UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

In the Matter of	Docket No. 52-011-ESP
SOUTHERN NUCLEAR OPERATING CO.	ASLBP No. 07-850-01-ESP-BD01
(Early Site Permit for Vogtle ESP Site)	Originally Filed: January 9, 2009 Revised: February 2, 2009

REVISED PREFILED DIRECT TESTIMONY OF WILLIAM POWERS IN SUPPORT OF EC 1.3

Q1: Please state your name and address.

A1: My name is William Powers, and my business address is 4452 Park Boulevard, San Diego, California, 92116.

Q2: What us your educational background?

A2: I received a Bachelor of Science from Duke University in Mechanical Engineering and a Masters of Public Health in Environmental Sciences from the University of North Carolina.

Q3: For whom do you work and in what capacity?

A3: I am the principal of Powers Engineering, an engineering firm that consults on power generation, pollution control, and cooling technology issues and implementation.

Q4: What is your professional background?

A4: I have over 25 years experience as a lead engineer and project manager for power generation, permitting, technical assessments, and emissions control projects for a number of clients.

Q5: Are you licensed to practice engineering?

A5: I have been a registered professional engineer (mechanical engineering) in California since 1986.

Q6: Have you received any academic honors or professional recognition in your fields of study and practice?

A6: In 1986, I received the "Engineer of the Year" award from the Naval Energy and Environment Support Activity, Port Hueneme. I also received the "Engineer of the Year" award from ENSR Consulting and Engineering, in 1991, and "Productivity Award of Excellence" from the US Department of Defense in 1985.

Q7: Have you testified as an expert previously in any jurisdiction or proceeding?

A7: I have provided expert testimony, conducted feasibility studies, and consulted on permitting regulations in a number of states including Alabama, Kentucky, Georgia, Pennsylvania, Montana, Massachusetts and California.

Q8: Do you have a written summary of your education, employment, experience and background, and papers and presentations you have made over your career?

A8: My professional and educational experience is summarized in the curriculum vitae attached to this prefiled direct testimony as JTI000044. In May of 2003, I co-authored and presented a paper entitled "Design Performance of Optimized Air-Cooled Condenser at Crockett Co-Generation Plant" at the EPA Symposium, Technologies Protecting Aquatic Organisms from Cooling Intake Structures. In 2005, I authored a study that compared the energy efficiency impact of using air cooling on a 500 MW supercritical coal-fired steam boiler, attached hereto as JTI000033.

Q9: What materials have you reviewed and actions have you taken in preparation for your testimony?

A9: I have reviewed Southern Nuclear Operating Company's ("SNC") application for an early site permit ("ESP") at the Vogtle Electric Generating Plant site (the "VEGP site"). I have reviewed excepts of the Final Environmental Impact Statement (NRC000001), SNC's feasibility study on the Air Cooling Condensation ("ACC") system, attached as JTI000034, and related documents submitted in this matter.

Q10: Have you given affidavits or declarations in support of or in connection with any of Joint Intervenors' contentions in this ESP proceeding?

A10: Yes, on November 12, 2007, I gave a declaration in support of Joint Intervenors' Response to SNC's Motion for Summary Disposition of EC 1.3, attached hereto as JTI000035.

Q11: What are the topics of your testimony?

A11: I will discuss the dry cooling alternative as a design alternative to the wet cooling tower system proposed in the ESP to a reasonable degree of scientific certainty.

Q12: Please summarize your conclusions regarding the dry cooling alternative as a design alternative to the wet cooling tower system proposed in the ESP.

A12: The dry cooling alternative is viable for proposed Units 3 and 4 because (1) the standard AP1000 design configuration accommodates both high and standard backpressure turbines, making dry cooling a reasonable alternative; (2) the current dry cooling system design is compatible with facilities like Plant Vogtle; (3) a dry cooling system is effective despite the impact of climate in the vicinity of the VEGP site; and (4) the potential financial, economic, and performance impacts upon facility design, construction, and operation do not favor a wet cooling rather than a dry cooling system.

<u>The standard AP 1000 design configuration accommodates both high and standard backpressure turbines</u>.

Q13: Please explain the Westinghouse AP1000 design regarding the cooling system.

A13: The standard design configuration of the Westinghouse AP1000 Nuclear Plant provides for steam to be passed across a steam turbine which turns a generator, creating electricity. The standard design accommodates any cooling system, wet or dry, as long as the cooling system maintains steam turbine backpressure within the design limitations of the steam turbine established by AP1000 design.

Q14: What is steam turbine backpressure?

A14: In a dry cooling system, backpressure is a function of the difference between the temperature of the outside air and temperature of the steam condensing inside the ACC units.

Q15: What is high backpressure?

A15: High backpressure means the steam turbine is capable of maintaining a rated steamflow with a backpressure of 8 HgA or greater.

Q16: What kind of backpressure can be used with the AP1000 design?

A16: High backpressure or standard backpressure can be used, and in fact, high backpressure turbines in combination with the ACC system may be even simpler and less expensive than standard turbines. It is not necessary to maintain the same backpressure with dry cooling at peak conditions that would be achieved with wet cooling.

Q17: What would be the annual average efficiency penalty of using dry cooling at Plant Vogtle?

A17: Using a 35° F ITD ACC, the estimated annual average efficiency penalty of using dry cooling at Plant Vogtle is approximately 1.5 percent.

Q18: Has a dry cooling system been used successfully at other steam-cycle power plants, including nuclear power plants?

A18: Yes, dry cooling is in common use at utility power plants in the United States. Midlothian Energy uses a dry cooling system at its 1,650 MW combined cycle plant located near Dallas, Texas. JTI000037. Air cooling has been used on a 330 MW coal-fired plant in Wyoming for over 30 years. Air cooling has been used on a 4,000 MW coal-fired power plant in South Africa for over 15 years. Dominion Resources is proposing a dry-cooling system for reactor 4 at their North Anna plant in Virginia. JTI000038.

The current dry cooling system design is compatible with facilities like Plant Vogtle.

Q19: Is the current dry cooling system design compatible with facilities like the proposed Vogtle plant?

A19: Yes, dry cooling would not require a substantial change to the AP1000.

Q20: What does the standard design accommodate?

A20: The standard design accommodates any cooling system, wet or dry, as long as the cooling system maintains steam turbine backpressure within the design limitations of the steam turbine established by Westinghouse Nuclear in its standard AP 1000 design.

Q21: Will there be space below the steam turbine to put in a dry cooling system?

A21: Yes, the surface condensers necessary with the wet cooling system in the proposed design are very large. No surface condensers are used within an ACC system. Removal of surface condensers will create adequate space for ACC steam ducts in the exact spot where these ducts need to be located below the steam turbine outlet.

Q22: How will these ACC steam ducts be installed?

A22: Openings will be designed into the turbine building wall to allow the steam ducts to be interconnected to the ACC. Accommodating 20-foot diameter openings in the wall of a large industrial building in no way rises to the level of reworking the entire turbine building. No other significant physical modifications will be required in or to the turbine building.

Q23: Does the modification to the plant interfere with the standard design?

A23: No, a standard design serves as a point of departure for customizing the design for a specific site with specific site constraints. The engineering teams at Westinghouse Nuclear and Toshiba who developed the standard AP1000 design have no knowledge of site constraints specific to Plant Vogtle or any other site-specific design issues. Moving boiler feedwater pumps to a slightly different location and providing openings in building walls to accommodate ACC steam ducts is a minor design engineering adjustment that does not present an engineering challenge.

Q24: Are you familiar with the EPA's regulations implementing Section 316(b) of the Clean Water Act?

A24: Yes, the Clean Water Act requires EPA to determine the Best Technology Available ("BTA") for eliminating impacts of cooling water intake structures, and then to set performance standards for facilities based on the BTA.

Q25: If dry cooling is a cost effective and practical alternative, why was it not designated as BTA by the EPA?

A25: The § 316(b) regulation does not require air cooling as BTA because in its rulemaking the EPA: (1) overstated power losses for coal plants; (2) asserted that all the power loss would have to be made up by new plants, accordingly exacerbating air pollution problems; and (3) the supposed high cost of air cooling. Each of these statements and assertions are incorrect. Moreover, the EPA's dry cooling analysis does not specifically discuss nuclear power plants, and is accordingly not entirely relevant to the ESP application. Perhaps most importantly, the fact that the EPA does not require air cooling as BTA does not mean that air cooling is not preferable in specific cases. For plants such as Vogtle, which are located in areas where the potential for drought could compromise the availability of water for cooling, a compelling argument can be made that reliance on water for cooling could compromise the reliability of the plant at times of greatest need (e.g. summertime high demand period). Finally, I note that the state of the art in cooling technology has changed since the EPA published its cooling water intake regulations in 2001.

<u>A dry cooling system is effective despite the impact of climate in the vicinity of the VEGP site</u>.

Q26: Can a dry cooling system be effective despite the impact of climate in the vicinity of VEGP?

A26: Yes, there are effective dry cooling systems in Texas, Wyoming, and South Africa. There are dozens of coal and natural gas-fired plants in the U.S. that use air-cooled condensers. The largest air-cooled plant in the U.S. is the 1,650 MW Midlothian Energy natural gas combined cycle plant near Dallas, Texas. The largest coal-fired air-cooled plant in the U.S. is the 330 MW

Wyodak plant in Wyoming. The largest air-cooled coal-fired plant in the world is the 4,000 MW Matimba power plant in South Africa. JTI000035 and JTI000037.

Q27: Please explain the temperature standards that you are using to reach the conclusion that dry cooling can be effective.

A27: During much of the year, the ambient temperature is less than 70° F and there would be relatively little differential in the MW output of wet or dry AP 1000 alternatives. Peak summertime design conditions generally occur less than 200 hours a year.

Q28: What would be the MW differential between a dry and a wet cooling system?

A28: The MW differential between a dry and a wet cooling system would only be between 15-20 MW at peak conditions. A high backpressure turbine can be substituted for standard backpressure turbines in the AP1000 design to assure maximum output from a dry cooled plant at higher ambient temperatures.

Q29: Are temperature fluctuations a problem?

A29: No, temperature fluctuations neither create instability nor potentially harm the power plant grid as a whole. An ambient air environment absent temperature fluctuation does not exist. Considerations of swings in ambient temperature are incorporated in every plant design.

The potential financial, economic, and performance impacts upon facility design, construction, and operation do not favor a wet cooling over a dry cooling system.

Q30: What are the benefits of an ACC system over the standard AP1000 design?

A30: An ACC design system would be simpler than the standard AP100 design. It is generally considered desirable in the power plant design engineering world to simplify complex systems whenever possible. Simplification generally makes the system more reliable.

Q31: How does the backpressure turbine impact financing projections for Plant Vogtle?

A31: High backpressure turbines, rated to 8 inches of mercury (Hg) backpressure or greater, are normally specified with air-cooled installations. High backpressure turbines are simpler and less expensive than standard backpressure turbines. Accordingly, and based upon a telephone communication with Charles Jones and General Electric on July 26, 2002, I believe that SNC might save money on the steam turbine portion of the AP1000 design if an air-cooled system is selected.

Q32: Is the current evaluation of the ACC design set forth in JTI000034 accurate?

A32: No, SNC performed a flawed evaluation resulting in an ACC design oversized by at least 100 cooling modules. SNC selected a 20° F ITD ACC for the case study because it presumed that it is necessary to maintain the same backpressure with dry cooling at peak hot summer day site conditions as would be achieved with wet cooling.

Q33: How does this presumption affect the plant design?

A33: This presumption will always result in a spectacularly oversized ACC design. It makes no sense to build a 334 module ACC that costs $361 million and has a 44 MW parasitic fan load when a 230 module ACC with 30 MW parasitic fan load would result in the same annual energy penalty for the dry cooling option. ACC design is a balance between cost, size, and performance.

Q34: Would there be a difference between the output of a wet plant versus a dry plant?

A34: No, during most of the year, whenever ambient temperature is less than approximately 70° F, there would be relatively little differential in the MW output of wet or dry AP 1000 alternatives.

In accordance with 28 U.S.C. § 1746, I state under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on January 9, 2009.

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

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