UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before the 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 Company	)	**ASLBP No. 07-850-01-ESP-BD01**
(Early Site Permit for Vogtle ESP Site)	)	**October 17, 2007**

SOUTHERN NUCLEAR OPERATING COMPANY'S STATEMENT OF UNDISPUTED FACTS IN SUPPORT OF APPLICANT'S MOTION FOR SUMMARY DISPOSITION ON INTERVENOR'S CONTENTION 1.3

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STATEMENT OF UNDISPUTED FACTS

In accordance with 10 C.F.R. §§ 2.323, 2.1204, 2.1205, as well as the May 7, 2007 Memorandum and Order (Prehearing Conference and Initial Scheduling Order) of the Atomic Safety and Licensing Board, Southern Nuclear Operating Company ("SNC") submits this Statement of Undisputed Facts in support of its Motion for Summary Disposition on the Intervenors' Contention EC 1.3, to-wit: that the Environmental Report ("ER") included with the application for the Early Site Permit ("ESP") in this proceeding should have evaluated a dry

cooling system as an alternative to the closed-cycle wet cooling system SNC proposed. As the undisputed facts set forth below demonstrate, SNC is entitled to a ruling as a matter of law that the contention has become moot as a result of further development of the record and, that, on the merits, the National Environmental Policy Act ("NEPA") does not require an evaluation of dry cooling system because it is not a feasible alternative to the cooling system evaluated as part of the applicant's proposed project.. The proposed undisputed facts supporting this motion are as follows:

1. As permitted in 10 C.F.R. Part 52, SNC filed an application for an ESP for two additional units at the existing Vogtle Electric Generating Plant ("VEGP"). The 3,169-acre VEGP site is located on a coastal plain bluff on the southwest side of the Savannah River in eastern Burke County, Georgia. The site is approximately 30 river miles above the U.S. 301 bridge and directly across the river from the Department of Energy's Savannah River Site (Barnwell County, South Carolina). Southern Nuclear Operating Company Vogtle Early Site Permit Application ("Application") Part 1, Section 1. SNC has selected two Westinghouse Electric Company, LLC AP1000 standard reactors as the proposed design to be constructed and operated at the VEGP site. Application Part 2, Section 1.1.

2. The Nuclear Regulatory Commission ("NRC" or "Commission") has repeatedly expressed its desire that the next generation of nuclear plants be standardized, including the balance of plant beyond the nuclear island. *See Draft Statement of Policy on Conduct on New Reactor Licensing Proceedings*, 72 Fed. Reg. 32139, 32142 ("the Commission encourages applicants to standardize the balance of their plants insofar as is practicable"). The NRC approved the AP1000 reactor as one of four standard designs that applicants may reference in applications for combined operating licenses. The NRC has encouraged applicants to choose

one of those designs to maintain standardization in their license applications. *Draft Statement on Policy of Conduct of new Reactor Licensing Proceedings*, 72 Fed. Reg. 32139 (June 11, 2007), *citing* 10 C.F.R. § 52.63 (2006). Although the balance of plant, including site specific systems such as cooling systems, are not required to be standardized by the design certification rule, the NRC has said it encourages standardization of such systems "insofar as is practicable." 72 Fed. Reg. at 32142.

3. The conceptual design for the cooling system for the AP1000 Nuclear Plant was developed by Westinghouse/Toshiba with the objective of achieving a generic standardized design for use at all potential sites and for all potential clients. The standardized plant design would facilitate and expedite the licensing, procurement, construction, and commercial operation of all the standardized units. Based on the Commission's policy directive codified in 10 C.F.R. Part 52, Westinghouse and Toshiba conceptualized the design of the turbine island and cooling system components. Cuchens Affidavit, Exhibit 1 at p. 2.

4. The standard AP1000 plant cooling system design includes a closed loop cooling system with a traditional steam surface condenser to condense steam from the turbine and a wet evaporative cooling tower. Cooling water is re-circulated from the tower to the condenser (for condensing steam) as the medium for transfer of heat from condensed steam emerging from the turbine. Air flowing through the cooling tower transfers heat to the air via evaporation of warm water (as a steam/plume leaving the cooling tower). Cuchens Affidavit, Exhibit 1 at. p. 3.

5. The standard design configuration of the AP1000 Nuclear Plant provides for steam to be passed across a steam turbine which turns a generator, creating electricity. The steam leaves the turbine and goes to a steam surface condenser, a large heat exchanger filled

with tubes that have cold water flowing through them. The cold water in the tubes absorbs the heat from the steam, causing it to condense back into liquid form; it is then pumped back to the nuclear reactor and the process begins again. The cold water circulating through the condenser tubes is pumped out to a wet cooling tower where it is cooled off by dumping its heat to the surrounding air. Once cool, the water is pumped back through the condenser tubes. Both circuits continue in a continuous process (hence the name – "closed loop cooling system"). Cuchens Affidavit, Exhibit 1 at p. 3.

6. The Design Control Document (DCD) for the AP1000 provides that the standard turbine generator for the AP1000 Nuclear Plant is a triple exhaust turbine, which means that steam from the turbine(s) will exhaust into three separate steam surface condenser shells. These are generally referred to the high pressure, intermediate pressure, and the low pressure turbines. *Id*. For optimum plant efficiency, the multi-pressure turbine generator for the AP1000 Nuclear Plant is designed to have the following backpressures at the design inlet cold water temperature of 91ºF as indicated below (from DCP/NUS0302).

HP Turbine backpressure	3.57 "HgA
IP Turbine backpressure	2.82 "HgA
LP Turbine backpressure	2.37 "HgA
Avg. Turbine backpressure	2.92 "HgA

Cuchens Affidavit, Exhibit 1 at pp 3-7.

7. Normal operation of the turbine generator is designed to be within an exhaust pressure (backpressure) range of ~ 1.0 to 5.0 "HgA. The higher the backpressure on the turbine, the less electricity the generator is able to produce, while the lower the backpressure is on the turbine, the more electricity the generator is able to produce (down to choke flow

backpressure @ ~ 1.0 “HgA). Further, this corresponding increase in exhaust or backpressure associated with a dry system causes the unit to exceed its alarm point much more frequently than with a wet system, leading to more shutdowns of the unit. Cuchens Affidavit, Exhibit 1 at pp. 3-4, 10. The AP1000 standard condenser is designed to yield a gross unit generation of approximately 1,193 MW. Cuchens Affidavit, Exhibit 1 at p. 8 and Figure 5.

8. The AP1000 standard design calls for the turbine generator to be located on a concrete pedestal above the steam surface condenser which allows steam to be routed directly from the turbine to the condenser below. The exhaust duct carrying the steam to the condenser is called the turbine hood which functions as a distribution/transition piece from the turbine to the surface condenser below. Minimizing the pressure losses in the hood from the turbine to the condenser is important to avoid loss of turbine efficiency and electric output. The design of the entire turbine island (thermal cycle) depends on the turbine and condenser performance. The powerhouse building design is dependent on the turbine and condenser arrangement, size, and configuration. The turbine pedestal supports the turbine with the steam surface condenser located directly under the turbine and pedestal. The design of the turbine extraction piping, location of feed-water heaters, and condensate pumps is largely dependent on turbine and condenser design and location. Cuchens Affidavit, Exhibit 1 at pp. 3-4.

9. The configuration of the triple exhaust turbine requires the steam surface condenser to also be segmented into three shells, similarly called the high pressure (HP), intermediate pressure (IP), and low pressure (LP) shells. The average pressure of the three condenser shells (HP+IP+LP)/3 is the key parameter for unit performance considerations and operating limitations on the turbine generator. Cuchens Affidavit, Exhibit 1 at p. 4.

10. The standard design for an AP1000 Nuclear Plant includes a cooling system utilizing a conventional steam surface condenser and either natural draft or mechanical cooling towers. The system relies on the cooling properties of circulating water, to achieve cooling. The standard steam surface condenser for the AP1000 Nuclear Plant includes the following design parameters:

Type Condenser:		Multi-pressure, Single Pass, Three Shell
Design Tube Material:		Titanium
Design Tube O.D. / Tube Gage:		1.0 “ O.D / 22 BWG
Design Tube Velocity:		8.2 FPS
Design Flow:		600,000 GPM
Design Heat Load (MBtu/Hr):		7,565.2 Btu/Hr x 106
Design Inlet Cold Water Temperature:		91.0 °F
Design Range (Delta T - ° F):		25.2 °F
Design Surface Area:		1,235,737 Sq. Ft.
Design TTD - ° F		5.33 °F
Design Pressures	High Pressure (HP) Shell	3.57 “HgA
	Intermediate Pressure (IP) Shell	2.82 “HgA
	Low Pressure (LP) Shell	2.37 “HgA
	Average (Avg.) Shell Pressure	2.92 “HgA

Cuchens Affidavit, Exhibit 1 at p. 7.

11. In contrast to the wet cooling system described in the AP1000 DCD, a dry cooling system would rely on air pumped from the outside and flowing over large metal-finned tubes to

cool the steam. The steam would be piped through large ducts (16 to 20 feet or more in. diameter) to the tubes. In the cooling unit (module), the fans force the air across the finned tubes to achieve optimum heat transfer. As it rejects its heat, the steam would condense to water and be drained to a large tank from which it would be pumped back to the nuclear steam supply system. Cuchens Affidavit, Exhibit 1 at p. 9.

12. The chief governing design characteristic of an air cooled condenser used in a dry cooling system is the Initial Temperature Difference ("ITD"), the constant difference between the temperature of the outside air and the temperature of the steam condensing within the tube bundles. The higher the ambient temperature in which an air-cooled turbine operates, the higher the steam saturation temperature, and therefore the backpressures, of the turbine will be. Backpressure, in turn, limits the efficiency and operability of the turbine. Current "state-of-the art" air-cooled condensers for the utility industry are designed with an ITD of around 40° F, although there have been a few such condensers built in the United States with an ITD of 35° F. No manufacturer of air-cooled condensers has successfully designed or built an air-cooled condenser with a lower ITD than this. Air cooled condensers in the United States have typically been employed in connection with smaller, combined cycle generating units with much lower heat loads than the AP1000. Cuchens Affidavit, Exhibit 1 at pp. 10-13.

13. Assuming an ACC could be designed for an AP1000 that can operate at 35ºF ITD, this would result in a steam saturation temperature approaching 133.5°F at 95°F ambient temperature. This steam saturation temperature would increase backpressures on the turbine far above the optimum design backpressure (average of 2.92 "HgA) and exceed the operational limit (5.0 "HgA) in at least one of the sections of the turbine. Thus, at the design ambient temperature of 95ºF, an ACC would seriously undermine the efficiency, electrical output and

even the reliability of the standard AP1000 turbine. Cuchens Affidavit, Exhibit 1 at pp. 10-12. Steam duct losses would likely further drive up the unit backpressure from the turbine outlet to the ACC significant enough (0.5-1.0 ”HgA) such that that the turbine itself would almost certainly see a pressure in excess of its allowable operating pressure at the design temperature. Because of the current limit of technology as described above (a minimum 35º- 40° F internal temperature differential ITD), an ACC could not provide adequate cooling to an AP1000 standard turbine operating in South Georgia. Cuchens Affidavit, Exhibit 1 at p. 11. In South Georgia, extreme maximum temperatures recorded in the vicinity of the site have ranged from 105°F to 112°F at Louisville IE station. The station record high temperature for the Midville Experiment Station (i.e., 105°F) has been reached on four separate occasions. Individual station extreme maximum temperature records were set at multiple locations on the same or adjacent dates. The similarity of the respective extremes indicates that these statistics are reasonably representative of the temperature extremes that might be expected to be observed at the VEGP site. Application, Part 3, Section 2.7.4.1.1. An ITD of 35° at these ambient temperatures would force steam saturation temperatures for a standard AP1000 above the minimum of 133.5°, and consequently backpressures would far exceed the maximum of 5 ”HgA in the high pressure shell. Cuchens Affidavit at p. 11. The minimum ITD is a material limitation on the technical feasibility of an ACC system in conjunction with the AP1000 steam turbine, especially when the peak ambient temperatures in the vicinity of Plant Vogtle are taken into account. Cuchens Affidavit, Exhibit 1 at p. 10-12.

14. On hot days, water tends to stay cooler than the surrounding air. Unlike wet bulb temperature, the driving force behind a wet cooling system, which remains much more constant over a day, the dry air temperature at the VEGP site can vary up to 20-30 degrees over

the course of the same day. Such fluctuations in temperature translate into 20°-30° swings in the ITD. This kind of instability would harm the operation of the power plant and create reliability difficulties for the electric grid as a whole. Cuchens Affidavit, Exhibit 1 at p. 19.

15. No one has ever built a triple pressure turbine that could operate continuously at pressures higher than 5 ”HgA. Even if a non-standard turbine were designed to operate at high backpressures necessary for utilization of an air-cooled condenser, significant inefficiencies, loss of standardization, adverse environmental consequences and prohibitive increases in cost would result. Cuchens Affidavit, Exhibit 1 at pp. 10-13.

16. Any increase in backpressure below the trip point for the current turbine would result in a substantial reduction in electrical output. For example, assuming an *average* turbine backpressure of 4 ”HgA could be achieved using an ACC in conjunction with the standard AP1000 turbine, which as noted above could not be achieved during the periods of the year in which the unit was needed most, the result would be a loss of around 40 MW out of the generator as compared to operation at the current design backpressure of 2.92 ”HgA. Cuchens Affidavit, Exhibit 1 at pp. 10-12. In addition, increased station service requirements for an air-cooled system would decrease net output by another approximately 41 MW and steam duct losses of approximately 37 MW. Cuchens Affidavit, Exhibit 1 at pp. 11, 14. Thus, the minimum reduction in net output per unit would amount to approximately 118 MW. Georgia Power Company and the other utility-owners of Vogtle 3 and 4, would need to obtain other generating resources to make up the shortfall. Cuchens Affidavit, Exhibit 1 at pp. 15-16.

17. Designing a dry cooling system to match the AP1000 steam surface condenser performance is purely academic, since no such system exists and the lack of any experience with a multi-pressure turbine suggests caution in assuming viability of concept. To

approximate backpressure low enough to permit efficient operation of the turbine the ACC would need to operate at an ITD of less than 20ºF, i.e. more than 40% less than the minimum ITD using current technology. Cuchens Affidavit, Exhibit 1 at pp. 12-13.

18. The closed-cycle wet cooling system described in the AP1000 approved design, and included as the basis for SNC's application for an ESP, capitalizes on the cooling properties of the water to cause evaporation, something the dry system cannot do. Due to this degradation in efficiency, an air-cooled system must be significantly larger than a comparable wet system to maintain the same unit performance. Cuchens Affidavit, Exhibit 1 at p. 12-18.

19. Assuming the limits of current technology of dry cooling could be improved to the point that an ACC could operate at an ITD of 20ºF in order to deliver appropriate backpressures to the turbine, the VEGP site would necessitate construction of approximately 334 modules linked with large ducts and would require SNC to clear an additional area equivalent to seven football fields, or more than half a linear mile, by 300 feet for each additional VEGP unit. Cuchens Affidavit, Exhibit 1 at pp. 12-20. The additional construction and land use would harm the environment, such as by necessitating filling existing bodies of water on or on the border of the site. Such adverse environmental impacts would include the grubbing and clearing of several wooded areas, excavation impacts, and adverse impacts to Mallard Pond, a natural area within the site. Application, Part 3, Section 2.3.1.1; Affidavit of Thomas C. Moorer.

20. Specifically, installation of a dry cooling system to an AP1000 would require substantial changes to the AP1000 standard turbine building design. In place of the current steam surface condenser, three large ducts would have to be constructed beneath the turbine. These ducts would then have to be run through the walls of the turbine building and outside to

a distance a minimum of 100 feet away prior to routing the ducts to individual sections of the dry cooling system up to 2000 feet away. This would necessitate changes to the wall of the turbine building and potentially the turbine pedestal. It could also cause layout changes to other equipment in order to provide a path for the steam ducts. Cuchens Affidavit, Exhibit 1 at pp. 12-18.

21. Another change that an ACC would certainly necessitate is to relocate the feed-water heaters that are currently designed to be placed in the neck of the steam surface condenser. Since there would no longer be an exhaust hood in the steam surface condenser in which to mount them, the heaters would have to be moved to a different location within the turbine building. The changes would also represent significant further deviation from the standardization of the AP1000 design. Cuchens Affidavit, Exhibit 1 at p. 19.

22. The cost of constructing approximately 334 modules alone is estimated to be an additional $361 million for each nuclear unit over the cost of the standard closed cycle wet cooling system for the AP1000. Cuchens Affidavit, Exhibit 1 at p. 14

23. The cost of a dry cooling system is estimated to be approximately five times greater than that of the closed-cycle wet system SNC proposed in its ESP. Cuchens Affidavit, Exhibit 1 at pp. 19-20 and Appendix. This cost comparison does not take into account the additional costs arising out of changes to the re-design of the turbine building and powerhouse and of the equipment, such as condensate storage tanks, air removal systems and piping. Neither does this estimate calculate the costs of the 16-20 foot (or more) wide ducts, which no one has ever designed for turbines as large as those necessary for the AP1000. Cuchens Affidavit, Exhibit 1 at pp. 19-20 and Appendix.

24. The Draft Environmental Impact Statement ("DEIS") analyzes a dry cooling system as an alternative cooling method for Vogtle 3 and 4. The DEIS concluded that a dry cooling system, larger in size than the proposed wet cooling system, would occupy more land, affecting land use and increasing terrestrial impacts of the plant. DEIS at 9-26.

25. The DEIS concluded that a dry cooling system at VEGP would have greater environmental impacts, because the cooling fans would create more noise pollution, and the dry cooling system would consume more electricity. The DEIS concludes that "based on the environmental impacts related with increased land use, fuel use, spent fuel transport, spent fuel storage, and the small impact that the proposed natural draft wet-cooling tower would have on the site environment and the Savannah River, the Staff concludes that a wet cooling tower system is preferable to either a dry or hybrid wet/dry cooling system for VEGP Units 3 and 4. *Id.*

26. The need for more electricity would create more spent fuel to transport and to store. *Id*.

27. The DEIS concluded that the additional expenses associated with a dry cooling system would make it significantly less cost effective than the wet system. DEIS at 9-25.

Respectfully submitted,

(Original signed by M. Stanford Blanton)

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Dated this 17th day of October, 2007

ATOMIC SAFETY AND LICENSING BOARD

Before the Licensing Board:

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CERTIFICATE OF SERVICE

I hereby certify that copies of SOUTHERN NUCLEAR OPERATING COMPANY'S STATEMENT OF UNDISPUTED FACTS IN SUPPORT OF APPLICANT'S MOTION FOR SUMMARY DISPOSITION ON INTERVENORS' CONTENTION EC 1.3 in the above captioned proceeding have been served by electronic mail as shown below, this 17th day of October 2007, and/or by e-submittal.

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