows below the minimum flow associated with Drought Level 3 (3800 cfs). The staff determined that at a river flow of 2000 cfs, the thermal plume would essentially double in area relative to the thermal plume that the staff modeled at a river flow of 3800 cfs. However, while the thermal plume would increase in size at these lower flow rates, it would still be small relative to the river width and would remain localized relative to the river's length adjacent to the VEGP site. See FEIS Figure 5-1. Accordingly, as explained in the FEIS (including the Errata) the staff concluded that given the small size of the plume under the assessment at 3800 cfs, even a potential doubling in the size of the plume would not represent a significant impact to water quality in the river. Moreover, as explained in the Errata, because the staff believes that such very-low flow conditions would be only temporary, the staff does not consider the impacts under these conditions to be significantly different from the impacts that the staff analyzed at 3800 cfs. The staff notes that while flows of as low as 2000 cfs were considered in the staff's assessment, the staff does not expect such extreme flows to occur during the timeframe of the

proposed action, and flows less than 3800 cfs would be expected to be of only a limited duration.

Question No. 12, FEIS Section 5.7.3, Page 5-57: *The FEIS references a study by the Institute for Energy and Environmental Research (IEER) that supposedly indicates that only a "small amount" of the radiological contamination in the Savannah River and its organisms can be attributed to the existing VEGP. Where in the IEER report are releases from VEGP addressed? If these releases are not directly addressed, please expand on the rationale for the above conclusion.*

Response No. 12 (Smith): The referenced IEER report does not address VEGP releases directly, but states on page 35 that the Savannah River Site (SRS) is the "principal source of tritium discharges to the Savannah River." The annual release of some radionuclides in liquid effluent for the existing and proposed units is comparable to releases from the Savannah River Site (SRS). However, as described in FEIS Section 5.9.3.1, liquid effluent doses to total body and maximum organ for the proposed units are well within the respective 0.03-mSv/yr (3-mrem/yr) and 0.1-mSv/yr (10-mrem/yr) 10 CFR Part 50 Appendix I design objectives. In fact, each proposed unit is about 0.6 percent and 0.2 percent of the Appendix I design objectives for total body and maximum organ dose, respectively. Dose assessments are based on consumption of 21 kg/yr (46.3 lbs/yr) of wild-caught fish. This consumption rate is not the maximum, but an average for the subgroup of the population that does consume wild-caught fish (i.e., above the average for the general population). Less than 2 percent of the total dose is from consumption of fish; therefore, adjustments to the fish consumption rate would have a minimal impact on the overall dose. Accordingly, the staff maintains that subsistence

consumption of fish species from the Savannah River would not present a health problem attributable to the existing and proposed units for minority and low-income populations.

Question No. 13, FEIS Section 5.9.2.1 and G.1.4, Pages 5-67 and G-2: *In FEIS Appendix G, the staff reports it reviewed the annual radiological effluent release reports for the existing VEGP units. The staff states that the highest liquid pathway releases occurred in 2001. What are the key factors that cause variations in the releases from one year to the next and why were the releases highest in 2001?*

Response No. 13 (Smith): In preparing its FEIS analysis, staff reviewed the most recent available annual radiological effluent release reports for the existing VEGP units. Staff reviewed these reports to confirm that the effluent releases selected by the applicant for its analyses were appropriate, bounding, and within the 10 CFR Part 20 effluent concentration limits. In this context "appropriate" means that the selected annual releases accurately represent releases from the current operating plants, i.e., (1) the results are not atypically low and (2) the data trend is not influenced by any apparent change in procedure or process. An illustrative example of a process change that could influence effluent releases would be the introduction of a demineralizer to the radioactive waste management system of a PWR that could reduce radioactive releases in liquid effluent. For the years reviewed (2000–2006), the annual offsite public dose resulting from liquid effluent from the existing VEGP units was highest in the year 2001 and is trending downward. Many factors can lead to variation in the annual liquid releases including: annual plant capacity, procedure or process changes, degradation or improvement in plant systems, and abnormal events. During this period (2000–2006),

no abnormal liquid releases were reported, and releases generally decreased during the period. The staff is not aware of any specific reason why the releases were highest in the year 2001; as expected, the peak release year was early during the 2000-2006 period.

Question No. 14, FEIS Section 5.9.4, Page 5-72: T*he FEIS provides the collective occupational dose from the operation of VEGP Units 1 and 2 for the year 2005. It also mentions the need to keep individual doses below the five-rem limit, but provides no data regarding those doses. What were the average and maximum individual worker occupational doses during that year?*

Response No. 14 (Smith): The requested data are reported in NUREG-0713, Volume 27, Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2005 (NRC 2006). For VEGP Units 1 and 2 the average occupational dose was 0.06 rem and the measureable average dose was 0.14 rem. The average dose includes all monitored individuals, while the measureable average dose includes only those monitored individuals that incurred a measureable dose. For the maximum individual dose for VEGP Units 1 and 2, three individuals were reported with doses of 1–2 rem.

References:

U.S. Nuclear Regulatory Commission (NRC). 2006. *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2005*. NUREG-0713, Vol. 27, U.S. Nuclear Regulatory Commission, Washington, D.C. Accession No. ML070600506.

Question No. 15, FEIS Section 6.1, Pages 6-1 to 14: *Is it necessary to analyze the greenhouse gas impacts of facility construction and operation, including those relating to the nuclear fuel cycle?*

Response No. 15 (Rishel): Greenhouse gas emissions, such as carbon dioxide and water vapor, are not regulated by a governing agency, such as the Environmental Protection Agency (EPA). Therefore, there are no existing regulations or guidance that direct the staff to reach explicit conclusions in its EISs regarding the impact of greenhouse gases that could be attributed to construction and operation of nuclear facilities. However, public comments concerning greenhouse gas emissions, including emissions associated with the nuclear fuel cycle, are addressed in Appendix E, Volume 2 of the FEIS. Specific comments and the staff's responses can be found on pages E-25 through E-28 and E-51. As a general matter, the staff continues to follow regulatory and scientific developments related to greenhouse gas emissions; as appropriate, the staff would address the significance of any newly applicable regulations in future FEISs.

Question No. 16, FEIS Section 7.2, Page 7-3: *Does the FEIS conclusion regarding the small impact to air quality assume simultaneous construction and/or operation of all the facilities discussed in section 7.2?*

Response No. 16 (Rishel): Yes. The staff evaluated air quality impacts following guidance in ESRP Section 2.7. As noted in Section 2.3.2 of the FEIS, the VEGP site is located in an air quality control district that is in attainment for all criteria pollutants for which the National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.314). Sources of air emissions related to construction and operation of VEGP

Units 3 and 4 are identified in Sections 4.2 and 5.2, respectively, of the FEIS. Because the area is in attainment, a conformity analysis including both direct and indirect emissions is not required (58 FR 63214). In its ER, VEGP has committed to develop mitigation plans to reduce fugitive dust and vehicular emissions. Applicable construction and operation air permits for VEGP would be obtained from the Georgia Department of Natural Resources (GDNR) Air Protection Branch. By design, the permits are intended to keep the area in attainment with respect to the NAAQS criteria air pollutants. Section 7.2 of the FEIS addresses cumulative air quality impacts by identifying existing and future facilities that are within the VEGP air quality control district. Existing sources, such as Plant Wilson, are regulated by current GDNR permits. Future sources, such as emissions from the proposed MOX facility, would also be regulated by air permits; again, the intent of those permits is to ensure emissions are such that the area remains in attainment status with respect to all criteria NAAQS pollutants.

Question No. 17, FEIS Section 7.3.1.1, Page 7-4: *Given the FEIS indicates that "[c]omparable levels for Drought Level 4 are not shown in Table 7-1 because the river discharge is not specified in the Drought Plan but is variable based on inflow conditions," what are the implications of Table 7-1 for lower river discharge rates? Presumably the plants will continue to operate during Drought Level 4. Subsequent analyses evaluated two Drought Level 4 flows. Why are they not included in this table?*

Response No. 17 (Vail): The staff prepared Table 7-1 to illustrate that flows lower than 3800 cfs would be considered extreme events, not fully quantifiable by the U.S. Army Corps of Engineers ("Corps") at present pursuant to its draft Drought Contingency Plan, and to define the context of the staff's evaluation of the cumulative impacts associated

with surface water use. As explained further below, Table 7-1 illustrates that assessment of impacts at levels significantly less than 3800 cfs would provide bounding values for impacts to surface waters that would occur only in extremely rare instances.

The staff's analysis determined that a decrease in streamflows results in an inversely proportional change in the fractional withdrawal. For example, decreasing the streamflow by half from 3800 cfs to 1900 cfs would result in a doubling of the fractional withdrawal from 4.6 percent to 9.2 percent. Consistent with the assumption expressed in the Board's question, the staff did not presume that, even at very low flows, an agency other than the NRC would require one or more units to derate or cease operation. Nevertheless, as the staff stated in the FEIS in response to public comments on the DEIS, if flows decline to a level that the consumptive use of water by the plant's cooling system or the discharge of blowdown to the Savannah River represents a significant environmental impact, the plant may be required by relevant State water permitting authorities (e.g., GADNR) to derate or stop operation. [FEIS at E-44.]

Consistent with the ESRP, the staff considered normal river flows in the FEIS. However, the staff also recognized the need to evaluate a range of flows, including low flow conditions. [ESRP Section 2.3.1] As the staff discussed in the FEIS, the Corps released a draft Drought Contingency Plan in 2006 (USACE 2006). The draft plan proposed releases from upstream reservoirs in the event of four defined drought levels. In the draft Drought Contingency Plan, the drought levels are defined by the elevations of the pool in the two Thurmond and Hartwell storage reservoirs. [FEIS at 2-20.] As the pools in the reservoirs drop, the drought levels increase from 1 to 4. As the drought level increases, the maximum release from Thurmond reservoir is decreased in an attempt to preserve the conservation pools in the reservoirs. These reductions in flows to preserve

the conservation pools are balanced with the need for minimum instream flow downstream from the Thurmond Dam.

The Drought Contingency Plan was not finalized at the time the DEIS was written. [FEIS at 2-20.] However, in the FEIS, the staff presented the reservoir release policies described in the draft Drought Contingency Plan, because it represented the most current understanding of future operations and releases by the Corps. The staff used these published minimum releases at Thurmond reservoir to represent streamflows downstream at the VEGP site during drought periods when the Contingency Plan would be in effect. As stated in the FEIS, the Savannah River Basin is currently in a severe and multiple-year drought. As a result, the Corps is presently operating in a manner similar to the draft Drought Contingency Plan, except that the Thurmond Dam discharge has been at 3600 cfs and not the 3800 cfs minimum currently prescribed in the draft plan. Based on the draft plan, at the time that the FEIS was prepared, the Savannah River Basin was at Drought Level 2 and had never reached Drought Level 3 or 4. [FEIS at 5-7.] However, the Corps had stated that without a reprieve in the drought, Drought Level 3 would be likely during the summer of 2008. [FEIS at 5-8.] This did occur and, as of the date of this response, the Savannah River hydrosystem is in Drought Level 3 for the first time. This development is discussed in a Draft Environmental Assessment and Finding of No Significant Impact published by the Corps in October 2008 concerning a "Temporary Deviation Drought Contingency Plan" for the Savannah River Basin. [Corps 2008 at 1.] At the time the FEIS was written, the staff was additionally advised that the Corps was considering revising the minimum releases in the December to April period downward to 3100 cfs. [FEIS at E-44.] This change has also now been proposed in the Corps' Temporary Deviation Drought Contingency Plan. [Corps 2008 at 1.]

The staff explained in the FEIS that the implementation of Drought Level 4 in the draft Drought Contingency Plan did not provide the explicit flows that would be needed for an impact analysis. [FEIS at 5-9] The Corps, the State of Georgia and the State of South Carolina are presently clarifying the operational implementation of Drought Level 4. 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 a Drought Level 4 would be an extremely rare event, the staff determined that it was still conservative to base its low-flow analysis in the FEIS on Drought Level 3 flows (3800 cfs).

However, in part because of the ongoing drought conditions and the reservoir-release changes contemplated by the Corps, the staff did include in the FEIS values that it calculated in order to disclose potential fractional withdrawals and consumptive water use at multiple flow rates. These rates included very-low flows of 3000 and 2000 cfs in addition to the 3800 cfs minimum for Drought Level 1, 2, and 3 from the current draft Drought Contingency Plan. [FEIS at 5-9 to 5-10.] The 3000 and 2000 cfs values are not specifically Drought Level 4 flow rates, but instead were the staff's attempt to provide additional conservative context for its analysis. The staff expects that the occurrence of these flows would be extremely rare and of only temporary duration. Although the Corps, as described above, is proposing a further seasonal drop in releases from Thurmond reservoir down to 3100 cfs, this value is still bounded by the very-low flows of 3000 cfs the staff already considered in the FEIS.

The staff notes that the current drought has provided a new drought of record for the Savannah River Basin. This occurrence increases the overall probability of a future occurrence of a similar event. However, it does not mean that the current state has

become the new norm. The staff considered it important to the NEPA review of a plant that would have an operating life of 40-plus years that it not bias the description of the affected site environment and the associated assessment of environmental impacts based on the limited context of current conditions. As stated in the FEIS in response to comments on the DEIS, the staff does not believe that the current drought conditions represent a new baseline condition for the Savannah River Basin.

In summary, with respect to Table 7-1, the staff did not specifically include flow values below Drought Level 3 levels in the Table because the Corps has not yet quantified what flows would be below the Drought Level 3 levels. To account for the unavailability of that specific information, the staff analyzed even lower flows and the possible impacts to surface water in an effort to bound the possible impacts. However, the staff's analysis of these lower flows was not intended to suggest that the lower flows would be typical or even anticipated conditions of the site, which is why the flows of 3000 or 2000 cfs were not included in the Table, only in the staff's FEIS textual analysis. In summary, the staff analyzed flow levels lower than those in Table 7-1 and, as explained above, determined that the impacts would remain small due to the short duration of these very-low flow conditions and the limited frequency with which they would be expected to occur.

References:

U.S. Army Corps of Engineers, Savannah District (Corps). 2008. "Draft Environmental Assessment and Finding of No Significant Impact." October 2008. ADAMS Accession No. ML082960588.

U.S. Army Corps of Engineers (Corps). 2006. *Drought Contingency Plan Update: Savannah River Basin. Draft Environmental Assessment*. Mobile/Savannah Planning Center, Savannah River District, U.S. Army Corps of Engineers, Savannah, Georgia. ADAMS Accession No. ML073240724.

Question No. 18: FEIS Section 7.3.1.1, Page 7-5: *Same comment for Table 7-2 as Table 7-1. Should it also consider cumulative utilization from other plants and the Savannah River Site (SRS)? Also, what is the basis for acceptability of a given flow percentage?*

Response No. 18 (Vail): A decrease in streamflows results in an inversely proportional change in the fractional consumptive water use. For example, decreasing the streamflow by half from 3800 cfs to 1900 cfs would result in a doubling of the fractional streamflow depletion from 3.4 percent to 6.8 percent. As the staff explained in the response to Question 17, we believe that the conditions considered are representative of a range of conditions consistent with a NEPA review.

The staff stated in the FEIS that groundwater discharges to the river would likely increase at extremely low stream flows, while the withdrawals would not. For these reasons, the staff considers it likely that the groundwater discharges to the river alone are approximately equivalent to the consumptive loss from the upstream users (even under lower flow conditions). In any event, whatever the potential difference between the upstream withdrawals and discharges, that difference would be very small compared to the total river flow.

In the FEIS, in response to comments on the DEIS, the staff explained that between the Thurmond Dam and the VEGP site, discharges to the river and withdrawals from the river will change the flows reaching the VEGP site. [FEIS page 2-33 to 2-34.] The two largest water withdrawals upstream of the VEGP site are from Urquhart Station at RM 195, which uses 3.61 m3/s (127.5 cfs), and the D-Area Powerhouse at RM 155, which uses 1.94 m3/s (68.4 cfs). Both are operated by South Carolina Electric and Gas.

Upstream of the VEGP site, primary discharges of groundwater and surface water (including from Butler Creek, Spirit Creek, Hollow Creek, McBean Creek, Upper Three Runs Creek, Four Mile Branch, and Pen Branch) into the river increase the streamflow. [FEIS at E-45.] The U.S. Geological Survey (USGS) estimated groundwater discharge over the reach of the river from just below Thurmond Dam to just above the VEGP site to be approximately 223 cfs during low flow conditions (i.e., river flow of 3800 cfs) (USGS 1987). [FEIS at 2-31 to 2-33.] Furthermore, the staff stated in the FEIS that groundwater discharges to the river would likely increase at extremely low stream flows, while the withdrawals would not. For these reasons, the staff considers it likely that the groundwater discharges to the river alone are approximately equivalent to the consumptive loss from the upstream users (even under lower flow conditions). In any event, whatever the potential difference between the upstream withdrawals and discharges, that difference would be very small compared to the total river flow. The Savannah River below Thurmond Dam would also receive surface water flows from various tributaries that would further increase the streamflow.

Since the issuance of the FEIS, the staff also has considered additional recent data for the Savannah River from the USGS gage at Waynesboro, Georgia. The USGS operation and maintenance of this real-time stream gage is funded in cooperation with Southern Nuclear under FERC licensing regulations. While the gage is located near the VEGP site, it has only been in operation since January 2005 and, therefore, the staff considered it to be of too limited a record to be the basis of the staff's assessment in the FEIS. However, the record of data from this new gage does show flows in excess of the releases from Thurmond Dam and shows some periods of flow significantly above the Thurmond Dam releases, consistent with the unregulated surface water flow that, as discussed above, would enter the Savannah River from tributaries below Thurmond

Dam (see Attachment C). Therefore, this additional data supports the staff's view that the flow at the VEGP site will exceed the release at Thurmond reservoir, because the inflow from tributaries and groundwater should generally exceed the consumptive water losses by users between Thurmond reservoir and the VEGP site (an assumption the basis for which is explained above).

With respect to the Licensing Board's question concerning the acceptability of particular flow percentages, staff guidance does not define a specific percentage of stream flow, either withdrawn or consumptively used, as being acceptable or unacceptable in terms of associated environmental impacts. Accordingly, the staff's evaluation of water-use impacts in the Vogtle FEIS was not based solely on assessment of withdrawal or consumptive use percentages. Rather, in determining the acceptability of a withdrawal or consumptive use of a proposed action, the staff considers the existing and likely future beneficial uses of the water downstream of the particular site. The staff also attempts to identify any existing or likely future thresholds with adverse consequences to downstream beneficial uses that may be triggered with an incremental flow diversion. In its environmental review of the Vogtle ESP application, the staff identified no imminent thresholds for significant adverse impacts to downstream beneficial uses of the Savannah River.

References:

Waynesboro Data From USGS Gauge #021973269 near Waynesboro, GA. Data obtained online at http://waterdata.usgs.gov/nwis/uv?021973269 (accessed 11/6/2008). [Provided as Attachment C to NRC Staff Response to Licensing Board's Questions Regarding Environmental Matters.]

Aucott, W.R., S.R.S. Meadows, and G.G. Patterson. 1987. *Regional Ground-Water Discharge to Large Streams in the Upper Coastal Plain of South Carolina and Parts of North Carolina and Georgia*. Water Resources Investigations Report 86-4332, U.S. Geological Survey, Columbia, South Carolina. Accessed January 23, 2008 at http://pubs.er.usgs.gov/usgspubs/wri/wri864332.

Question No. 19, FEIS Section 7.3.1.1, Page 7-5: *The basis for the statements and conclusions in FEIS section 7.3.1.1 that the impacts would be small and mitigation is not warranted does not appear to reflect the cumulative effects of all river users or any Drought Level 4 conditions, only the VEGP site under Drought Level 3 conditions. Explain why the conclusions would be unchanged if the D-Area Powerhouse and Urquhart station, as well as other present and future water users, are included in the analysis assuming the 2000 cubic feet per second (cfs) Drought Level 4 assumption used elsewhere in this section.*

Response No. 19 (Vail): As explained above in the response to question 18, the water withdrawals by upstream users were already accounted for in the staff's conclusions in section 7.3.1.1 because of the Staff's use of the Thurmond Dam release as a surrogate for flows at the VEGP site; for the reasons described, the additional inflows from surface water and groundwater would compensate for these upstream water users. Additionally, the staff did look at impacts under very-low flows of 3000 and 2000 cfs to provide a bounding assessment of the impacts because the Corps has not yet provided specific release values for Drought Level 4 conditions, and these very-low flow values similarly account for the major upstream withdrawals. Moreover, during the staff's review, no significant future water users were identified either upstream or downstream of the VEGP site.

Question No. 20, FEIS Section 7.3.1.1, Page 7-6: *This section indicates that "the percentage of streamflow reduction in the Savannah River due to the operation of VEGP Units 1 through 4 would be 4.3 percent at 3000 cfs and 6.5 percent at 2000 cfs." Why does this surface water consumption analysis not include the other nearby water users*

such as the D-Area Powerhouse consumptive use (1.94 cubic meters per second (m3/s [68.4 cfs]) and the Urquhart Station consumptive use (3.61 m3/s [127.5 cfs])? At 2000 cfs river flow, the total consumptive use from these sources (129 cfs + 68.4 cfs + 127.5 cfs = 324.9 cfs) apparently would be 16 percent of the streamflow. Is this acceptable? What determines the limits? What is the basis for the 2000 cfs assumption?

Response No. 20 (Vail): As mentioned in the response to Question 18, the withdrawals from these upstream water users is already reflected in the baseline analysis presented in Chapter 5. Additionally, as mentioned in the response to Question 17, the staff believes that the 2000 cfs flows are highly conservative for NEPA review, and the analysis of these very-low flows provides a reasonable bounding analysis for flow conditions that, while considered unlikely, were presented solely to compensate for the uncertainty in the exact values for releases that may be associated with Drought Level 4.

Question No. 21, FEIS Section 7.3.2.1, Page 7-12: *Please explain the basis for the statement that the impacts under river flow rates below the Drought Level 3 value would not be significantly different from the impacts analyzed under the Drought Level 3 condition. Section 5.3.3.1 does not appear to identify any analyses at the lower flow rates.*

Response No. 21 (Vail): As explained above in response to Question #11, the Errata to the FEIS (dated September 3, 2008 (ML0825500400)), includes the staff's discussion of impacts at the lower flow rates. As described in response to that question, the staff determined that impacts under these very-low flow rates would not be significantly different from the impacts analyzed under Drought Level 3 flows of 3800 cfs because

adequate streamflow would still exist after the cumulative consumptive loss of water from the various users. Again, as explained in response to Question 17, the staff considered it important for the purposes of its NEPA review that it not bias the assessment of impacts based on the limited context of the current conditions. As stated in the FEIS in response to comments on the DEIS, staff does not believe that the current drought conditions represent a new baseline condition for the Savannah River Basin. [FEIS at E-44.]

Question No. 22, FEIS Section 7.5.2, Page 7-23: *The FEIS indicates that "[i]n addition to the above analysis, the staff also considered the cumulative impacts to aquatic biota in the Savannah River associated with the normal withdrawal rates for all four units at the VEGP site at two river flow rates below the Drought Level 3 values. Even assuming river flows of 3000 cfs and 2000 cfs, rather than the Drought Level 3 case of 3800 cfs river flow, the percentage of water withdrawn from the Savannah River due to the operation of VEGP Units 1 through 4 would be 5.8 percent at 3000 cfs and 8.7 percent at 2000 cfs." This analysis does not include the other major water users. Please explain why the conclusions would be unchanged if these other water users (present and future) were included?*

Response No. 22 (Krieg/Masnik):

Masnik: The staff's cumulative impact discussion in FEIS Section 7.5.2 analyzes the cumulative impacts on aquatic biota from operations on the Savannah River. As explained in the FEIS (FEIS at 7-21), when discussing cumulative impacts, it is important to consider the impacts of water withdrawal, and associated impingement and

entrainment losses, as well as the impacts of consumptive water loss and the resulting potential loss of aquatic habitat.

Impacts to aquatic organisms related to the withdrawal of water are principally due to impingement and entrainment. Although in the FEIS the staff did not reach an explicit conclusion with respect to the impingement-related impacts to aquatic biota at very-low flows for all four Vogtle Units and considering other major water users in combination, the staff did evaluate the impingement impacts from each of these sources, and, in the context of its evaluation of cumulative impacts, concluded for each, separately, that the impingement losses would be minor and cumulatively would be unlikely to adversely affect Savannah River fish populations.

With respect to the cumulative impacts of impingement from Vogtle Units 1, 2, 3 and 4, the staff concluded on FEIS page 7-22 that "Preliminary data collected from the first few months of an impingement study indicate that the impingement losses from the VEGP Units 1 and 2 are minor. Based on the similarity in design of VEGP Units 3 and 4 to Units 1 and 2, the staff determined that impingement at these units would also be minor." This data was collected between March and May of 2008, when the Savannah River was in Drought Level 2. Later in the fall of 2008, the basin reached Drought Level 3. The flows at the VEGP site during this period are representative of flows that would occur during drought conditions.

With respect to impingement at very-low flows for all four units, the staff concluded in the FEIS on page 7-24 that impingement mortality losses to fish would be minor at very-low flows and that there would be no detrimental effect on the fishery of the Savannah River. The staff reached this conclusion because many of the factors controlling impingement losses, such as fish behavior or physiology, are unaffected by the very-low flows

considered. Healthy, adult fish inhabiting medium-sized rivers are accustomed to flowing water and are capable of swim speeds that exceed the through-screen velocities (0.5 ft/sec) and should be able to escape impingement.

With respect to impingement from other major water users, the staff stated on FEIS page 7-22 that the SRS, the largest historical water user in the vicinity of the VEGP site, conducted impingement studies (during the 1982-1985 period when the SRS was withdrawing the greatest amounts of water) and found that the impingement losses from that facility were minor (Specht 1987). The impingement losses reported by Specht are bounding because the major water user in the vicinity of the VEGP site, the SRS, is currently operating at a reduced rate of withdrawal as compared to the period in 1982-1985. The staff also notes that the other major water user above the VEGP site, the Urquhart Station is 44 river miles above the VEGP site.

The anticipated contribution to impingement losses in the Savannah River from all four units at the VEGP site, even under very-low flow conditions, is minor, and the impacts from current water users in the vicinity of the VEGP site (the SRS) are less than the historic impacts which were reported to be minor by Specht. The staff thus concludes that the impacts from very-low flows, all four units and other major water users would still be minor and that no detrimental effects on the fishery would occur.

Krieg: The second primary type of impact from water withdrawals on the aquatic biota of the Savannah River at very-low flows is from entrainment. On page 7-24 of the FEIS, the staff discussed the combination of entrainment losses from all four units at the VEGP site during the hypothetical very-low flow conditions of 3000 and 2000 cfs, in combination with the entrainment losses from other water users. The staff concluded that losses from other users, combined with entrainment losses from the four units at the

VEGP site during the hypothetical very-low flow conditions of 3000 and 2000 cfs “could have a localized detrimental effect on some fish populations[.]” However, the staff determined that “such effects are unlikely to have any long term persistent impacts on populations in the river because the unusual low flow conditions would likely be temporary.” The staff further concluded, on FEIS page 7-24, that “the impact to some species of fish from entrainment may be significant and detectable” and that “although the resource may be affected through the alteration of the fish community, with some species declining in abundance while others increasing [increased], the staff concluded that the resource would not be destabilized (i.e., the effects would not result in the collapse of the fishery).” This analysis was based on the following very conservative assumptions.

First, rather than considering the impact of current major water users, the staff considered the impact of entrainment from historic water withdrawals from the Savannah River Site (SRS), which resulted in a conservatively high estimate of the entrainment impacts. Between 1982 and 1985, the SRS estimated that it entrained between 8.3 percent and 12.3 percent of the ichthyoplankton (fish eggs and larvae) drifting past the canals on the Savannah River. This information is based on Paller et al. 1986 and is discussed in the FEIS at 7-24 and 5-32. The staff considers that the historic entrainment losses at the SRS discussed in the FEIS are greater than (i.e., bound) the current entrainment rates from other water users upstream of the VEGP site. Currently the two major water users located in the Savannah River (in addition to the VEGP site) are the Urquhart Station, which uses 3.61 m3/s (127.5 cfs), and the D-Area Powerhouse at RM 155 (at the SRS), which uses 1.94 m3/s (68.4 cfs). These facilities are both upstream of the VEGP site. The water users that are downstream of the site are approximately 106 miles downstream (FEIS at 2-33) and it is highly unlikely that the same organisms will be

affected by entrainment downstream. The Urquhart Station is located at RM 195, near Augusta, GA, approximately 44 RMs upstream from the VEGP site. The intake for the D-Area Powerhouse at the SRS is located at RM 155, immediately upstream of the VEGP site (approximately 4 RM). The combined withdrawal of water from these two facilities would be about 6.5 percent of the river flow at 3000 cfs and 9.8 percent of the river flow at 2000 cfs. Assuming that losses to ichthyoplankton would be about the same percentage as the water withdrawal (see Environmental Protection Agency's Phase 1 Final regulations for new facilities that withdraw water from waterbodies for cooling purposes; 66 FR 65256, 65277; Dec. 18, 2001), and assuming 100 percent mortality of entrained organisms, these upstream withdrawals could result in entrainment losses of 6.5 percent to 9.8 percent, which is less than the SRS historic entrainment rate (1982-1985) of between 8.3 percent and 12.3 percent of the ichthyoplankton drifting past the canals based on studies by the SRS at normal flows (FEIS at 7-24).

Second, as discussed in the FEIS at page 7-24, the very-low flow conditions would likely be temporary (on the order of days or weeks) rather than consistent over the entire year. In addition, the period of time with the highest concentration of ichthyoplankton in the river (spring) also corresponds to the periods of greater water flow in the river thereby reducing the proportion of river flow withdrawn by operations and resulting in a corresponding reduction in the percentage of organisms entrained.

Third, the staff recognizes that there are no unique spawning areas in the vicinity of the VEGP and SRS sites that would jeopardize entire populations of a given species of fish and that there are multiple spawning sites for fish along the river both above and below the intakes of the VEGP site and the other major water users. This determination is

further verified by the historic data at the SRS site. The conclusion reached by Specht, 1987, for the historic entrainment at the SRS is that:

> "While a substantial fraction of the Savannah River ichthyoplankton are entrained at the SRP [Savannah River Plant] cooling water intake structures, there appears to be no effect on the fishery of the river. Impacts may be mitigated by the fact that all of the species entrained have numerous spawning sites in the Savannah River and the fact that ichthyoplankton have high rates of natural mortalities."

Fourth, as mentioned in the FEIS (at 5-32), and also mentioned above in the quote by Specht (1987), ichthyoplankton (especially those that are most likely to be entrained) have high rates of natural mortalities. Correspondingly, they have high levels of fecundity.

Finally, the assumption that losses to ichthyoplankton would be about the same percentage as the water withdrawal is based on the assumption that all ichthyoplankton in the Savannah River are in the water column. However, as indicated in the FEIS (at 2-88 and 2-89) some species, such as the robust redhorse, lay their eggs in the substrate of the river, where they hatch and the larvae remain for a period of time, rather than being in the water column where they could be entrained.

All of these factors support the staff's conclusion that even at the very-low flows of 3000 cfs or 2000 cfs, the cumulative impacts from entrainment associated with other major water users as well as all four of the VEGP units are unlikely to have any persistent impacts on populations of aquatic biota in the river.

In addition to impacts from entrainment and impingement, the staff considered the consumptive water withdrawals from the river. Consumptive water losses can impact

the aquatic biota by reducing the amount of habitat available. The FEIS did not explicitly discuss the cumulative effects of consumptive water use at very-low flows in combination with the impacts of operation of Units 1, 2, 3 and 4 and other major water users. However, as further explained in response to question 18, the staff estimated that the withdrawals from the river between Thurmond Dam and the VEGP site are generally offset by discharges from surface water and ground water entering the Savannah River. Consequently, consumptive water losses from upstream users are already incorporated in the staff's analysis of the cumulative impacts to aquatic biota.

References:

Specht, WA (ed.). 1987. Comprehensive Cooling Study Final Report, Volume V, Aquatic Ecology. DP-1739, E.I. Du Pont de Nemours and Company. Aiken, South Carolina.

66 FR 65277. December 18, 2001. "National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities." Federal Register, U.S. Environmental Protection Agency. (FR notice starts on 66 FR 65256).

Question No. 23, FEIS Section 9.2, Page 9-3: *The FEIS states that "[f]or analysis of energy alternatives, [SNC] assumed a bounding electrical output target value of 2234 megawatts electric (MW[e]) (Southern 2008). The staff also used this level of output in its analysis of energy alternatives." Does this mean that the analysis is applicable to any plant size smaller than the proposed two new VEGP units? For example, explain whether the analysis would still be applicable if only one of the two reactors were built.*

Response No. 23 (Hendrickson): In its application, Southern assumed a target value of 2234 MWe for the net electrical output from a new two unit nuclear generation facility

at the Vogtle site. Southern stated that the 2234 MWe represents a bounding value that was used as the basis for its analysis of energy alternatives (Southern 2008, section 9.2.2.1 of ER). The staff determined that 2234 MWe is a reasonable value for the expected output of two AP1000 units and followed Southern's assumption in preparing section 9.2 of the FEIS. Much of the analysis in section 9.2 of the FEIS would generally be applicable to plant combinations smaller than 2234 MWe, e.g., construction of only one new nuclear unit instead of the two proposed units. However, the staff's estimated impacts and impact characterizations, as summarized in Tables 9-1, 9-2, 9-3, and 9-4 of the FEIS, would likely need to be adjusted for some impact categories for a smaller proposed plant size. The following paragraph uses the staff's analysis and impact characterizations for an alternative coal-fired plant summarized in Table 9-1 of the FEIS to illustrate the preceding points.

The analysis in Chapters 4 and 5 of the FEIS is based on Southern's proposal to build two new nuclear units at the Vogtle site. Consequently, the analysis in section 9.2.2.1 of the FEIS assumes the construction and operation of four coal-fired units at the Vogtle site in order to generate approximately the same amount of power as two new nuclear units. If only one nuclear unit were proposed, then, by analogy, two alternative coal-fired units would be needed. In making impact characterizations, the staff uses the definitions for SMALL, MODERATE, and LARGE (S/M/L) set out at p. 1-4 of the FEIS. With two rather than four alternative coal-fired units, the actual impacts would be expected to change, at least incrementally, for all impact categories. However, some of the impact category characterizations (i.e., S/M/L) in Table 9-1 may not necessarily change because the S/M/L definitions allow for the possibility of a range of impacts (as opposed to a single point level of impacts) within a particular S/M/L impact characterization. For example, the categories for which impact characterizations may not change would likely

include land use, water use and quality, human health, historic and cultural resources, and environmental justice. Environmental impacts for these impact categories would be smaller than if four coal-fired units were constructed, but probably would not be sufficiently smaller that the staff's impact characterizations would change (e.g., from MODERATE to SMALL).[1] Impacts for the other impact categories (air quality, ecology, waste management, and socioeconomics) would also be smaller if two coal-fired units were constructed, but additional specific analysis would be needed to determine if the staff's impact characterizations would change.[2] The discussion in this paragraph would also generally apply to the staff's analysis and impact characterizations for an alternative natural gas combined-cycle plant, as summarized in Table 9-2 of the FEIS.

In summary, impacts for smaller plants sizes are indeed likely to be smaller, but because changes in some impact categories are more likely to be significant (or near S/M/L impact characterization thresholds) than in others, the staff does not assume that the analysis in section 9.2 of the FEIS would be generically applicable to any smaller plant size. For purposes of section 9.2, the staff prepared its evaluation of energy alternatives based on the target plant output in Southern's application, which the staff determined was reasonable.

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[1] Impacts for water use and quality and human health are already characterized as SMALL in Table 9-1 of the FEIS and, consequently, the characterizations could not be further reduced.

[2] In the case of socioeconomics, the beneficial impacts for two units would likely be reduced from a LARGE beneficial to a MODERATE beneficial impact characterization in Table 9-1.

Question No. 24, FEIS Section 9.2.4, Page 9-23: *The combination of alternatives discussion assumes 60 MW of wind energy. What was the basis for this choice? What are the factors regarding wind energy generation that limit the plant size? Is there a wind energy limit for this site that precludes considering it as base load capacity?*

Response No. 24 (Hendrickson): In section 9.2.4 of the FEIS, in accord with ESRP 9.2.2 (NRC 2000 and 2007[3]), the staff considered a possible alternative combination of energy resources to achieve Southern's target electricity production. While many combinations of energy resources could be reasonably considered, the staff believes that the combination identified in section 9.2.4 is reasonable and representative. It would not be reasonable to examine every possible combination of energy alternatives in an EIS. Doing so would be counter to the direction of the Council on Environmental Quality (CEQ) that an EIS should be analytic rather than encyclopedic, shall be kept concise, and shall be no longer than absolutely necessary to comply with NEPA and CEQ's regulations [40 C.F.R. §1502.2(a), (b)].

The three primary energy sources for generating electric power in the U.S. are coal, natural gas, and nuclear energy (EIA 2007). Coal-fired plants are the primary source of baseload generation in the U.S. (EIA 2007). Natural gas combined-cycle generation plants are often used as intermediate generation sources (EIA 2007), but can and are also used as baseload generation sources (Progress Energy 2008). Given that Southern's objective is for a new baseload generation facility, a fossil energy source, most likely coal or natural gas, would need to be a significant contributor to any reasonable alternative energy combination. Consistent with these factors, the staff in

[3] The *Environmental Standard Review Plan* (ESRP), NUREG-1555, is being revised by the staff to reflect new information and experience. Draft Revision 1 for certain ESRP sections, including Section 9.2.2, was issued for use by the staff and for public comment in July 2007.

section 9.2.4 of the FEIS assumed three 530 MWe natural gas combined-cycle generating units as part of the combination of energy resources.

In light of the available wind resource in the southeast, the staff chose 60 MW of wind energy as a representative amount that wind energy could contribute to the combination of energy resources. The reasonableness of that assumption is supported by the staff's discussion of wind power in section 9.2.3.2 of the FEIS. As discussed in section 9.2.3.2, the Vogtle site is in a wind power Class 1 region (average wind speeds lower than 5.6 meters per second) which has the lowest potential for wind energy generation. Wind energy generation potential increases as average wind speeds increase. As noted in section 9.2.3.2, the U.S. Department of Energy (DOE) states that Class 1 areas are unsuitable for wind energy development. Given DOE's assessment, the 60 MW of wind energy would need to be generated at a location in Southern's region of interest other than the Vogtle site, probably on the Georgia coast where there are more favorable wind resources. Southern and Georgia Institute of Technology (GIT) examined the wind power potential off the Georgia coast in a 2007 report (Southern and GIT 2007). Southern and GIT reached the following conclusion:

> The available data indicates that a wind farm located offshore in Georgia would likely have an adequate wind speed to support a project, although offshore project costs run approximately 50 – 100% higher than land based systems. Based on today's prices for wind turbines, a commercial size 50 MW to 160 MW offshore wind farm could produce electricity at 12.9 to 8.2 cents/kWh respectively, assuming a 20-year life and regulatory incentives such as a federal production tax credit with accelerated depreciations similar to those currently available (Southern and GIT 2007, p. 6).

The staff took account of this conclusion in the Southern-GIT report in selecting 60 MW as a representative amount of wind energy to include in the combination of energy resources.

References:

Progress Energy. 2008. "Options for Baseload Generation." Online at: http://www.progress-energy.com/aboutenergy/poweringthefuture_florida/levy/faq_options.asp.

Southern Company and Georgia Institute of Technology (GIT). 2007. *Southern Winds: Summary Project Report 2007*. Online at: http://www.energy.gatech.edu/research/Summary-Southern-Winds.pdf.

U.S. Energy Information Administration (EIA). 2007. *Electric Power Annual: Overview*. Online at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG-1555. Online at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/sr1555.pdf.

U.S. Nuclear Regulatory Commission (NRC). 2007. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Updates to the March 2000 Version.* Online at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/updates.html.

Question No. 25, FEIS Section 9.3, Pages 9-25 to 27: *While once-through cooling seemingly is not suitable for this site, other options, such as cooling ponds, might be reasonable alternatives. Why were such alternatives not evaluated?*

Response No. 25 (Vail): In the staff's initial review to determine if alternative cooling systems would be practical at Vogtle, the staff determined that, based on the site footprint and topographic relief, insufficient level area existed for locating cooling ponds. Typically, cooling ponds are only practical in special circumstances (e.g., when there is an abundance of level property). The cooling pond approach was not considered practical for the Vogtle site because there was too much topographic relief on the site.

Question No. 26, FEIS Section 9.4.2, Pages 9-28 to 29: *What was the basis for the staff's conclusion that SNC's methodology for selecting alternative sites was reasonable? Did the staff confirm there were no feasible sites in Mississippi that needed to be evaluated? What was the rationale for accepting the SNC approach of excluding non-nuclear sites from further evaluation, despite the possibility such sites might have been judged more favorably regarding such relevant criteria as water availability during a drought?*

Response No. 26 (Hendrickson): In evaluating Southern's site selection process, the staff followed the guidance in ESRP 9.3 (NRC 2007). As stated in ESRP Section 9.3 (NRC 2007, pp. 9.3-5 – 9.3-6), "the overall goal of the review is to understand the applicant's site selection methodology so that an eventual evaluation can be made of the reasonableness and capability of this process to identify candidate sites that are among the best that can reasonably be found" in the applicant's region of interest. ESRP Section 9.3 (NRC 2007, p. 9.3-6) directs the staff reviewer to consider the applicant's site selection process and the "reasonableness of the products" (e.g., the potential and candidate sites and the proposed site) identified by the process. The staff's analysis of Southern's site selection process is summarized in section 9.4.2 of the FEIS.

In developing its list of potential sites, Southern determined that co-locating new nuclear generating units with an existing power plant owned by Southern outweighed the potential advantages of other possible siting alternatives (Southern 2008). Southern's reasons for this decision are set out at p. 9-28 of the FEIS. Southern's initial step in identifying potential sites was to identify all sites in its service area with existing generation units relatively the same size or larger than the proposed AP1000 units, with available land for expansion, and with available cooling water (Southern 2007). This

process resulted in the identification of nine potential sites with existing coal fired power plants, three potential sites with existing nuclear generating units, and one potential greenfield site. All 13 potential sites identified by Southern are in Alabama or Georgia. Southern did not include any potential sites in Mississippi, in spite of the fact that Mississippi is within Southern's region of interest, because it did not identify any sites in Mississippi that met its screening criteria for potential sites (Southern 2007). Given that Southern's process for selecting potential sites identified 13 sites, which the staff considered to be a reasonable pool of potential sites for further screening and evaluation, the staff did not find the lack of one or more potential sites in Mississippi to be unreasonable. The staff did not independently confirm that there were no potential sites in Mississippi. The staff considers this approach to be consistent with the guidance in ESRP 9.3 (NRC 2007, p. 9.3-8) which states that the goal of the process to identify potential sites "is not to identify every potential site."

In screening its 13 potential sites to four candidate sites, Southern eliminated the potential sites with coal-fired power plants. Southern's reasons for this decision are stated at p. 9-29 of the FEIS and in Southern (2007), and included such factors as the known environmental and suitability conditions at existing nuclear sites and the fact that existing nuclear sites had previously been screened as part of an alternative site analysis and had been found acceptable by the NRC. While it is possible that one or more of the potential sites with existing coal fired generation units could have better water availability during a drought than the proposed Vogtle site, the staff did not independently verify whether this might be the case. Instead, the staff relied on Southern's screening criterion that all selected potential sites had available cooling water. The staff did examine the availability of cooling water at each of Southern's four candidate sites. This examination is documented in section 5.3 of the FEIS for the

proposed Vogtle site, section 9.5.1.2 of the FEIS for the alternative Hatch site, section 9.5.2.2 of the FEIS for the alternative Farley site, and section 9.5.3.2 of the FEIS for the alternative Barton site.

Southern's process for screening the four candidate sites and selecting the proposed Vogtle site is summarized at p. 9-29 of the FEIS. In performing the screening, Southern used similar environmental categories (e.g., land use, air quality, water-related, etc.) to those that the staff used in the FEIS to evaluate impacts at the candidate sites.

The staff reviewed Southern's overall site selection process using the staff guidance in ESRP Section 9.3 (NRC 2007). Based on its review, the staff determined that:

- Southern used a logical process to identify potential sites.
- Southern's candidate sites all appear to be potentially licensable sites.
- Southern's site selection process was reasonable and resulted in candidate sites that are among the best that could reasonably be found in its region of interest.

References:

Southern Nuclear Operating Company, Inc. (Southern). 2008. *Southern Nuclear Operating Company, Vogtle Early Site Permit Application, Revision 4*. Southern Company, Birmingham, Alabama. Accession No. ML081020073.

U.S. Nuclear Regulatory Commission (NRC). 2007. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Updates to the March 2000 Version.* Online at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/updates.html.

Southern Nuclear Operating Company, Inc. (Southern). 2007. "Description of SNC Selection Process for Candidate Sites to Support Environmental Report Chapter 9 Alternate Site Selection." August 8, 2007. Southern Company, Birmingham, Alabama. Accession No. ML072270351.

Question No. 27, FEIS Sections 9.5.1.2, 9.5.2.2, and 9.5.3.2, Pages 9-33, 9-50, and 9-70: *The water use and quality evaluations for all sites were based upon the 7Q10 flow. Why was the maximum expected drought condition not evaluated for each of these sites and then compared to the VEGP site?*

Response No. 27 (Vail): In its environmental reviews pursuant to NEPA, the staff does not base its conclusions on a severe "worst case" analysis. Rather, the staff's environmental analysis is based on likely conditions, including explicit consideration of normal patterns of variability. In contrast, for plants that rely on streamflow for safety-related purposes, extreme water conditions such as maximum probable flood and maximum probable drought conditions would be evaluated in the staff's safety review and documented in its Safety Evaluation Report (SER).

In the Vogtle FEIS, the staff accordingly based its alternative sites analysis in part on the 7Q10 flow, which is defined as the expected lowest average-daily flow for seven consecutive flows over a ten year period. While it does not represent a worst-case river flow scenario, the 7Q10 flow is still a very conservative flow value. The staff considers the 7Q10 to be a reasonable basis for determining short-term impacts during low-flow conditions in a NEPA analysis. The 30Q2 (expected lowest flow for thirty consecutive days over a two year period) and the mean flow, which the staff also considered in the alternative sites evaluation with respect to water use, provide additional measurements of the typical seasonal variability. If the staff determined that the use of water by a plant at an alternate site would represent either significant fraction of the 7Q10, staff would perform a more detailed review of the water supply and cooling system alternatives for the proposed alternative site. Regulatory Guide 4.2, Rev. 2, states that the applicant is

not expected to conduct detailed environmental studies at alternative sites; only preliminary reconnaissance-type investigations need be conducted. Because they provide a reasonable and consistent characterization of flow variability, these measurements are adequate for staff to make a determination of the water-use related impacts at the depth of analysis consistent with the alternative sites analysis.

In summary, the staff believes that an alternative site assessment based on the 7Q10 (a condition that is only expected to occur only four times for one-week over the forty year life of the plant's license) and 30Q2 (a condition that characterizes typical annual seasonal variability) provides both a consistent and appropriate summary of water availability at alternative sites consistent with the needs of NEPA.

Question No. 28, FEIS Section 10.0, Page 10-1: *The last paragraph of this section indicates the staff performed its own independent review of the alternative sites analysis in applicant SNC's ER. Please describe the manner in which the staff performed this independent review.*

Response No. 28 (Hendrickson): The staff reviewed Southern's site selection process using ESRP Section 9.3 (NRC 2007) as guidance. ESRP Section 9.3 (NRC 2007, p. 9.3-6) calls for a two-part sequential test to determine whether an alternative site is obviously superior to the proposed site. The first stage of the test determines whether there are environmentally preferred sites among the alternative sites. The second stage of the test considers economics, technology, and institutional factors among the environmentally preferred sites to see if any such site is obviously superior to the

proposed site. If no obviously superior site is found, the proposed site prevails. The 2000 version of ESRP Section 9.3 (NRC 2000) contains the same two-part test.

As stated on p. 10-1 of the FEIS, the staff independently reviewed whether any of the alternative sites would be environmentally preferable to the proposed site. The staff's review findings are discussed in section 10.2 of the FEIS. The review involved comparing the staff's construction and operational impact characterizations at the proposed site to corresponding impact characterizations for the alternative sites. In conjunction with developing its impact characterizations for the four candidate sites, the staff (1) visited the proposed site and the three alternative sites; (2) consulted with Federal and State agencies; (3) reviewed Southern's ER; (4) conducted its own literature reviews; (5) reviewed NRC's Environmental Statements prepared prior to construction and operation of the existing nuclear units at the Farley, Hatch, and Vogtle sites; (6) prepared and submitted requests for additional information to Southern; (7) reviewed the public scoping comments and comments on the draft EIS, and (8) considered the applicable guidance in NUREG-1555 (NRC 2000 and 2007). In evaluating alternative sites, the staff used reconnaissance-level information as provided for in ESRP Section 9.3 (NRC 2007).

Southern's ER (Southern 2008, Tables 9.3-2 and 9.3-3) contains impact characterizations for the four candidate sites. The staff independently prepared its own impact characterizations for the four candidate sites. The staff's impact characterizations differ in some cases from Southern's characterizations.[4] Based on its

[4] For example, Southern characterized historic and cultural impacts during construction at the Vogtle site as SMALL in Table 9.3-2 of its ER, whereas the staff characterized the impacts as MODERATE in Table 10-1 of the FEIS. As another example, Southern characterized aesthetic

independent review and comparison of the expected impacts and impact characterizations at the proposed and alternative sites, the staff determined that none of the alternative sites would be environmentally preferable to the proposed Vogtle site.

As discussed in the response to question 26, the staff determined that Southern's site selection process was reasonable and resulted in candidate sites that are among the best that could reasonably be found in Southern's region of interest. The staff's evaluation of potential impacts at each alternative site is in section 9.5 of the FEIS.

References:

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG-1555. Online at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/sr1555.pdf.

U.S. Nuclear Regulatory Commission (NRC). 2007. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Updates to the March 2000 Version.* Online at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/updates.html.

Southern Nuclear Operating Company, Inc. (Southern). 2008. *Southern Nuclear Operating Company, Vogtle Early Site Permit Application, Revision 4*. Southern Company, Birmingham, Alabama. Accession No. ML081020073.

Question No. 29, FEIS Section 11.6.2.1, Page 11-16: *Please explain the basis upon which the staff has concluded that the estimated construction capital costs for Units 3 and 4 ($7.1 to $7.8 billion) are valid given the seemingly higher cost estimates for other AP1000 facilities, such as the proposed new Turkey Point facilities recently referenced by the Licensing Board in the Bellefonte combined operating license proceeding, LBP-08-16, 68 NRC _, _ (slip op. at 67) (Sept. 12, 2008)?*

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impacts during operation at the Vogtle, Farley, and Hatch sites as SMALL in Table 9.3-3 of its ER whereas the staff characterized the impacts as SMALL to MODERATE in Table 10-2 of the FEIS.

Response No. 29 (Cort): As guided by ESRP 10.4.2 and explained in Section 11.6.2.1 of the FEIS, the staff reviewed the applicant's estimate of overnight capital costs, and compared these estimates to the ranges of overnight capital cost estimates that have been produced by three of the most comprehensive studies on nuclear capital costs available at the time of the writing, which included the following:

- Massachusetts Institute of Technology (MIT). 2003. *The Future of Nuclear Power: An Interdisciplinary MIT Study.* Massachusetts Institute of Technology, Cambridge, Massachusetts. Accessed at http://web.mit.edu/nuclearpower/.
- University of Chicago. 2004. *The Economic Future of Nuclear Power. University of Chicago,* Chicago, Illinois. Accessed at http://www.anl.gov/Special_Reports/NuclEconAug04.pdf.
- U.S. Department of Energy (DOE). 2004. *Study of Construction Technologies and Schedules, O&M Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactor Designs.* Vol. 2 - MPR-2610, prepared by Dominion Energy, Inc., Bechtel Power Corporation, TLG, Inc., and MPR Associates under Contract DE-AT01-020NE23476, May 27.

To ensure that the comparison and evaluation was appropriate and up-to-date, the staff escalated the results of these cost studies to reflect real price increases (as well as inflationary increases) in the cost of labor and key construction commodities (see footnote (a), page 11-15 of FEIS) to 2007 prices and dollar values. The staff concluded that the applicant's estimates of overnight capital costs were well within the range of these other independent study estimates.

The Licensing Board's question concerns whether these cost estimates remain valid in light of cost estimates for the proposed new Turkey Point facilities estimates that were recently referenced by petitioners for intervention in the Bellefonte combined operating

license (COL) proceeding. For the reasons discussed below, the staff does not believe that its analysis of the benefit-cost balance of the proposed Vogtle Units 3 and 4, presented in the Vogtle FEIS, is affected by the Turkey Point cost estimates discussed in the Bellefonte proceeding.

First, the staff notes that the cost estimates referenced by the Bellefonte petitioners are from statements taken from testimony by FPL to the Florida Public Service Commission (PSC) regarding FPL's Petition to Determine Need for Turkey Point Nuclear Units 6 and 7. Thus, the FPL testimony and cost estimates cited were prepared for a different purpose, distinct from the NRC COL application process. FPL is in the process of evaluating the need for power in its region of interest and is submitting information to the Florida PSC, as required by the Florida PSC, which regulates electric power generation and electric rates in the state of Florida. The FPL testimony that is cited is directed toward answering questions that are relevant to the need for power analysis and cost-recovery and rate setting process in the state of Florida. Consequently, the questions that are being addressed in the testimony concern matters that are distinct from those that would be examined pursuant to NRC's ESRP guidance concerning the appropriate analysis of benefits and costs (ESRP Section 10.4.2) of the proposed action. The estimates are not for a project for which an application is pending before the NRC, nor are they from an application under NRC review. Accordingly, the cost estimates in question have not been presented for staff review in the context of an application before the NRC.

Rather, the joint petitioners in the Bellefonte proceeding referred in their petition to "October 2007 testimony before the Florida Public Service Commission by Florida Power and Light Company (FPL) indicating that the cost of a new AP 1000 unit (including

escalation during construction) at the location of its existing two-unit Turkey Point to be between $5492 and $8041 per kW."[5] These estimates were subsequently referenced by the Bellefonte COL Licensing Board in its ruling on the admissibility of a contention concerning cost estimates in the applicant Tennessee Valley Authority's application.

In following the guidance provided in ESRP Section 10.4.2, the staff evaluates the cost estimates presented by an applicant and compares these with referenced studies and analyses that are subject to confirmation in order to ensure that an appropriate comparison is made. Although comparisons with independent studies can be employed as a useful evaluation tool by the staff, there is no requirement that the applicant or staff integrate every available cost estimate or statement on the topic when completing the FEIS. Consequently, it is not the staff's practice to compare an applicant's cost estimates with isolated statements concerning a separate specific construction project, such as the FPL testimony in question.

In any event, from the language presented in the Bellefonte contention, it is not clear to the staff what is included in the cost numbers associated with the FPL testimony. For example, it is unclear what assumptions were made regarding the breadth of construction activities, materials, labor, and site-specifications; whether these are overnight capital cost estimates; or whether this is a net present value calculation that integrates the cost of financing and risk factors. A brief review by the staff of the cited testimony suggests that the FPL numbers are not equivalent overnight cost of capital

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[5] The Bellefonte petitioners cited their source as: Direct Testimony of Steven D. Scroggs, Florida Power & Light Company, before the Florida Public Service Commission, Docket No. 07____-EI (October 16, 2007) ("FPL 2007 Testimony"). On the Internet at http://www.psc.state.fl.us/dockets/cms/docketFilings2.aspx?docket=070650, (document number 09467-07, Exhibit SDS-8). Note that the docket number is as cited on the document (Taken from Contention Sixteen, from Footnote # 31).

estimates (as presented in the Vogtle FEIS), but rather time-related and site-specific costs that incorporate future predicted cost escalations, interest rates, and financing costs (see page 49 and 50 of testimony). These referenced FPL numbers would, thus, be inappropriate to compare with the overnight capital cost estimates provided in the Vogtle FEIS (see Vogtle FEIS page 11-15 for discussion and definition of "overnight capital costs.") In fact, in the same FPL testimony, a comparable estimate of 2007$ overnight capital costs is presented (see Power Island costs, page 47), and these costs range from $2,444 up to $3,582 per kW installed capacity for the Turkey Point Project – a range comparable to the Vogtle estimates presented in the FEIS, which range from $3200 to $3500 per kW. Accordingly, while the time-related, present-value cost estimates cited in the Bellefonte proceeding are seemingly higher than those presented in the Vogtle FEIS, the staff believes that the FPL estimates are not comparable to the overnight capital cost numbers in the Vogtle FEIS and thus not a reasonable basis for comparison.

The VEGP ESP FEIS for Units 3 and 4 is the first new nuclear application that has included a section on Benefit-Cost and, thus, the comparisons with other applicants' cost estimates were limited at the time of the writing of the FEIS. Although the NRC staff continuously updates its estimates based on current research, there are many dynamic factors involved in these cost estimates, and, in all cases, the estimates presented are only a representation of a specific point and time. Despite these limitations, however, the staff believes that its analysis presented in the Vogtle FEIS is both appropriate and reasonable. The applicant provided current capital cost estimates, which reflected information it had obtained from April 2008 negotiations with Shaw Construction and Westinghouse (proposed reactor vendor) before signing an Engineering, Procurement, and Construction contract with these companies. The staff compared these estimates

with comprehensive, peer-reviewed nuclear cost studies, and found Southern's estimates to be reasonable. In sum, there is no reason to believe that the information presented in the FPL testimony should affect the validity of these cost estimates or the adequacy of the evaluation in the FEIS.

Question No. 30: Are there any ESP license conditions that the staff will impose to address environmental matters associated with the VEGP site and, if so, what are they?

Response No. 30 (Sackschewsky): The staff does not anticipate any environmental related license conditions attached to the VEGP ESP. However, the ESP will likely incorporate the VEGP site characteristics, AP1000 design parameters, and site interface values as listed in Appendix I of the FEIS. Additionally, construction activities authorized under a Limited Work Authorization associated with this ESP likely would be subject to an Environmental Protection Plan that would be attached to the ESP.

ATTACHMENT B

Reviewer Affidavits and Statements of Professional Qualifications

November 7, 2008

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 KATHERINE A. CORT CONCERNING
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Katherine A. Cort, do hereby state as follows:

1. I am employed as a Research Economist at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned socioeconomics, environmental justice, need for power and benefit-cost issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Katherine A. Cort

KATHERINE ALLEN CORT
Research Scientist/Economist
Technology Planning and Deployment
Energy Science and Technology Division
Pacific Northwest National Laboratory

EXPERIENCE

Research Economist, Pacific Northwest National Laboratory, Richland, WA
Spring 1998 – Present.

Forecasting and Program Benefit Estimations. Performed quantitative analysis of energy and environmental benefits, as prescribed by the Government Performance and Results Act, of all Building Technology programs supported by the U.S. Department of Energy (USDOE). Managed task developing model to evaluate economic impact of proposed commercial building energy codes on individual states.

Benefit-Cost Analysis. Completed a series of benefit-cost studies evaluating the potential impact of commercial building energy codes on four states. Project manager for evaluation of site restoration alternatives for two Washington nuclear plants that had never been commissioned. Assisted in developing input/output model to evaluate economic impacts of energy-saving technologies and privatizing public facilities.

Energy Policy and Intelligence. Completed analyses and reports regarding the energy trade between FSU and Europe and Turkey's strategic influence on U.S. oil and gas supply. Completed economic portions of two USDOE technical information notes (TIN) on electricity deregulation and restructuring in U.S., Europe and Russia and completed assessment of economic structure and future viability of all nuclear plants in Russia.

Environmental Impact Statements. Part of team of researchers reviewing construction and operating license applications for new nuclear plants and completing corresponding Environmental Impact Statements for the U.S. Nuclear Regulatory Commission. Specialize in the evaluation of matters related to socio-economics, Environmental Justice, benefit-cost analyses, land-use issues, need for power assessments and potential energy alternatives. Contributed to developing guidelines for reviewing the impacts of nuclear plant closures.

Market Analysis and Staffing Assessments. Provide research support for market analysis and strategic planning (internal) for energy-efficiency programs. Managed tasks focusing on staffing, training, and sustainability issues related to the deployment of advanced detection technologies and systems at various international seaports.

Training Curriculum Development: Involved in managing and developing and deploying curriculum and training program for U.S. Department of Homeland Security Rail Security initiative and USDOE Second Line of Defense program focusing on installation of radiation detection equipment and international seaports.

Previous Experience

Economic Analyst, Washington State, Office of Insurance Commissioner, Olympia, WA, 1996 - 1998.

Analyzed economic impact of legislation and regulation, such as environmental claims rules and health insurance rate regulation, on citizens and businesses.

Research Associate, Tropical Science Center, San Jose, Costa Rica, 1994 - 1996.
Economic Incentives for Watershed Protection and Land Use. Worked in conjunction with the Tropical Science Center (Costa Rica) and the International Institute for Environment and Development of London (U.K.) to evaluate economic incentives for watershed protection and land use in Lake Arenal Region of Costa Rica, as part of a fellowship sponsored by the Social Science Research council and the Ford Foundation. Lead Researcher for irrigation water valuation study and study of economic benefits of cloud forest biological preserves. Completed case study evaluating major drivers of Central American economies including the impact of sustainable eco-tourism. Supported GIS mapping of Arenal watershed and designed and managed statistical database for all participants in watershed land use study (170 ranchers & farmers).

Economist Intern, Seattle Public Utilities, Seattle, Washington, 1993 - 1994.
Analyst for numerous economic studies regarding water conservation, utilizing cost-benefit and econometric techniques, including: benefit/cost analysis of proposed city landscape code and water conservation kit program; study of outdoor water use; estimation of indoor water demand for multi-family dwellings. Designed and managed large databases, including information on all Seattle water customers.

EDUCATION

M.A. Economics, University of Washington, Seattle, WA	1993
B.S. Southern Methodist University, Dallas, TX	1991
Cemanahuac Language School, Cuernavaca, Mexico	1994
Fundación José Ortega y Gasset, Madrid, Spain	Fall 1991
University College, Oxford, England	Summer 1991

RECENT PUBLICATIONS AND PRESENTATIONS:

Chapters/PNNL Reports:

- Dirks JA, DM Anderson, DJ Hostick, DB Belzer, and KA Cort. 2008. *Lost Opportunities in the Buildings Sector: Energy-Efficiency Analysis and Results* . PNNL-17623, Pacific Northwest National Laboratory, Richland, WA.

- Cort KA, DJ Hostick, DB Belzer, and OV Livingston. November 2007. *Modeling EERE Deployment Programs.* PNNL-17089, Pacific Northwest National Laboratory, Richland, WA.

- Livingston OV, MJ Scott, DJ Hostick, JA Dirks, and KA Cort. 2008. *Impact of the FY 2009 Building Technologies Program on United States Employment and Earned Income* . PNNL-17598, Pacific Northwest National Laboratory, Richland, WA.

- "Appendix G - Building Technologies Program Inputs for FY 2008 Benefits Estimates." Completed for the U.S. Department of Energy's Energy Efficiency and Renewable Energy Program. PNNL-SA-54941, 2007.

- "Technical Appendix: GPRA FY06 Building Technologies Program Documentation," Cort KA, DM Anderson, DB Belzer, JA Dirks, and DJ Hostick. 2005. "Technical Appendix: GPRA FY06 Building Technologies Program Documentation." In Projected Benefits of

Federal Energy Efficiency and Renewable Energy Programs FY 2006 - FY 2050. DOE-EERE, Washington, DC.

- "Analysis of Potential Benefits and Costs of Adopting a Commercial Building Energy Standard in South Dakota," Belzer DB, KA Cort, DW Winiarski, and EE Richman. 2005. PNNL-15101, Pacific Northwest National Laboratory, Richland, WA.

Nuclear Regulatory Commission Reports:

- *Final Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site.* Division of New Reactors, Office of Nuclear Regulatory Commission. NUREG-1872, Vol1, August 2008.

- *Final Environmental Impact Statement for License Renewal at the National Bureau of Standards Reactor.* Division of Regulatory Improvement Programs, Office of Nuclear Regulatory commission. PNNL-16665 and PNNL-16779, Pacific Northwest National Laboratory, Richland, WA. June 2007.

Journal articles:

- "The value of energy efficiency programs for US residential and commercial buildings in a warmer world." Scott MJ, JA Dirks, and KA Cort. *Mitigation Adaptation Strategies for Global Climate Change* (June 2007).

- "The Impact of DOE Building Technology Energy Efficiency Programs on U.S. Employment, Income, and Investment" Scott MJ, DM Anderson, KA Cort, JM Roop, and RW Schultz. *Energy Economics (Fall 2007)*.

- "Sustainable Ecotourism in Costa Rica: the Monteverde Cloud Forest Preserve" with B. Aylward, J. Echeverría, & J. Tosi. *Journal of Conservation and Biodiversity (March, 1996)*

Conference Papers and Presentations:

- "DOE's Building Technology's Controls and Sensors Planning Crosscut: Baseline Information." McDonald SC, KA Cort, MR Brambley, DJ Hostick, and S Katipamula. 2005. PNNL-SA-47010 Pacific Northwest National Laboratory, Richland, WA.

- "A Ten Year Retrospective on Environmental Justice: What Have We Learned?" Scott MJ, JA Jaksch, and KA Cort. 2005. In Proceedings, Waste Management 2005, February 27 – March 3, 2005, Tucson, Arizona. "Global Accomplishments in Environmental and Radioactive Waste Management: Cost-Effectiveness, Risk Reduction, and Technology Implementation". PNNL-SA-43942, Pacific Northwest National Laboratory, Richland, WA.

- "The Adaptive Value of Energy Efficiency Programs in a Warmer World: Building Energy Efficiency Offsets Effects of Climate Change." Scott MJ, JA Dirks, and KA Cort. 2005. In 2005 International Energy Program Evaluation Conference. PNNL-SA-45118, Pacific Northwest National Laboratory, Richland, WA.

November 7, 2008

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 PAUL L. HENDRICKSON CONCERNING
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Paul L. Hendrickson, do hereby state as follows:

1. I am employed as a Staff Scientist at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned land use, energy alternatives, and alternative site selection issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Paul L. Hendrickson

PAUL L. HENDRICKSON

Staff Scientist
Radiological Sciences and Engineering Group
Energy and Environment Directorate

EDUCATION

B.S.	Chemical Engineering, University of Washington	1968
J.D.	University of Washington Law School	1971
M.S.	Industrial Management, Purdue University	1972

EXPERIENCE

Since joining the Pacific Northwest National Laboratory (PNNL), Mr. Hendrickson has worked extensively in the areas of legal and regulatory policy analyses, environmental studies, and analysis of the impact of regulations on technology. He has conducted and managed a wide variety of studies in such areas as the licensing and regulation of power plants and nuclear fuel cycle facilities; energy resources, development, and conservation; environmental control and impact; natural resources; and energy materials transportation. Mr. Hendrickson is a member (inactive status) of the Washington State Bar Association. Some of the programs in which he has been a major contributor include:

- Clean Air Act Support for DOE. Mr. Hendrickson has provided extensive support under the Clean Air Act (CAA) for the U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assistance. He has supported the Office in several ways including 1) preparing draft comments on proposed rules issued by the Environmental Protection Agency (EPA) under the CAA, 2) editing and combining DOE staff comments on such rules, 3) providing technical support for DOE's preparation of guidance documents for DOE field and program offices on final rules issued by EPA under the CAA, and 4) providing technical review of CAA materials prepared for the Office by other DOE laboratories and contractors.

- Environmental Impact Statement (EIS) Support for DOE and NRC. Mr. Hendrickson has supported the preparation of a number of draft EISs that PNNL has prepared for DOE and the U.S. Nuclear Regulatory Commission (NRC). His work has focused on examination of regulatory issues including permit and license requirements for the alternatives under consideration in the EIS. He has examined land use impacts of alternatives, related Federal project activities, prepared draft versions of Federal Register Notices related to EISs, and prepared draft responses to public comments on draft EISs. He has also prepared analyses of alternatives to the renewal of operating licenses for existing nuclear power plants and for early site permit applications. Specific DOE EISs he has worked on include the Dual Axis Radiographic Hydrodynamic Test Facility, Hanford K Basins spent nuclear fuel, Hanford solid waste management, Waste Isolation Pilot Plant, the medical isotopes production plant, and decommissioning of the Fast Flux Test Facility at Hanford. Specific NRC EISs he has worked on include early site permit applications to the NRC for the Grand Gulf, North Anna, and Vogtle sites; combined operating license applications for the South Texas, Calvert Cliffs, and North Anna sites; and various supplemental EISs associated with applications to the NRC to renew the operating license of individual commercial nuclear power plants.

- Revision to NUREG-1555, Environmental Standard Review Plan. Mr. Hendrickson is managing a project for the NRC to support the update to NUREG-1555, *Environmental Standard Review Plan*. This document provides guidance to NRC staff in implementing NRC's 10 CFR 51 regulations implementing the National Environmental Policy Act (NEPA).

- Hanford Site NEPA Characterization. PNNL prepares an annual report for the DOE Richland Operations Office covering background environmental data to be used in the preparation of Hanford-related NEPA documents. Mr. Hendrickson prepares the portion of the report covering statutory and regulatory requirements.

- Preparation of DOE Directives. Mr. Hendrickson assisted the National Nuclear Security Administration's Office of International Regimes and Agreements in the revision of a DOE Order covering DOE requirements and responsibilities related to the Safeguards Agreement between the U.S. and the International Atomic Energy Agency. He also assisted the Office with the preparation of a revised Order and an accompanying Manual to reflect the pending Additional Protocol to the Safeguards Agreement.

- Regulatory Analysis Guidelines and Handbook. Mr. Hendrickson managed a project for the NRC involving providing technical assistance to the NRC for its preparation of Regulatory Analysis Guidelines and an associated Handbook to aid analysts in preparing regulatory analyses. The Guidelines and Handbook are used to analyze proposed requirements to be imposed on NRC licensees. This project also involved presenting a training course to NRC staff on use of the Handbook in performing regulatory analyses.

- Preconstruction Schedules, Costs, and Permit Requirements for New Power Resources in the Northwest. Mr. Hendrickson was project manager and an author for this study conducted for the Bonneville Power Administration. The study developed estimates for preconstruction schedules, costs, and federal and state permit requirements for new electric power generating resources in the Pacific Northwest. Mr. Hendrickson wrote the section of the report covering permit requirements.

- Financial Qualifications Review of Applicants for Nuclear Power Plant Construction Permits. Mr. Hendrickson managed a study for the NRC that involved an investigation of whether there is any empirical evidence of a relationship between a utility's financial health at the time of its construction permit application and the subsequent safety performance of the operating plant.

- Impact of Financial Assurance Requirements on Materials Licensees. Mr. Hendrickson managed a study for the NRC relating to a proposed rulemaking that would impose financial assurance requirements on materials licensees to assure the availability of cleanup funds for accidental releases. The study involved an investigation of types of financial assurance mechanisms, their availability and costs, and the impacts on licensees of obtaining financial assurance.

- Fitness for Duty of Nuclear Power Plant Workers. Mr. Hendrickson participated in a study for NRC that analyzed regulatory options for assuring the fitness for duty of workers at commercial nuclear power plants. The project provided the technical basis for NRC's rulemaking on drug and alcohol abuse.

- Role of State PUC Regulation on QA During Nuclear Power Plant Construction. PNNL conducted a multiyear study for NRC on quality control and assurance during nuclear power plant construction. As part of this work, Mr. Hendrickson completed a report on the role that state public utility commissions have played and potentially can play in assuring construction quality and in allocating construction costs between the utility, its shareholders, and ratepayers when quality is deficient.

- Methods to Assure the Availability of Decommissioning Funds. Mr. Hendrickson wrote chapters on the relative merits of alternative approaches to assuring the availability of decommissioning funds for seven different studies for the NRC. Each study examined the decommissioning of a separate type of fuel cycle facility.

- Legal/Regulatory Issues Affecting the Aquifer Thermal Energy Storage and the Compressed Air Energy Storage Concepts. PNNL conducted a multiyear investigation of these concepts for DOE. Mr. Hendrickson conducted an investigation of legal and regulatory issues that will affect implementation of each concept. Issues examined included environmental protection requirements, property rights issues, and potential liability.

SELECTED PUBLICATIONS

D.A. Neitzel, editor, P.L. Hendrickson, et al., Hanford Site National Environmental Policy Act (NEPA) Characterization, PNL-6415 Rev. 18, September 2007.

M. H. Killinger, P.L. Hendrickson, et al., "DOE Preparation for U.S. Implementation of the Additional Protocol," presented at the 45th Annual Meeting of the Institute of Nuclear Materials Management, July 2004.

P.L. Hendrickson, et al., "Revision of DOE Directives to Implement the US/IAEA Safeguards Protocol," presented at the 41st Annual Meeting of the Institute of Nuclear Materials Management, July 2000.

K.A. Cort, P.L. Hendrickson, et al., Evaluation of Site Restoration Alternatives for Washington Nuclear Plants 1 & 4, PNWD-2468, June 1999.

P.L. Hendrickson and K.K. Daellenbach, "Regulation of Hazardous Air Pollutants Emitted from Fossil-Fired Boilers," Proceedings of the 3rd Environmental Technology Congress, Atlanta, Georgia, October 1993; also published in Energy Engineering Journal, Association of Energy Engineers, vol. 91, no. 4, 1994.

O.H. Paananen and P.L. Hendrickson, Selection of a Discount Rate For Use in NRC Regulatory Analyses And Application of Discount Rates to Future Averted Health Effects, PNL-8970, January 1993.

P.L. Hendrickson, et al., Preconstruction Schedules, Costs, and Permit Requirements for Electric Power Generating Resources in the Pacific Northwest, PNL-7420, July 1990.

P.L. Hendrickson, "Regulatory Requirements Affecting Aquifer Thermal Energy Storage," Water

Resources Bulletin, February 1990, pp. 81-85.

R.L. Martin, P.L. Hendrickson, and J. Olson, Incentive Regulation of Nuclear Power Plants by State Public Utility Commissions, NUREG/CR-5509, PNL-7192, December 1989.

P.L. Hendrickson, "Incorporating Energy Efficiency Into Residential Appraisals," The Real Estate Appraiser and Analyst, the Journal of the Society of Real Estate Appraisers, Summer 1989.

J.F. Keller, P.L. Hendrickson, et al., Regulatory Requirements Important to Hanford Single-Shell Tank Waste Management Decisions, PNL-6821, June 1989.

P.L. Hendrickson, M.F. Mullen, and D.B. Carr, Financial Qualifications Review of Applicants for Nuclear Power Plant Construction Permits, NUREG/CR-5218, PNL-6632, September 1988.

V. Barnes, P. Hendrickson, et al., Fitness for Duty in the Nuclear Power Industry: A Review of Technical Issues, NUREG/CR-5227, September 1988.

P.L. Hendrickson, et al., Impact of Proposed Financial Assurance Requirements on Nuclear Materials Licensees, NUREG/CR-4958, September 1987.

November 7, 2008

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 CHARLES T. KINCAID CONCERNING
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Charles T. Kincaid, do hereby state as follows:

1. I am employed as a Scientist V at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned groundwater quality and use issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Charles T. Kincaid

CHARLES T. KINCAID

Staff Scientist
Energy and Environment Directorate
Pacific Northwest National Laboratory

EDUCATION

B.S.	Civil Engineering, Humboldt State College	1970
Ph.D.	Engineering (Hydraulics), Utah State University	1979

EXPERIENCE

Since joining Pacific Northwest National Laboratory (PNNL) in 1979, Dr. Kincaid has devoted his attention to soil physics and ground-water studies including technical contributions, project and task management, and line management roles. He has specialized in the area of computational fluid mechanics of environmental systems. He has experience in both finite difference and finite element numerical methods and their application to surface and subsurface flows. He has collaborated in studies involving 1) mathematical models of physical processes and chemical reactions, 2) analytical and numerical code developments, and 3) site-specific applications of models/codes. Dr. Kincaid has played a leadership role in the production of the performance assessments for low-level radioactive waste defense wastes (LLW) in grout and glass waste forms at Hanford, an environmental impact statement for a weapons testing facility at Los Alamos National Laboratory, and a composite analysis of radioactive wastes to remain in the central plateau at the Hanford Site after site closure. Dr. Kincaid is a former member of the DOE headquarters Peer Review Panel (PRP) that reviewed all LLW performance assessments from the DOE complex. Dr. Kincaid was the technical leader for development and application of a stochastic System Assessment Capability designed to assess the risk and impact associated with radioactive and chemical wastes to remain at the Department of Energy's Hanford Site in Washington. He currently contributes to reviews conducted by the Laboratory on behalf of the U.S. Nuclear Regulatory Commission.

Early in his tenure at PNNL, Dr. Kincaid collaborated in the development of codes and their subsequent application to the problem of thermal energy storage in the ground-water environment. He has collaborated in the development and improvement of a multi-dimensional ground-water flow and transport code. Dr. Kincaid has managed work for government and industrial clients including a major two-part project involving (1) an evaluation of codes available for the modeling of solute leaching from electric utility solid waste disposal facilities, and (2) the subsequent design, development and testing of a code that coupled subsurface transport and mechanistic geochemistry. Transport processes considered are advection, longitudinal dispersion, and diffusion. Chemical speciation, precipitation/dissolution, and adsorption/desorption reactions are included in the geochemical component.

To compliment his code development work, Dr. Kincaid has been a contributor to site-specific applications of models for the purpose of assessing the long-term performance of a variety of wastes at the Hanford Site. He was a key contributor in preparation of the Hanford Defense Waste Environmental Impact Statement published in December 1987. He directed completion of the performance assessment for grouted low-level radioactive wastes proposed for disposal in the shallow-land deposits on the 200 Area plateau of the Hanford Site. He directed completion of the geology, soils and water resources sections of the environmental consequences chapter of the EIS for the Dual Axis Radiographic Hydrodynamic Test Facility at Los Alamos. Dr. Kincaid provided technical leadership for the design and completion of the 1998 composite analysis for radioactive waste disposed on Hanford's central plateau.

On three occasions Dr. Kincaid has been a Visiting Lecturer at Whitman College in Walla Walla, Washington. He has taught an undergraduate groundwater hydrology course within the geology curriculum at the college.

PROFESSIONAL AFFILIATION

American Geophysical Union
Registered Hydrogeologist, State of Washington

CONTRIBUTIONS TO BOOKS

Kincaid, C. T. and G. W. Gee. 1993. "Estimating Infiltration at Waste Sites: Methodology Development." Chapter 14 in Water Flow and Solute Transport in Soils: Developments and Applications, eds. D. Russo and G. Dagan, pp. 246-261. Springer-Verlag, Berlin.

Schwartz, F. W., C. B. Andrews, D. L. Freyberg, C. T. Kincaid, L. F. Konikow, C. R. McKee, D. B. McLaughlin, J. W. Mercer, E. J. Quinn, P. S. C. Rao, B. E. Rittmann, D. D. Runnells, P. K. M. van der Heijde, and W. J. Walsh. 1990. Ground Water Models: Scientific and Regulatory Applications. National Academy Press, Washington, D.C.

REPORTS AND PAPERS

MJ Anderson, Simpson, BC, RA Corbin, and CT Kincaid. 2007. Hanford Soil Inventory Model (SIM) Rev.2 Software Documentation – Requirements, Design, and Limitations. PNNL-16940. Pacific Northwest National Laboratory, Richland, Washington.

Simpson, BC, RA Corbin, MJ Anderson and CT Kincaid. 2007. Hanford Soil Inventory Model (SIM) Rev.2 User's Guide. PNNL-16925. Pacific Northwest National Laboratory, Richland, Washington.

Simpson, BC, RA Corbin, MJ Anderson and CT Kincaid. 2007. Using Open Crystal Ball and Crystal Ball for Environmental Modeling at the Hanford Site. PNNL-SA-55320. Pacific Northwest National Laboratory, Richland, Washington, and (in) Proceedings of the 2007 Crystal Ball User Conference, Denver, Colorado.

Eslinger, PW, CT Kincaid, WE Nichols and SK Wurstner. 2006. A Demonstration of the System Assessment Capability (SAC) Rev.1 Software for the Hanford Remediation Assessment Project. 2006. PNNL-16209. Pacific Northwest National Laboratory, Richland, Washington.

Simpson, BC, RA Corbin, MJ Anderson and CT Kincaid. 2006. Hanford Soil Inventory Model (SIM) Rev.1 User's Guide. PNNL-16099. Pacific Northwest National Laboratory, Richland, Washington.

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Kincaid, CT, PW Eslinger, RL Aaberg, TB Miley, IC Nelson, DL Strenge and JC Evans, Jr. 2006. Inventory Data Package for Hanford Assessments. PNNL-15829, Rev.0. Pacific Northwest National Laboratory, Richland, Washington.

Last, GV, WE Nichols, and CT Kincaid. 2006. Geographic and Operational Site Parameters List (GOSPL) for Hanford Assessments. PNNL-14725, Rev.1. Pacific Northwest National Laboratory, Richland, Washington.

Nichols, WE, GV Last and CT Kincaid. 2005. *Vadose zone modeling of dispersed waste sites in the framework of an integrated stochastic environmental transport and impacts assessment code for the Hanford Site*. Stochastic Environmental Research and Risk Assessment. 19:24-32.

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Last, GV, WE Nichols and CT Kincaid. 2004. Geographic and Operational Site Parameters List (GOSPL) for the 2004 Composite Analysis. PNNL-14725, Rev.0. Pacific Northwest National Laboratory, Richland, Washington.

Kincaid, CT, RW Bryce and JW Buck. 2004. Technical Scope and Approach for the 2004 Composite Analysis of Low-Level Waste Disposal at the Hanford Site. PNNL-14372. Pacific Northwest National Laboratory, Richland, Washington.

Bryce, R. W., C. T. Kincaid, P. W. Eslinger, and L. F. Morasch. 2002. An Initial Assessment of Hanford Impact Performed with the System Assessment Capability. PNNL-14027. Pacific Northwest National Laboratory, Richland, Washington.

Kincaid, CT, PW Eslinger, WE Nichols, RW Bryce, and Amoret Bunn. 2002. "A Stochastic Assessment of Nuclear Waste Management Practices at the Hanford Site, Washington." In *Scientific Basis for Nuclear Waste Management XXV: symposium held November 26-29, 2001 Boston, Massachusetts, U.S.A. / Materials Research Society Symposium Proceedings*, vol. 713, ed. BP McGrail, GA Cragnolino, pp 275-283. Materials Research Society, Warrendale, PA.

Kincaid, CT, FM Coony, DL Strenge, RL Aaberg, and PW Eslinger. 2001. "Appendix A. Inventory Data for Initial Assessment Performed with the System Assessment Capability (Rev 0)." In *Addendum to Composite Analysis for Low-Level Waste Disposal in 200 Area Plateau of the Hanford Site* by Bergeron, Freeman, and Wurstner. PNNL-11800, Addendum 1. September 2001. Pacific Northwest National Laboratory, Richland, Washington.

Kincaid, CT, PW Eslinger, WE Nichols, AL Bunn, RW Bryce, TB Miley, MC Richmond, SF Snyder, and RL Aaberg. 2000. System Assessment Capability (Rev 0); Assessment Description, Requirements, Software Design, and Test Plan. BHI-01365. Draft A. Bechtel Hanford Inc, Richland, Washington.

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Kincaid, CT, MP Bergeron, CR Cole, MD Freshley, NL Hassig, VG Johnson, DO Kaplan, RG Serne, GP Streile, DL Strenge, PD Thorne, LW Vail, GA Whyatt, and SK Wurstner. 1998. Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site. PNNL-11800. Pacific Northwest National Laboratory, Richland, Washington.

Mann, FM, RJ Puigh II, PD Rittmann, NW Kline, JA Voogd, Y. Chen, CR Eiholzer, CT Kincaid, BP McGrail, AH Lu, GF Williamson, NR Brown, and PE LaMont. 1998. Hanford Immobilized Low-Activity Tank Waste Performance Assessment. DOE/RL-97-69. United States Department of Energy, Richland, Washington.

Fayer, M. J., M. D. White, and C. T. Kincaid. 1997. Sensitivity Tests of the Waste-Form-Alone Design for Low-Activity-Waste Disposal System. PNNL-11717. Pacific Northwest National Laboratory. Richland, Washington.

Rockhold, M. L., M. J. Fayer, C. T. Kincaid and G. W. Gee. 1995. Estimation of Natural Ground Water Recharge for Performance Assessment of a Low-Level Waste Disposal Facility at the Hanford Site. PNL-10508. Pacific Northwest Laboratory, Richland, Washington.

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Rhoads, K., B. N. Bjornstad, R. E. Lewis, S. S. Teel, K. J. Cantrell, R. J. Serne, J. L. Smoot, C. T. Kincaid, and S.K. Wurstner. 1992. Estimation of the Release and Migration of Lead Through Soils and Groundwater at the Hanford Site 218-E-12B Burial Ground; Volume 2: Appendices. PNL-8356, Volume 2, Pacific Northwest Laboratory, Richland, Washington.

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Chatters, J. C., W. J. Waugh, M. G. Foley, and C. T. Kincaid. 1990. Strategy for Identifying Natural Analogs of the Long-Term Performance of Low-Level Waste Disposal Sites. PNL-7302, Pacific Northwest Laboratory, Richland,Washington.

Hostetler, C. J., R. L. Erikson, J. S. Fruchter, and C. T. Kincaid. 1989. Overview of the FASTCHEM Code Package: Application to Chemical Transport Problems. EPRI EA-5870-CCM, Volume 1, Electric Power Research Institute, Palo Alto, California.

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PANELS AND COMMITTEES

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With D. P. Lettenmaier (chairman), D. H. Rinds, R. E. Dickinson, R. J. Gurney, S. Manabe, P. C. Milly, J. C. Schaake, Jr. D. Wollock and E. F. Wood. Organizing and program committees for the Chapman Conference on "Hydrologic Aspects of Global Change," June 12-14, 1990, Campbell's Resort in Lake Chelan, Washington.

With F. W. Schwartz (chairman), C. B. Andrews, D. L. Freyberg, L. F. Konikow, C. R. McKee, D. B. McLaughlin, J. W. Mercer, E. J. Quinn, P. S. C. Rao, B. E. Rittmann, D. D. Runnells, P. K. M. van der Heijde, and W. J. Walsh. National Research Council, Water Science and Technology Board, Committee on Ground Water Modeling Assessment 1987-1989.

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November 7, 2008

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 H. KRIEG CONCERNING
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Rebekah H. Krieg, do hereby state as follows:

1. I am employed as a Senior Research Scientist at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned aquatic ecology and threatened and endangered species issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Rebekah H. Krieg

Resume

Rebekah Harty Krieg

Ecology Group
U.S. DOE's Pacific Northwest National Laboratory, operated by Battelle
P.O. Box 999 K6-85
Richland, WA. 99352
(509) 371-7155 (509) 371-7160 (fax)

Education:

M.S. in Fisheries and Oceanographic Sciences, University of Washington, 1983

B.S. in Biology, Washington State University, 1979.

Experience:

Senior Research Scientist (1979-2002 and 2005 – present) Battelle, Pacific Northwest National Laboratory, Richland, WA.

Technical Reviewer for the aquatic ecology sections of the Combined License (COL) application in support of the U.S. Nuclear Regulatory Commission's (NRC's) environmental evaluation of Tennessee Valley Authority's application for a COL for Bellefonte Units 3 and 4.

Technical Reviewer for the aquatic ecology sections of the Early Site Permit (ESP) application in support of the U.S. Nuclear Regulatory Commission's (NRC's) environmental evaluation of Southern Nuclear Corporation's application for an ESP for Vogtle Units 3 and 4.

Preapplication Team lead for COLs for Summer (SCEG), Bellefonte (TVA), Levy (Progress Energy), and Victoria (Exelon). Aquatic Ecology reviewer for Comanche Peak preapplication.

Technical contributor on project to assist the Army Corps of Engineers (Walla Walla District) develop configuration and operation plans for their hydroelectric projects to meet the requirements of the Biological Opinion on anadromous salmonid species listed under the Endangered Species Act.

Task leader for the Knowledge Management portion of the Infrastructure for New Reactor Environmental Reviews project. This project includes developing tools (GIS, comment databases, collaboration sites) for the Nuclear Regulatory Commission and their contractors to use during the environmental reviews that will occur when applications are received for new power reactor licenses.

Technical leader for NRC's review of license renewal applications. Managed interdisciplinary teams that provided technical support to the NRC on their review of the

environmental impacts related to the renewal of operating licenses for commercial nuclear power stations. Specifically Ms. Krieg managed the team that developed the Supplemental Environmental Impact Statement for the Oconee Nuclear Station and co-managed the teams for McGuire and Catawba.

Technical leader for development of an interdisciplinary team that provided assistance to the NRC on the development of a Supplemental Environmental Impact Statement for the Watts Bar Nuclear Plant.

Deputy Team lead for updating and revising the Environmental Standard Review Plan (ESRP), NUREG-1555.

Project Manager for assisting the NRC with development of a Generic Environmental Impact Statement (GEIS) to decommissioning of commercial nuclear power reactors. Includes the development of a revision to the Generic Environmental Impact Statement (GEIS) on Decommissioning that was originally published in 1988, development of Regulatory Guides and review plans related to the initial phases of the decommissioning process, technical review of the types of accidents that are of concern during the decommissioning process and the development of a handbook related to decommissioning for resident inspectors.

Project Manager to provide technical assistance to the NRC on the cleanup of Three Mile Island, Unit 2. Included occupational dose calculations, safety evaluations, development of supplements to a programmatic environmental impact statement, and measurement of fuel quantities remaining in the facility.

Provided technical support to the U.S. Department of Energy (DOE) in relation to the use of collective dose as a performance measurement, the development of guidance for fetal/reproductive health hazards from ionizing radiation and chemicals and extremity dosimetry.

Publications:

Krieg, RH, E.E. Hickey, J.R. Weber, and M.T. Masnik. 2004. *Nuclear Power Plants, Decommissioning of* contained in *Encyclopedia of Energy*. Cutler J. Cleveland, Editor-in-Chief. Volume 4. Elsevier Inc. Oxford, England.

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Reece, W. D., R. T. Hadley, R. Harty, J. Glass, J. E. Tanner and L. F. Munson. 1984. *Personnel Exposure from Right Cylindrical Sources (PERCS).* NUREG/CR-3573, U.S. Nuclear Regulatory Commission, Washington, D.C.

Fisher, D. R., and R. Harty. 1982. "The Microdosimetry of Lymphocytes Irradiated by Alpha Particles." Int. J. Radiat. Biol. 41(3):315-324.

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November 7, 2008

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
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Michael T. Masnik, do hereby state as follows:

1. I am employed as a Senior Aquatic Biologist in the Division of Site and Environmental Reviews in the U.S. Nuclear Regulatory Commission's Office of New Reactors. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned aquatic ecology and threatened and endangered species issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Michael T. Masnik

Michael T. Masnik
STATEMENT OF PROFESSIONAL QUALIFICATIONS
UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C.

I am currently employed as a Senior Aquatic Ecologist in the Office of New Reactor Operations, U. S. Nuclear Regulatory Commission (NRC). As a senior member of the staff I am responsible for understanding and assessing the non-radiological impacts of nuclear power generation on a variety of aquatic environments.

I hold a Bachelor of Science in Conservation from Cornell University (1969), a Master of Science in Zoology from Virginia Polytechnic Institute and State University (1971), and a Doctor of Philosophy in Zoology also from Virginia Polytechnic Institute and State University (1975).

While at Virginia Polytechnic Institute and State University (VPI&SU), I undertook research in a variety of areas, specializing in zoogeography and distribution of freshwater fishes in large river systems. Other areas of research which resulted in published papers include thermal studies on fishes, recovery of damaged aquatic ecosystems, and development of sampling methodology for fish and macroinvertebrates. I have authored or co-authored some 16 publications on the above areas or research. My formal education has encompassed and emphasized studies in Zoology, Aquatic Ecology, Ichthyology, and Evolutionary Biology. Prior to joining the Federal government I participated as scientific staff for a Duke University Caribbean cruise conducting oceanographic investigations, and served as a consultant, through VPI&SU, for American Electric Power Company, Koppers Company, Inc., U.S. Army Corps of Engineers, and the Tennessee Valley Authority. I was also employed by Ichthyological Associates as a field biologist investigating the fisheries resources of the Delaware Bay as part of a baseline study for several new nuclear stations.

I joined the Atomic Energy Commission, the predecessor to the NRC, in 1974 as a Fisheries Biologist performing and overseeing NEPA reviews for nuclear power reactor license applications. My principal expertise was in evaluating the impacts of various cooling system designs and intake structures on fish and shellfish in source and receiving waterbodies. In the late 1970s and early 1980s I participated in the initial licensing reviews for more than 10 sites, three alternative site reviews and investigated numerous environmental events involving aquatic resources occurring at operating nuclear power stations. In 1976, as the NRC representative, I participated in the development of U.S. Environmental Protection Agency's draft Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment as well as the 316(a) Technical Guidance Manual and Guide for Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements. I also provided expert testimony at a number of NRC administrative hearings on a variety of environmental topics including shipworms, alternative site reviews, impingement and entrainment, and shortnose sturgeon. I developed the NRC staff's practices related to Commission compliance to the Endangered Species Act.

In 1982 I became the Technical Assistant to the Director of the Three Mile Island (TMI-2) Program Office. For the next 13 years I provided technical oversight on all aspects of the TMI-2 cleanup. I made over 15 containment entries at TMI-2, conducted numerous inspections and surveys developed custom technical specifications for the damaged facility, and oversaw the preparation of three supplements to the programmatic environmental impact statement on the cleanup. I provided expert testimony at an administrative hearing on the impacts of disposal of

the TMI-2 accident generated water. From 1982 to 1995 I served as the Designated Federal Official (DFO) to the NRC sponsored TMI-2 Advisory Panel. During my tenure as the DFO the panel held over 65 public meetings in the Harrisburg, PA area. In 1993, as the TMI-2 cleanup effort neared its conclusion I assumed project management responsibilities for the decommissioning of the Trojan Nuclear Power Plant. Trojan was the first large PWR to permanently cease operation and immediately begin active decontamination and dismantlement.

In 1997 I became first Acting, then Section Chief, of the Decommissioning Section in the NRC's Office of Nuclear Reactor Regulation (NRR). I was responsible for the project management of 19 permanently shutdown reactors. I also oversaw the implementation of NRC's 1996 final rule on decommissioning and the development of the 2002 Generic Environmental Impact Statement on the decommissioning of nuclear power reactors. During my tenure as Section Chief I made numerous presentations on the subject before industry, trade, and professional society meetings. In 1997, along with two coworkers, I developed and taught a one week course on reactor decommissioning at the University of Kiev, Ukraine. During my assignment to the TMI-2 cleanup effort and then as Chief of the Decommissioning Section I continued to periodically assist the NRC in the specialized areas of aquatic impact assessment and compliance with the Endangered Species Act. In the early 1990s I assisted in the development of the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, and the Final Environmental Impact Statement, Operating License Stage, for the Watts Bar Nuclear Station Unit 1.

In 2001, with the transfer of the responsibility for decommissioning within the NRC to the office of Nuclear Materials Safety and Safeguards I joined the license renewal effort in NRR, again as an expert in environmental impacts assessment. Since 2001 I has served as the license renewal environmental project manager for the St. Lucie, Browns Ferry, and the Oyster Creek nuclear stations, worked on numerous other license renewals as well as several early site permits serving as the Commission's expert in aquatic and terrestrial ecology, and water intake design. I also was responsible for or assisted in conducting formal and informal endangered species consultations for a number of nuclear power stations including Crystal River, Hatch, Saint Lucie, and Turkey Point. I provided oversight in the preparation of the aquatic and in some cases the hydrological sections of the supplemental environmental impact statements for license renewal for the following both closed-cycle and once through nuclear stations: Arkansas, Turkey Point, Saint Lucie, Fort Calhoun, North Anna, Surry, Catawba, Ginna, Summer, Cook, Quad Cities, Millstone, Vermont Yankee, Nine Mile Point, Monticello, FitzPatrick and Wolf Creek.

In early 2007 I transferred to the NRC's Office of New Reactors to devote myself full time to the environmental assessment of the construction and operation of new reactors, both at existing as well as Greenfield sites, on aquatic ecosystems. I am the NRC's principal contact for endangered species concerns with the National Marine Fisheries Service (NMFS) Southeast Regional Office (SERO). I assisted in the development of the Biological Assessment for the Vogtle Early Site Permit (ESP) application that was submitted to SERO for their review. I have also provided oversight to the aquatic ecology and hydrology sections for the preparation of the environmental impact statements for the North Anna, Clinton, and Grand Gulf ESP sites. I am currently providing technical oversights to the Grand Gulf, North Anna, Bellefonte, Vogtle, and Levy Combined License Applications as well as the Vogtle ESP. I am a member of the American Fisheries Society.

November 7, 2008

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 JEREMY P. RISHEL CONCERNING
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Jeremy P. Rishel, do hereby state as follows:

1. I am employed as an Atmospheric Scientist at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned meteorological and air quality issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Jeremy P. Rishel

Jeremy P. Rishel

Pacific Northwest National Laboratory
505-375-6947
jeremy.rishel@pnl.gov

EDUCATION:
Master of Science, Meteorology, May 1998
The Pennsylvania State University, State College PA

Bachelor of Science, Meteorology, Distinction, May 1996
The Pennsylvania State University, State College PA

PROFESSIONAL EXPERIENCE:
Scientist, Atmospheric Science & Global Change Division, PNNL, Richland, WA.
(09/2005-Current)

- Assist in NRC-related project work as it pertains to air quality and meteorological-site characterization for nuclear reactor license renewals, early site permits (ESPs), and construction and operating licenses (COLs).
- Participate in the development of various dispersion model codes for the NRC, including the PAVAN08 code for design basis accidents and the RASCAL code for emergency response operations.
- Work on Department of Homeland Security (DHS) projects concerning the transport, dispersion, and fate of contaminants in major metropolitan areas.
- Apply current, regulatory dispersion models to study the transport of routine releases and point emissions from various industrial and Army base installations.
- Provide on-call dispersion modeling and meteorological expertise in support of the Hanford Emergency Operational Center (EOC).

Meteorologist, Meteorology & Air Quality Group, LANL, Los Alamos, NM.
(12/2002-09/2005)

- Provided on-call dispersion modeling and meteorological expertise in support of the LANL's Emergency Operational Center (EOC).
- Generated weather forecasts to support critical projects and general Laboratory operations.
- Assured data quality and integrity of the Laboratory's seven, multi-level instrumented meteorological towers and SODAR system.
- Developed and managed the "LANL Weather Machine"—a website providing real-time access to measured data, local forecasts, current weather hazards, and climatology.
- Performed meteorological studies of meteorological network, instrument performance, and site characterization.
- Assisted in air quality modeling and permitting projects to demonstrate regulatory compliance with state and national regulations.

Meteorologist and Applications Product Specialist, Trinity Consultants, Inc., RTP, NC.
(05/1998 - 12/2001)

- Provided timely technical support to over 2,000 licensed customers on Trinity's BREEZE PC-based air dispersion modeling software. Supported applications and models include: ISCST3, ISCLT3, PCRAMMET, BPIP, AERMOD, AERMET, AERMAP, CAL3QHC, CALINE4, MOBILE5, DEGADIS, SLAB, AFTOX, INPUFF, as well as several fire/explosion models.
- Developed/co-developed desktop dispersion model applications and utilities, including RMP Advisor, a wizard-type application for assessing the Environmental Protection Agency's (EPA's) 112(r) Risk Management Plan requirements.
- Processed hourly surface meteorological data and twice-daily soundings for direct use in various Environmental Protection Agency (EPA) dispersion models.
- Instructed domestic and international air dispersion modeling and boundary layer meteorology training courses, including a course on AERMOD for the United Kingdom Environmental Agency.
- Maintained customer support and problem-tracking databases to improve customer satisfaction, staff productivity, and product quality.
- Authored software user guides, marketing collateral, and online help systems.
- Attended and presented at several industry trade shows and user-group meetings.
- Performed numerous consulting services, such as air pollution modeling and emissions inventory projects.

Research Assistant, PSU, State College, PA.
(08/1996 - 05/1998)

- Worked on a collaborative research project with the Office of Naval Research, Woods Hole Oceanographic Institution, and Penn State.
- Analyzed sonic anemometer, pressure, humidity, and wave-wire time series data taken aboard a moored research vessel, FLIP (Floating Instrumentation Platform), of the Pacific coast.
- Isolated surface-layer eddies and wind-wave structures in FLIP time series data using a statistical analysis technique called principal component analysis (PCA).
- Applied spectral and chaotic temporal analysis to principal components (PC's) to group related atmospheric structures. Rebuilt time series for grouped structures and plotted results using Matlab for visualization.
- Estimated mean sensible heat, moisture, and momentum fluxes associated with isolated structures.

Instructor, Synoptic Meteorology Laboratory, PSU, State College, PA.
(01/1998 - 05/1998; 01/1997 - 05/1997)

- Instructed two sections of an undergraduate-graduate level synoptic meteorology laboratory practicum each spring semester. Topics and course content included cyclogenesis; front and cyclone identification; isoplething; diagnosing areas of upper-level vorticity advection; temperature advection; and divergence; developing synoptic forecasting skills using the NGM, ETA, MOS, and MRF forecast models.
- Developed, edited, and restructured course laboratory notes.

- Graded weekly homework assignments, proctored mid-term and final examinations.
- Conducted a regional precipitation-forecasting contest for State College, PA.

Instructor, Weather Forecasting Principles Laboratory, PSU, State College, PA.
(08-1997 - 12/1997; 08/1996 - 12/1996)

- Instructed two sections of an undergraduate weather analysis practicum each fall semester. Topics included front and cyclone identification; radar and satellite (visible, infrared, water vapor) imagery interpretation; isoplething; decoding surface observations (METAR) and upper-air (TTAA, TTBB, PPBB) sounding data; inferring stability from Skew-T diagrams; reading surface and upper-air diagnostic and prognostic weather maps.
- Incorporated departmental computer system (Sun Solaris) and web-based instruction into class assignments.
- Developed and graded weekly homework assignments and exams.

RECENT PUBLICATIONS:

Wang W, WJ Shaw, TE Seiple, JP Rishel, and YL Xie. 2008. "An Evaluation of a Diagnostic Wind Model (CALMET)." Journal of Applied Meteorology and Climatology 47(6):1739-1756.

Shaw WJ, KJ Allwine, BG Fritz, FC Rutz, JP Rishel, and EG Chapman. 2008. "An Evaluation of the Wind Erosion Module in DUSTRAN." Atmospheric Environment 42(8):1907-1921. doi:10.1016/j.atmosenv.2007.11.022

RECENT TECHNICAL REPORTS:

Allwine KJ, FC Rutz, WJ Shaw, JP Rishel, BG Fritz, EG Chapman, BL Hoopes, and TE Seiple. 2007. Final Technical Report: Development of the DUSTRAN GIS-Based Complex Terrain Model for Atmospheric Dust Dispersion. PNNL-16588, Pacific Northwest National Laboratory, Richland, WA.

Shaw WJ, W Wang, FC Rutz, EG Chapman, JP Rishel, YL Xie, TE Seiple, and KJ Allwine. 2007. Meteorological Integration for the Biological Warning and Incident Characterization (BWIC) System: General Guidance for BWIC Cities . PNNL-16422, Pacific Northwest National Laboratory, Richland, WA.

Xie YL, WJ Shaw, W Wang, TE Seiple, JP Rishel, FC Rutz, EG Chapman, and KJ Allwine. 2007. "A Genetic Algorithm Used to Optimize the Siting of Meterological Monitoring Stations." In Proceedings of the International Conference on Genetic and Evolutionary Methods (GEM'07), ed. HR Arabnia, JY Yang, and MQ Yang, pp. 81-87. CSREA Press, Athens, GA. 2006

Rishel JP, EG Chapman, FC Rutz, and KJ Allwine. 2006. Using DUSTRAN to Simulate Fog-Oil Dispersion and Its Impacts on Local Insect Populations at Ft. Hood: Final Report . PNNL-16321, Pacific Northwest National Laboratory, Richland, WA.

Allwine KJ, FC Rutz, JG Droppo, JR, JP Rishel, EG Chapman, SL Bird, and HW Thistle. 2006. SPRAYTRAN 1.0 User's Guide: A GIS-Based Atmospheric Spray Droplet Dispersion Modeling System . PNNL-16075, Pacific Northwest National Laboratory, Richland, WA.

Allwine KJ, FC Rutz, WJ Shaw, JP Rishel, BG Fritz, EG Chapman, BL Hoopes, and TE Seiple. 2006. DUSTRAN 1.0 User's Guide: A GIS-Based Atmospheric Dust Dispersion Modeling System . PNNL-16055, Pacific Northwest National Laboratory, Richland, WA.

Chapman EG, JP Rishel, FC Rutz, TE Seiple, RK Newsom, and KJ Allwine. 2006. Dust Plume Modeling at Fort Bliss: Full Training Scenario. PNNL-15935, Pacific Northwest National Laboratory, Richland, WA.

Chapman EG, JP Rishel, FC Rutz, TE Seiple, RK Newsom, and KJ Allwine. 2006. Dust Plume Modeling at Fort Bliss: Move-Out Operations, Combat Training and Wind Erosion. PNNL-16123, Pacific Northwest National Laboratory, Richland, WA.

Ramsdell JV, Jr, and JP Rishel. 2006. Regional Atmospheric Transport Code for Hanford Emission Tracking, Version 2(RATCHET2) . PNNL-16071, Pacific Northwest National Laboratory, Richland, WA.

November 7, 2008

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 R. SACKSCHEWSKY CONCERNING
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Michael R. Sackschewsky, do hereby state as follows:

1. I am employed as a Senior Research Scientist at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned the limited work authorization and issues deferred to the Combined License, and I performed the role of the PNNL team lead.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Michael R. Sackschewsky

Resumé

Michael R. Sackschewsky

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Education:

Ph.D. in Botany, Washington State University, 1987
Dissertation: Factors Affecting Species Distribution and Coexistence in the Colorado Shortgrass Steppe.

B.A. in Biology, University of Colorado, 1983. Graduated with Distinction.
Independent Research: Heavy metal tolerance in *Heterotheca villosa*.

Employment History:

Senior Research Scientist (1994 - present). Pacific Northwest National Laboratory, Richland, WA. (Operated by Battelle Memorial Institute)

Manager for Hanford Site Ecological Compliance Assessment, including day-to-day task oversight, performance and evaluation of field surveys for rare plant and animal species, perform wetland delineation, work with projects to develop and implement of mitigation actions. Developed the Hanford Site biological resource mitigation strategy.

Technical team leader for the preparation of NRC licensing-action Environmental Impact Statements, including responsibility for all aspects of technical coordination, supervision of document production, budget, and resource planning.

Technical lead for terrestrial ecology, wetlands, and threatened and endangered species evaluations portions of Environmental Impact Statements for the Nuclear Regulatory Commission, the Department of Energy, and Federal Energy Regulatory Commission.

Task manager and technical leader for the evaluation of Endangered Species Act Compliance of all NRC licensed commercial nuclear power generating facilities.

Provide botanical and ecological support, such as the field analysis of plant communities at the National Training Center (Ft. Irwin, CA), the Hanford Site, and other locations; taxonomic support to various projects; and preparation of biological assessments and NEPA support documents.

Project manager for Hanford Site habitat mitigation projects, including the development and application of methods for habitat analysis and mapping using HEP and GIS based approaches, and develop and evaluate revegetation and habitat restoration techniques.

Project manager for the development of the Environmental Quality Profiling Tool (EQPT), and the Health and Ecological Risk Management and Evaluation System (HERMES) - GIS based environmental decision support tools to predict and evaluate impacts to biological resources.

Senior Scientist (1989 - 1994) Westinghouse Hanford Company, Richland, WA.

Lead scientist for projects supporting environmental remediation and restoration. Planned and performed ecological evaluations and rare plant surveys for NEPA documentation and RCRA/CERCLA remedial investigations, development and evaluation of soil surface stabilization and revegetation enhancement techniques, performing and managing ecological and human health risk assessments, and operating a lysimeter facility as part of the permanent isolation barrier development program.

Instructor (1988 - 1989) Department of Mathematics, Lycoming College. Williamsport, PA.

Taught undergraduate level introductory Statistics.

Post-Doctoral Fellow (1988) Biology Dept., Bucknell University, Lewisburg, PA.

Performed research on the effects of gall forming insects on carbon allocation in goldenrod using C-14 labeling techniques, responsible for the design and execution of experimental and analytical procedures, and performed all subsequent data analysis and interpretation.

Graduate Student Committees:

Christopher Kemp, MS Environmental Science, WSU, 1995
Jennifer Lewinsohn, MS, Biology, WSU, 2001
Dianne Garrison, MS Candidate, Environmental Science, WSU, 2009

Significant Scientific Awards and Recognition:

Phi Beta Kappa National Honor Society
American Botanical Society Young Botanist Award - 1983

Experience:

- Laboratory Team Leader, Vogtle Combined License Environmental Impact Statement, Vogtle Early Site Permit Environmental Impact Statement and Browns Ferry Nuclear Plant, License Renewal Supplemental Environmental Impact Statement.

- Prepared terrestrial ecology, wetlands, and threatened and endangered species sections and prepared Biological Assessments to support the Oconee, St. Lucie, Turkey Point, Peach Bottom, Ginna, and Brunswick Nuclear Plant license renewal supplemental EIS's, the North Anna Early Site Permit EIS, the Watts Bar full-power license supplemental EIS, and the commercial nuclear power plant decommissioning generic EIS (NRC).

- Wetlands, terrestrial ecology, and threatened and endangered species technical lead for the Spokane River Hydropower license renewal Environmental Impact Statement (FERC).

- Prepared wetlands, terrestrial ecology, and threatened and endangered species impacts analysis for the Moab Uranium Mill Tailings Remediation EIS (DOE).

- Management of the Department of Energy Hanford Site Ecological Compliance Assessment Project. This program evaluates the potential impacts of all Hanford Site projects and provides assurance to DOE that potential impacts of Hanford projects on State and Federally listed threatened and endangered species and important habitats are identified and minimized through early field investigations.

- Task manager for the evaluation of the status of Endangered Species Act compliance at all NRC licensed nuclear power generating facilities. Perform ESA compliance reviews and prepared biological assessments at commercial nuclear facilities such as San Onofre, Diablo Canyon, and Columbia Generating Station.

- Primary Contributor to the NRC Environmental Standard Review Plan for license renewal and new license applications.

- Lead an interdisciplinary team of biologists, risk assessors, economists, and GIS specialists in the development of EQPT, an integrated environmental decision support tool based on GIS technology. This tool allows the user to evaluate multiple aspects of environmental decisions, including ecological risk, habitat loss, and monetary costs.

- Prepared Biological Assessment of the potential impacts on Bald eagle, Gray wolf, Grizzly bear, Peregrine falcon, Marbled Murrelet, and Northern Spotted Owl resulting from construction and operation of hatchery facilities and acclimation ponds for the Yakima Fisheries Project, Kittitas County, Washington.

- Lead author of “Vascular Plants of the Hanford Site”, which is the most extensive compilation available of the local flora of the Hanford Site near Richland, WA.

- Completed U.S. Army Corps of Engineers Wetland Delineation Training Program.

- Developed the use of natural polysaccharides as soil fixatives for use in radioactive or hazardous waste clean-up settings. Products evaluated included potato starch, wood processing by-products, and sugar beet by-products. These materials were shown to be effective soil stabilizers that did not interfere with in-field contaminant screening or with soil treatment processes.

- Conducted research in support of the development of permanent isolation barriers for radioactive and hazardous waste sites. Tasks included investigating the effects of vegetation and soil surface treatments on soil water balance and assessing the potential long-term impacts of plants on barrier functionality and the effects of long- and short-term successional changes on barrier function and integrity.

- Applied GPS/GIS technology to the analysis of plant community resources of the US Army's National Training Center proposed expansion area. Principle components and ordination analyses were used to identify major habitat characteristics that correlate most strongly with the distribution of wildlife species. This allowed the NTC to pinpoint areas of significant ecological value based on a generalization of point-samples to the overall landscape.

Peer-Reviewed publications:

Durham, R. E., B. A. Zamora, and M. R. Sackschewsky. 2001. Predicting first-year bare-root seedling establishment with soil and community dominance factors. In: E. D. McArthur and D. J. Fairbanks, Compilers, Shrubland Ecosystem genetics and Biodiversity: Proceedings. 2000 June 13-15, Provo, UT. Proceedings RMRS-P-21, Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 365 pp.

Sackschewsky, M.R., C.J. Kemp, S.O. Link, and W.J. Waugh. 1995. Soil water balance changes in engineered soil surfaces. Journal of Environmental Quality 24:352-359.

Waugh, W.J., M.E. Theide, L.L. Cadwell, G.W. Gee, H.D. Freeman, M.R. Sackschewsky, and J.R. Relyea. 1991. Small Lysimeters for documenting arid site water balance. In R.G. Allen (ed.) Proceedings of the International Symposium on Lysimetry. Amer. Soc. Civil Engr., New York. Pp. 151-159.

Monson, Russell K.; M.R. Sackschewsky; and G.J. Williams III. 1986. Field measurements of photosynthesis, water-use efficiency, and growth in *Agropyron smithii* (C3) and *Bouteloua gracilis* (C4) in the Colorado shortgrass steppe. Oecologia 68:400-409.

Williams, G.J. III and M.R. Sackschewsky. 1985. Regulation of a shortgrass steppe community in time and space: Physiology and genetics. pp. 239-250 In: Genetic differentiation and dispersal in plants. Ed. by P. Jacquard, G. Heim, and J. Antonovics. Springer-Verlag.

Technical Reports:

Durham, R. E. and M. R. Sackschewsky. 2008. IDF Sagebrush Habitat Mitigation Project: FY2008 Compensation Area Monitoring Report. PNNL-17927. Pacific Northwest National Laboratory, Richland, WA.

Durham, R. E. and M. R. Sackschewsky. 2008. L-325 Sagebrush Habitat Mitigation Project: FY2008 Compensation Area Monitoring Report. PNNL-17926, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky, M. R., K. D. Leigh, B. M. Miller, J. A. Stegen, J.V. Ramsdell, J. P. Rishell, K. A. Cort, R.H. Krieg, P. L. Hendrickson, M.A. Smith, C. Cook, C.T. Kincaid, P.M. Daling, D.C. Stapp. 2008. Final Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site. NUREG-1872. U.S. Nuclear Regulatory Commission, Washington, DC.

Duberstein CA, M Simmons, MR Sackschewsky, and JM Becker. 2007. Development of a Habitat Suitability Index Model for the Sage Sparrow on the Hanford Site. PNNL-16885, Pacific Northwest National Laboratory, Richland, WA.

Duncan JP, KW Burk, MA Chamness, RA Fowler, BG Fritz, PL Hendrickson, GV Last, TM Poston, EP Kennedy, MR Sackschewsky, MJ Scott, SF Snyder, MD Sweeney, and PD Thorne. 2007. Hanford Site National Environmental Policy Act (NEPA) Characterization . PNNL-6415 Rev 18, Pacific Northwest National Laboratory, Richland, WA.

Durham, R. E. and M. R. Sackschewsky. 2007. IDF Sagebrush Habitat Mitigation Project: FY2007 Compensation Area Monitoring Report. PNNL-16976. Pacific Northwest National Laboratory, Richland, WA.

Durham, R. E. and M. R. Sackschewsky. 2007. L-325 Sagebrush Habitat Mitigation Project: FY2007 Compensation Area Monitoring Report. PNNL-16975, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky MR. and J.L. Downs 2007. Ecological Data in Support of the Tank Closure and Waste Management Environmental Impact Statement, Part 2: Results of Spring 2007 Field Surveys . PNNL-16620, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky MR. 2007. Ecological Data in Support of the Tank Closure and Waste Management Environmental Impact Statement, Part 1: Historical Data . PNNL-16503, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky, M. R. (ed.). 2006. Ecological Compliance Assessment Management Plan. DOE/RL-95-11 Rev. 2 U.S. Department OF Energy, Richland, WA. (PNNL-16902)

Sackschewsky, M. R. 2006. Mitigation Action Plan for the U.S. Department of Energy, Hanford Site, Project L-325 Electrical Utility Upgrades Project. HNF-31621, Fluor Hanford Co. Richland, WA.

Sackschewsky, M. R. 2006. Mitigation Action Plan for the U.S. Department of Energy, Hanford Site, Integrated Disposal Facility (IDF) Construction. PNNL-15629 limited distribution, published as DOE/ORP-2005-5.

Sackschewsky, M. R. 2006. Compensatory Mitigation Implementation Plan for the Integrated Disposal Facility. PNNL-15630 limited distribution, published by CH2MHill Hanford Group as RPP-29051.

Sackschewsky, M. R. 2006. Inter-Agency ESA Section 7 Conference Summary and Endangered Species Evaluation – Columbia Generating Station, Benton County, WA. PNNL-15936, Pacific Northwest National Laboratory, Richland, WA.

Parkhurst. M, BM Miller, LW Vail, MJ Scott, JA Ward, JV Ramsdell, Jr, PL Hendrickson, WF Sandusky, III, MR Sackschewsky, PR Nickens, PM Daling, EE Hickey, JA Jaksch, and DA Neitzel. 2006. Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna ESP Site, Final Report . PNNL-16260, Pacific Northwest National Laboratory, Richland, WA. [NUREG 1811]

Sackschewsky, MR, JA Stegen, WF Sandusky, III, KA Cort, K Rhoads, SB Saslow, and PL Hendrickson. 2005. Environmental Impact Statement for the Browns Ferry Nuclear Power Plant License Renewal. PNNL-16622, Pacific Northwest National Laboratory, Richland, WA. [NUREG 1437 Supplement 21]

Alexander, A. K. and M. R. Sackschewsky. 2005. Use of artificial burrows by burrowing owls (*Athene cunicularia*) at the HAMMER facility on the U. S. Department of Energy Hanford Site in the summer 2005. PNNL-15327, Pacific Northwest National Laboratory, Richland , WA.

Sackschewsky, M. R. 2005. Biological Assessment, Effect of Continued Operation of the San Onofre Nuclear Generating Station on Threatened or Endangered Marine Species. PNNL-14999, Pacific Northwest National Laboratory, Richland, WA

Sackschewsky, M. R. 2005. Biological Assessment, Effect of Continued Operation of the Diablo Canyon Power Plant on Threatened or Endangered Species. PNNL-15000, Pacific Northwest National Laboratory, Richland, WA

Sackschewsky, M. R. 2005. Status and Management Recommendations for the Columbia Springsnail (*Pyrgulopsis* sp.) near the 300 Area. PNNL-15215, Pacific Northwest National Laboratory, Richland, WA.

Kropp RK, KL Sobocinski, CW May, GD Williams, JA Southard, MR Sackschewsky, and CA Duberstein. 2005. *Aquatic Resources Program Endangered Species Act Compliance Project Covered Species Technical Paper: Marine Mammals, Selected Rockfish, Selected Anadromous Fish, Selected Freshwater Fish, Plants, and Selected Birds* . PNWD-3626, Battelle—Pacific Northwest Division, Richland, WA.

Neitzel DA, AL Bunn, SD Cannon, JP Duncan, RA Fowler, BG Fritz, DW Harvey, PL Hendrickson, DJ Hoitink, DG Horton, GV Last, TM Poston, EL Prendergast-Kennedy, SP Reidel, AC Rohay, MR Sackschewsky, MJ Scott, and PD Thorne. 2005. *Hanford Site National Environmental Policy Act (NEPA) Characterization Report, Revision 17*. PNNL-6415 Rev. 17, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky MR. 2004. Threatened and Endangered Species Evaluation for Operating Commercial Nuclear Power Generating Plants. PNNL-14468, Pacific Northwest National Laboratory, Richland, WA.

Durham, R. E. and M. R. Sackschewsky. 2004. W-519 Sagebrush Mitigation Project FY-2004 Final Review and Status. PNNL-14901, Pacific Northwest National Laboratory, Richland, WA.

Segaran PR, and MR Sackschewsky. 2004. Environmental factors in artificial seeding of Wyoming big sagebrush and Sandberg's bluegrass . PNNL-14790, Pacific Northwest National Laboratory, Richland, WA.

Poston TM, M Simmons, JL Downs, MR Sackschewsky, DW Harvey, RE Peterson, GW Patton, BL Tiller, MA Chamness, RW Hanf, and KD Hand. 2004. "Literature Review of Environmental Documents in Support of the 100 and 300 Area River Corridor Baseline Risk Assessment." PNNL-SA-41467

Patton GW, MA Chamness, AA Stegen, TM Poston, JL Downs, BL Tiller, RE Peterson, and MR Sackschewsky. 2003. "Evaluation of Aquatic and Riparian Receptor Impacts at the 100-N Area: Literature and Data Review." PNNL-SA-39495, Pacific Northwest National Laboratory, Richland, WA

Sackschewsky, M.R. (ed.). 2003. Hanford Site Biological Resource Mitigation Strategy. DOE/RL-96-88.

Durham, R. E. and M. R. Sackschewsky. 2002. W-519 Sagebrush Mitigation, FY 2002 Review and Status. PNNL-14131, Pacific Northwest National Laboratory, Richland, WA.

Hester JM, and MR Sackschewsky. 2002. "Germination Enhancement of *Oenothera pallida*." PNNL-SA-37787, Pacific Northwest National Laboratory, Richland, WA.

Lewinsohn JS, and MR Sackschewsky. 2002. "Germination and emergence patterns of *Erigeron piperianus* and *E. Poliospermus*: implications for restoration of a restricted and widespread species." PNNL-SA-36113, Pacific Northwest National Laboratory, Richland, WA.]

Bilyard, G. R., M.R. Sackchewsky, S.A. Tzemos. 2002. Hanford Site Ecological Quality Profile. PNNL-13745, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky, M.R. and J.L. Downs. 2001. Vascular Plants of the Hanford Site. PNNL-13688, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky, M. R., C. A. Duberstein, and J. M. Becker. 2001. 200 Areas Ecological Data Compilation. Letter Report for CH2M Hill Hanford Company. July 2001.

Durham, R.E., J.S. Lewinsohn, and M.R. Sackschewsky. 2001. W-519 Sagebrush Mitigation Project FY 2001 Status Report. PNNL-14123, Pacific Northwest National Laboratory, Richland, WA..

Sackschewsky M. R. and L. Stull. 2001. Biological Assessment for Endangered and Threatened species potentially affected by the continued operation of the Turkey Point Nuclear Plant and Associated Transmission lines. Biological Assessment prepared for the U. S. Nuclear Regulatory Commission. July, 2001.

Becker, J.M. and M. R. Sackschewsky. 2001. Addendum to the 200 West Area Dust Mitigation Strategy. Letter Report to CH2M Hill Hanford Group. June 2001. PNNL-13884, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky, M. R. and J. M. Becker. 2001. 200 West Area Dust Mitigation Strategy. Letter Report to CH2M Hill Hanford Group. April 2001. PNNL-13883, Pacific Northwest National Laboratory, Richland, WA.

Sackschewsky, M. R., J. S. Lewinsohn, and R. E. Durham. 2000. W-519 Sagebrush Mitigation Project, FY 2000 Status Report. Letter Report to U.S. Department of Energy. September 2000.

Sackschewsky, M. R. 1999. Safe Interim Storage Project (Project W-058) Sagebrush Mitigation FY 1999 Monitoring Report. Letter Report to U.S. Department of Energy. PNNL-14122, Pacific Northwest national Laboratory. September 1999.

Sackschewsky, M. R. 1999. Biological Assessment for Endangered and Threatened species potentially affected by the continued operation of the Oconee Nuclear Station and Associated Transmission lines. Biological Assessment prepared for the U. S. Nuclear Regulatory Commission. June 1999.

Brandt, C. A. and M. R. Sackschewsky. 1999. Ecological Compliance Assessment Project Implementation Plan. Draft DOE/RL-95-11 Rev 2.

Sackschewsky, M. R. 1998. Safe Interim Storage Project Sagebrush Mitigation 1998 Monitoring Report. Letter Report to U.S. Department of Energy. July 1998.

Sackschewsky, M. R. 1998. Mitigation Implementation Plan for the Tank Waste Privatization Phase I, Infrastructure Development. Letter Report to Numatec Hanford Corporation, June 1998.

Sackschewsky, M.R. 1997. Threatened and Endangered Species Evaluation for 75 Licensed Commercial Nuclear Power Generating Plants. Prepared for the U.S. Nuclear Regulatory Commission. PNNL-11524, Pacific Northwest National Laboratory, Richland, WA.

Kemp, C.J. and M.R. Sackschewsky. 1997. Vegetation and Moisture Performance on a Resource Conservation and Recovery Act - Equivalent Landfill Cap at the Hanford Site. BHI-00980, Bechtel Hanford Inc., Richland WA.

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Link, S.O., L.L. Cadwell, K.L. Petersen, M.R. Sackschewsky, and D.S. Landeen. 1995. The Role of Plants and Animals in Isolation Barriers at Hanford, Washington. PNL-10788, Pacific Northwest Laboratory, Richland, WA.

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November 7, 2008

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 A. SMITH CONCERNING
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Michael A. Smith do hereby state as follows:

1. I am employed as a Scientist at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the "Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned the fuel cycle, health physics, and non-radiological health issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

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Michael A. Smith

Michael A. Smith

Radiological Science and Engineering
Scientist III
Pacific Northwest National Laboratory
PO Box 999
Richland, WA 99352
E-mail: Michael.Smith@pnl.gov

Biography

Mr. Smith has a diverse academic background in environmental science and nuclear engineering, along with practical research, laboratory, and teaching experience. Since arriving at Pacific Northwest National Laboratory in June 2005, he has contributed to updates and training for the FRAMES, MEPAS, and GENII computer codes; reviews of environmental impact statements for North Anna, Grand Gulf, and Clinton early site permits; technical contributions to Vogtle ESP EIS and North Anna COL EIS; team lead and technical contributor to Levy County COL EIS; calibrator for RPMP; review of the Hanford radiological exposure tracking system (REX), review of NIOSH dose reconstruction spreadsheet calculations, PI for separate projects on the review and dose assessment for use of source material under 10 CFR Part 40 and byproduct material under 10 CFR Part 30, and dose assessments for exemption request for release of granular activated carbon and resin from Hanford.

Prior to arriving at PNNL, Mr. Smith contributed to ongoing work at Southwest Research Institute in performance, safety, and environmental assessment of high-level waste geologic repositories, independent spent fuel storage facilities, uranium reprocessing facilities, uranium in-situ leaching facilities, and various decommissioning projects. For 5 years, he was principal investigator for a public outreach project that developed posters, brochures, presentations, and physical and computer models for use at public meetings and exhibits to communicate complex regulatory concepts about high-level waste to members of the public and affected units of local government. He was principal investigator for a project that performed an evaluation of multi-media models for complex dose analysis, specifically GoldSim, MEPAS, GENII, and RESRAD-OFFSITE. From 2001–2003, he was principal investigator for a project that evaluated potential doses to members of the public if licensees seek to remove soils from NRC-licensed facilities. From 2000–2005, he was a member of the Institute's radiological health and safety committee.

During his practicum for his Master's degree at Oak Ridge National Laboratory he gained experience in the operation and maintenance of a radiation detection laboratory, completed formal training in Gamma-Ray Spectrometry with Techniques and Applications for Investigating Environmental Processes, and completed a 15-week study for his thesis project. The study characterized and modeled the movement of radionuclides through soil, vegetation, and surface water at a 25-acre pasture on the U.S. Department of Energy Oak Ridge Reservation where contaminated biosolids had been applied by surface spraying.

Research Interests

His research interests include environmental radiation detection, transport, and modeling; risk assessment; communications; and environmental policy.

Education and Credentials

- B.S. Nuclear Engineering, Kansas State University, 1994
- M.S. Environmental Science, Ohio State University, 1997
- M.S. Nuclear Engineering, Ohio State University, 1997
- American Board of Health Physics, Certified Health Physicist, 2006

Affiliations and Professional Service

- American Geophysical Union
- Health Physics Society
- Columbia Chapter Health Physics Society

Selected Publications

2008

Smith MA, IL Larsen, and AW Fentiman. 2008. *Fate of Co-60 at a Sludge Land Application Site*. Journal of Environmental Radioactivity 99(10):1611-1616. doi:10.1016/j.jenvrad.2008.06.006

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2006

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Whelan G, KJ Castleton, GM Gelston, DL Strenge, and MA Smith. 2005. *FRAMES 2.0 Workshop for NRC*. Presented by Gene Whelan, Karl J Castleton, Dennis L Strenge, Michael A Smith (Invited Speaker) at FRAMES 2.0 Workshop for NRC, Rockville, MD on November 15, 2005. PNNL-SA-47454.

2002

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CNWRA (contributing author). 2002. *Integrated Issue Resolution Status Report*. NUREG-1762. U.S. NRC, Washington, DC.

2001

Mackin, P, D Daruwalla, J Winterle, M Smith, D Pickett. 2001. *A Baseline Risk-Informed Performance-Based Approach for In-Situ Leach Uranium Extraction Licensees*. NUREG/CR-6733. Center for Nuclear Waste Regulatory Analyses, San Antonio, TX.

2000

McKenney, C, P LaPlante, J Weldy, and M Smith. 2000. *Incorporation of Dose Modeling into NRC's Total System Performance Code*. Society for Risk Analysis Annual Meeting. Seattle, WA. December 2–5, 2000.

1999

Smith, M, T McCartin, and S Mohanty. 1999. *Demonstration of TPA 3.2 Code's Capability to Evaluate the Effects of Human Intrusion*. Transactions of the American Nuclear Society: Vol. 81, Long Beach, CA.

1997

Smith, M, A Fentiman, and I Larsen. 1997. *Investigation of Co-60 at a Sludge Land-Application Site*. Transactions of the American Nuclear Society: Vol. 76, Orlando, FL.

November 7, 2008

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
THE NRC STAFF RESPONSE TO THE LICENSING BOARD'S
QUESTIONS REGARDING ENVIRONMENTAL MATTERS

I, Lance W. Vail, do hereby state as follows:

1. I am employed as a Senior Research Engineer at Pacific Northwest National Laboratory, operated by Battelle Memorial Institute. I am providing responses to the Licensing Board's questions under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

2. As part of the NRC staff's environmental review of the Vogtle ESP application, documented in NUREG-1872, the Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site," August 2008, I assisted the NRC staff in its analysis of the aspects of the applicant's Environmental Report that concerned surface water and system design alternative issues.

3. I am responsible for those responses to Licensing Board questions (or portions of questions) in Attachment A to the "NRC Staff Response to the Licensing Board's Questions Regarding Environmental Matters" for which I am listed as the author.

4. 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.

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

_____
Lance W. Vail

STATEMENT OF PROFESSIONAL QUALIFICATIONS OF LANCE W. VAIL

CURRENT POSITION

Senior Research Engineer II
Environmental Technology Division
Battelle, Pacific Northwest Division
Pacific Northwest National Laboratory

Since joining Battelle in 1981, Mr. Vail has been involved in projects covering a diverse set of water related issues. His professional experience includes basic and applied research, and regulatory compliance assessments. His areas of expertise cover a broad spectrum of areas related to water resources.

RESEARCH INTERESTS

Water resource management
Multiple objective tradeoff analysis in water resources
Uncertainty analysis in water resources
Advanced hydrologic process modeling
Impacts of climate on water resources
Neural networks, fuzzy logic, and genetic algorithms applied to water resource issues
Linking simulation models with optimization methods to water resource problems
Linkage of physical and biological models in fisheries management

EDUCATION

B.S.	Humboldt State University, environmental resources engineering	1979
M.S.	Montana State University, civil engineering	1982

PROFESSIONAL AFFILIATIONS

American Geophysical Union
American Society of Civil Engineers
American Water Resources Association

CURRENT PROJECTS

Hydrologic Site Safety Reviews for Early Site Permits. Principal Investigator and Project Manager. Three applications for an Early Site Permit (ESP) have been submitted to the Nuclear Regulatory Commission. This project provides an independent assessment of hydrologic suitability of the proposed sites. Assessments include a broad range of considerations such as flooding, low water conditions, ice impacts, seiches, storm surge, and tsunamis.

Water-related Environmental Reviews for Early Site Permits. Task Manager. Three applications for an Early Site Permit (ESP) have been submitted to the Nuclear Regulatory Commission. This task provides an independent assessment of the proposed sites' environmental suitability. Assessments include a broad range of considerations such as water-use conflicts and changes in water quality.

Snohomish Basin Characterization. Technical Lead. Advanced distributed watershed models were applied to provide the Tulalip Tribes of Western Washington state a thorough understanding of the impacts of logging, development, and climate on the Snohomish River Basin.

Acid Rain TMDL. Principal Investigator and Technical Project Manager. The objective of this work assignment for Region II of the U.S. Environmental Protection Agency is to develop a preliminary assessment approach for TMDLs for pH impaired waters listed on the New York State Section 303(d) list. The intent is to enhance and further develop TMDL program capabilities by providing expertise in both acid deposition and TMDL development. The development of such an assessment approach requires that available models and data resources be reviewed. Systems engineering methods will be used in developing a conceptual model to ensure the relationships between models and data are fully understood. The assessment approach will be tested on one or more representative watersheds to be determined in close coordination with EPA, NYSDEC and Battelle. http://acidraintmdl.pnl.gov

PAST PROJECTS

Environmental Impact of License Renewal of Commercial Nuclear Power Plants. Contributor. Mr. Vail assesses the water use, water quality, and hydrologic impacts of license renewal for the Nuclear Regulatory Commission's NEPA process. He has performed this function for the following commercial nuclear plants: Calvert Cliffs, Oconee, Arkansas Nuclear One, Hatch, McGuire, Catawba, North Anna, Robinson, Ginna, and St. Lucie.

Chehalis Basin Characterization. Principal Investigator and Project Manager. Advanced numerical modeling and GIS methods were applied to assist the Corps of Engineers in characterizing the Chehalis Basin in Western Washington State. The Chehalis Basin is subject to frequent flooding. The native populations of anadramous fish have been stressed to adverse changes in habitat resulting from development and logging.

Generic Environmental Impact Statement (GEIS) for Decommissioning Commercial Nuclear Power Plants. Contributor. Mr. Vail is providing expertise in the development of a GEIS for decommissioning of nuclear plants. He provides expertise on water use, water quality, and hydrologic impacts for the Nuclear Regulatory Commission.

Impact of Climate on the Lower Yakima Basin. Principal Investigator and Project Manager. The objective of this three-year EPA STAR Grant Project was to develop and demonstrate an integrated assessment of the impact of climate variability and climate change on a diverse set of interests in the Lower Yakima Valley in Central Washington State. Interests considered include: surface and groundwater supply, surface and groundwater quality, air quality, public health, farm and regional economics, and fisheries. The project considered the effectiveness of changes in land management (crop selection) and water management (reservoir operation) in adapting to an uncertain future climate. A diverse set of models was linked with an optimization procedure to ensure that the tradeoffs between various resource management objectives are clearly articulated. http://projects.battelle.org/yakima/

Use of NOAA's Seasonal Climate Forecast for Water Resource Management. Task Manager of Reservoir Optimization Task. The objective of this NOAA funded project was to show the potential value of improved climate forecasts in managing surface water reservoirs for multiple objectives. Using a pareto genetic algorithm, the reservoir operating rules were optimized to define the tradeoff curves for hydropower, flood control, and instream flow requirements in the Tennessee River basin. Changes in forecast reliability result in changes to these tradeoffs and thereby express the value of such improved forecasts.

Accelerated Climate Prediction Initiative. Task Manager of Water Resources and Habitat Task. This project will provided a limited, systematic assessment of the potential effects of anthropogenic climate change over the next half-century on water resources in the western United States. This objective was accomplished by "downscaling" the results of the global-scale simulations described above to the spatial and temporal resolution needed to drive impact assessment models. Downscaling is particularly important

for the West, where topography is a dominant climate driver. An important aspect of the hydrology of almost all western rivers is water management. Other than a few headwater streams, the hydrology of most rivers in the west is strongly affected by water use and artificial storage. Water management models were used to study the effect of reservoir operations and understand the implications of climate variability and change on the water resources of the west. http://acpiwater.pnl.gov

Linking Physical and Biological Models. Principal Investigator and Project Manager. The objective of this three-year Laboratory Directed Research and Development project is to develop and demonstrate an integrated natural resource analysis framework. This framework: dramatically improves the ability to integrate physical and biological models, thereby encouraging the utilization of advanced process models; allows utilization of large, sparse, and distributed data sets (including model output); communicates high-level tradeoffs and their respective uncertainties; and assesses, communicates, and minimizes scales issues. During the first year, the fundamental structural differences between such models was identified as a significant obstacle to successful linking of physical and biological models. The pervasive vagueness of rules and the multivaluedness associated with temporal/spatial upscaling suggested an approach using "fuzzy methods". The second year of this project utilized a variety of fuzzy methods including: fuzzy arithmetic, fuzzy logic, fuzzy clustering, and adaptive neural fuzzy inference systems (ANFIS). A series of rules and a database from the Multispecies Framework Process were employed to test the various fuzzy methods. These rules and data are used to define aquatic habitat diversity in the Pacific Northwest. A tool called FuzzyHab was developed to estimate habitat diversity from a set of categorical statements about the environment. Each of these categorical statements is vaguely defined. Estimates for each categorical statement are derived from physical process models.

Integrated Natural Resource Data System. Contributor. This project is to demonstrate INRDS. INRDS is an advanced, web-based environmental information system that will promote public understanding of natural resource management issues and assist planners and decision makers in accessing the most relevant information and analytical tools and evaluating the tradeoffs of alternate actions. http://inrds.pnl.gov

Early Warning of El Ni o Southern Oscillation (ENSO) Events for Regional Agriculture. Task Manager of Reservoir Optimization Task. This project is investigating the current predictability of interannual variability in climate conditions in the Pacific Northwest to determine whether and how early warning and seasonal climate forecasts by the Climate Prediction Center (CPC) of the National Oceanic and Atmospheric Administration (NOAA) forecasts can be used to reduce the vulnerability of irrigated agriculture to low water-availability conditions. The study is funded by a grant from the economics and Human Dimensions Program of the NOAA Office of Global Programs. The Economics and Human Dimensions program aims to improve our understanding of how social and economic systems are currently influenced by fluctuations in short-term climate (seasons to years), and how human behavior can be (or why it may not be) affected based on information about variability in the climate system. http://elrino-northwest.labworks.org

Impact of Reservoir Operating Strategies on Resident Fish - Mr. Vail has employed several models to assess the impact on resident fish species of a variety of reservoir operating strategies. This study was undertaken as part of the Columbia Basin System Operation Review process. Mr. Vail helped define the values and value measures of the Resident Fish Work Group.

Multiobjective Optimization - Mr. Vail is the project manager of an effort to assess the multiobjective optimization needs of Bonneville Power Administration. Objectives include: hydropower, resident fish, anadramous fish, irrigation, flood control, wildlife, and navigation. Mr. Vail is developing definitions of the canonical mathematical form of each of these objectives. The resulting multiobjective statement will be used to define the required optimization tools.

Integrated Environmental Monitoring Initiative - Mr. Vail is a co-principal investigator for the Integrated Environmental Monitoring Initiative. The objective of this initiative is to develop and demonstrate a

comprehensive interdisciplinary methodology targeted to improve the effectiveness of environmental monitoring and restoration activities. This objective required comprehensive integration of monitoring regimes, analytical practices, design methodologies, and compliance needs.

Coupled Simulation/Optimization of Ground Water Remediation - Mr. Vail developed a computer code that coupled a ground water flow model with an optimization procedure. The code was able to provide estimates of the pumping/injection rates that would mitigate or remove a plume at minimal cost.

Simulation of Watershed Hydrologic Responses to Alternative Climates - Mr. Vail is the principal investigator of a project studying the impacts of global climate change on the hydrologic response of a watershed. The results of hydrologic simulations using distributed snowmelt and soil moisture accounting algorithms were graphically compared via video displays of daily simulated snow water equivalent, soil moisture, and runoff for the American River, Washington, which drains 204 square kilometers of the east slopes of the Cascade Mountains, Washington. Snow water equivalents and snowmelt were simulated using a simplified distributed temperature-index model augmented with seasonally estimated net solar radiation. A classification scheme was used to partition the empirical cumulative probability distributions of precipitation (rain plus melt) and a topographic index over the basin into groups of near-equal membership. Topographically-based soil moisture capacities were assumed for each class and were estimated via automated calibration methods using historical data. The simulated soil moisture and snow water accumulations for each class were geographically mapped for visualization. Test of the effect of alternative, warmer climates on snow accumulation, the seasonal distribution of soil moisture, and runoff were conducted by adjusting historical (daily) temperature and precipitation and repeating the analysis.

Pacific Northwest Climate Change Case Study - Water Resource Impacts - Mr. Vail is investigating the effects of global climate change on water resources of the Pacific Northwest. Spatially distributed snowmelt, soil moisture, and runoff models have been combined with a graphics visualization package to understand the changes in snowpack, soil moisture, and evapotranspiration over time. A weather classification scheme has been developed which estimates point precipitation as a function of large-scale atmospheric variables. This allows the synthesis of point precipitation given large-scale meteorological information as might be produced by GCM simulations. Orographic effects also have a significant role in defining climate at the watershed scale. Efforts are under way to develop a scientific basis to extend the sparse meteorological measurements basis to extend the sparse meteorological measurements available for any watershed to estimate the spatial distribution of precipitation, temperature, and wind speed within the watershed. A reservoir network model for the Columbia River Basin has been aggregated to fourteen nodes. This network model of the Columbia River Basin has been aggregated to fourteen nodes. This network model will be driven by a collection of index watersheds. A daily hydroclimatological data set has been developed to aid in the selection of index watersheds.

Acid Rain Watershed Modeling Project - Mr. Vail directed the hydrologic part of a study to evaluate and apply several coupled hydrology/geochemical codes that were developed to model the impact of acid rain on surface water chemistry. The project involved extensive behavior and sensitivity analyses of three coupled geochemical/hydrological simulation codes.

Incineration at Sea - The objective of this project was to assess the impact of incinerating toxic waste at sea on the aquatic environment. Mr. Vail developed a model on an IBM-PC to estimate the concentration of contaminant in the ocean.

Aquifer Thermal Energy Storage - The objective of this project was to develop and apply computer codes that would simulate the trade-offs between different management policies of an Aquifer Thermal Energy Storage system. Mr. Vail independently developed, validated, and applied several computer codes for this purpose.

Flow and Fractured Media - The objective of this study is to develop a state-of-the-art predictive capability for flow and transport in saturated fractured media. Mr. Vail was responsible for implementing, modifying, and testing a computer code that models steady flow in permeable media with discrete fractures. Mr. Vail has also developed a computer code that models steady flow through fractures in an impermeable rock mass. The fractures can either be specified or generated via Monte Carlo Methods. This code was applied in an investigation of the potential impact of a nuclear meltdown on groundwater.

Modeling Flow With Certainty in Hydraulic Parameters - The objective of this study is to develop a methodology to analyze the uncertainty in predicting piezometric surfaces caused by uncertainty in groundwater flow parameters. Mr. Vail developed a computer code that couples perturbation and finite-element techniques to estimate the mean and variance of the piezometric surface.

Stripa Mine Hydrogeologic Characterization - The objective of this study was to perform three-dimensional simulations with the CFEST code for ground water flow at the Stripa Mine in Sweden. Mr. Vail was the Battelle project manager of this effort.

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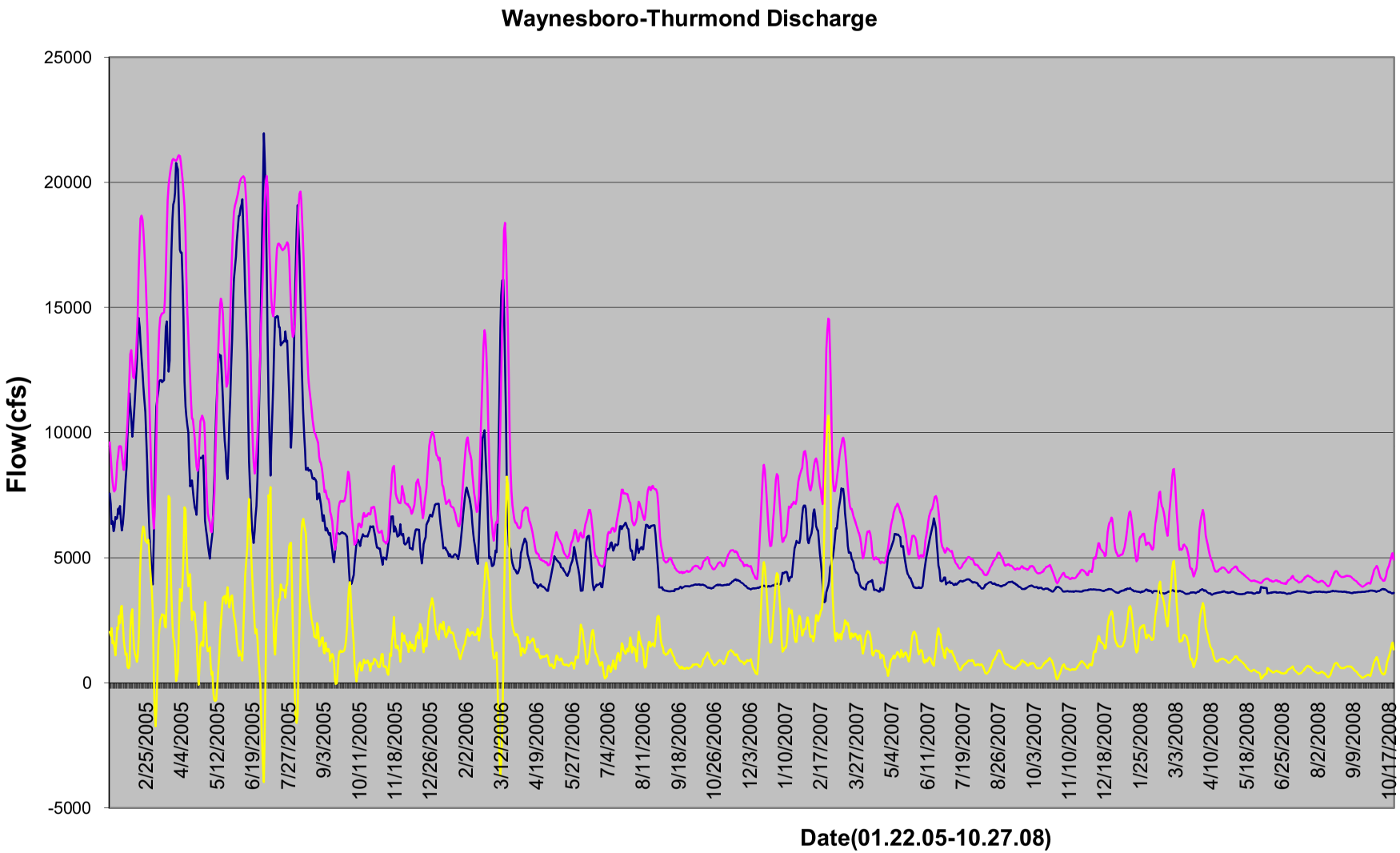
ATTACHMENT C

Waynesboro Data From USGS Gauge #021973269 near Waynesboro, GA.



Waynesboro Data From USGS Gauge #021973269 near Waynesboro, GA
http://waterdata.usgs.gov/nwis/uv?021973269 (accessed 11/6/2008)

Thurmond Data From U.S. Army Corps of Engineers Data Retrieval Interface
http://water.sas.usace.army.mil/hist.htm (accessed 11/6/2008)

Thurmond Waynesboro Difference