UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-424-OLA-3
GEORGIA POWER COMPANY, *et al.*	)	50-425-OLA-3
	)	
(Vogtle Electric Generating Plant	)	Re: Licensee Amendment
Units 1 and 2)	)	(Transfer to Southern
	)	Nuclear)

TESTIMONY OF EDWARD B. TOMLINSON AND PIERCE H. SKINNER ON DIESEL GENERATOR AIR QUALITY

Q1. Would you each please state your name, job title, employment affiliation, and professional qualifications?

ANSWER

My name is Edward B. Tomlinson. I am employed by the U.S. Nuclear Regulatory Commission (NRC) as a Senior Reactor Engineer in the Office of Nuclear Reactor Regulation. My education and professional qualifications are summarized in Attachment A.

My name is Pierce H. Skinner. I am employed by Region II of the NRC as the Chief of Reactor Projects, Section 3B. My education and professional qualifications are summarized in Attachment B.

Q2. What is the purpose of your testimony?

ANSWER

The purpose of this testimony is (1) to present the NRC Staff's position with respect to Intervenor's allegation that exceeding dew point criteria could lead to the formation of moisture in the Diesel Generator (DG) pneumatic lines and that this moisture prevented

DG 1A from performing its function during the March 20, 1990 Site Area Emergency (SAE), and (2) to address questions concerning Intervenor's air quality concern that have arisen during the testimony of Intervenor and Georgia Power Company (GPC) witnesses during this hearing. This testimony supersedes the previous "Testimony of Pierce Skinner on the Air Quality Allegation," which was prefiled on April 4, 1995, prior to the Memorandum and Order (Summary Disposition; Air Quality), dated April 27, 1995. Questions related to the completeness and accuracy of communications to the NRC will be addressed by the NRC panel testimony of Messrs. Matthews, Skinner, and Hood.

Q3. Are you familiar with the DG starting air system at Vogtle?

<u>ANSWER</u>

(Tomlinson) Yes. On August 25, 1995, I visited the Vogtle facility and reviewed of the DG starting air system, including inspection of the pneumatics in the DG control panel. Subsequently, I reviewed the following documentation in order to understand the design and operation of the DG pneumatic control system: Dwg. 09-835-76021; Dwg. 09-695-76021; Dwg. 09-500-76021, sheet 1; and a system function narrative in the Transamerica Deleval Instruction Manual for the Vogtle diesel generators. In addition to the above, I read the following information related to the air quality issue: Vogtle Final Safety Analysis Report (FSAR) § 9.5.6 (Board Ex. 3) and § 9.4.7; Intervenor Exs. II-11 (ISA Standard) and II-169 (Demonstrative Aid #4); SER § 9.5.6 (Board Ex. 4) and § 9.4.5; Appendix J of NUREG-1410, Loss of Vital AC Power and the Residual Heat Removal System During Mid-Loop Operations at Vogtle Unit 1 on March 20, 1990, dated June 1990 (GPC Ex. II-167); the Mosbaugh prefiled testimony (revised) (ff.

Tr. 8263); the OwYoung and Johnston prefiled testimony, dated August 21, 1995 (ff. Tr. 12428); and the Hill and Ward prefiled testimony, dated August 21, 1995. I also heard the testimony by Messrs. OwYoung and Johnston in Augusta, Georgia, and the testimony of Messrs. Stokes and Chenault in Rockville, Maryland.

(Skinner) Yes. In my present position with Region II, I have made numerous visits to the Vogtle facility. I am familiar with the DG starting air system, including the pneumatic control system. I have also read the testimony and exhibits in this proceeding, and I have reviewed the technical data and schematic drawings associated with this system identified by Mr. Tomlinson, above. I have also been present during the testimony of Intervenor and GPC related to air quality issues.

Q4. What NRC requirements, guidance, or recommendations apply to the DG starting air system, and has Staff previously found Vogtle to be in compliance?

ANSWER (Tomlinson)

General requirements applicable to the DG starting air system are contained in 10 C.F.R. Part 50, Appendix A, General Design Criteria for Nuclear Power Plants (GDC), Criteria 1, 2, 4, 5, and 17. Specific guidance concerning NRC review of this system is contained in Section 9.5.6 of NUREG-0800, Standard Review Plan (SRP). The SRP addresses conformance with NUREG/CR-0660, Enhancement of Onsite Emergency Diesel Generator Reliability, which includes specific recommendations regarding the use of air dryers.

The results of NRC's review of Vogtle's DG starting air system was provided in Safety Evaluation Report (SER), NUREG-1137, Section 9.5.6 (Board Exhibit II-4), dated

June 1985. The NRC concluded that the DG starting air system meets design requirements of GDC 1, 2, 4, 5 and 17, and the recommendations of NUREG/CR-0660.

NUREG/CR-0660 at page V-4, includes a recommendation that refrigerant type air dryers should be used in a DG starting air system to reduce moisture. The Vogtle facility conforms with this recommendation. As a practical matter, the NRC acknowledges in Appendix E of NUREG/CR-0660 that standard refrigerant driers cannot produce dew points lower than 35°F. The refrigerant dryers at Vogtle are factory set at a 35°F dew point.

SRP § 9.5.6, II.4.j, states that the starting air dew point should be maintained at least 10°F below the lowest expected ambient temperature of the DG room. Section 9.4.7 of the FSAR describes the DG building ventilation system. This system is designed to maintain the building temperature between 120°F and 50°F. The lowest expected ambient temperature of the DG room is 60°F. Heaters in the DG building are set to energize if temperature decreases to 60°F. Thus, to be consistent with SRP § 9.5.6, II.4.j, guidance that starting air dew point should be controlled to at least 10°F less than the lowest expected ambient temperature of the DG room, the starting air dew point at Vogtle should generally be 50°F or lower. FSAR Table 9.5.6-1, identifies that the dew point of air leaving the dryer is 50°F (Board Ex. 3). This is adequate for the DG control air system, and meets SRP guidance.

In NUREG-1410, Section 3.2.2, the NRC found that Vogtle has maintained its facility consistent with this guidance by stating, in part, that:

> The dew point [of the starting and control air system for the Emergency Diesel Generators (EDGs)] has generally been kept at close to 40 °F. The dryers on occasion have been out of service for short periods: however, no evidence has been found of significant moisture or its effects in the instrument air lines or sensors. The 5-micron filter has always been clean when replaced; no significant amount of contaminants have been found in the instrument air system.

Q5. What is Staff's position with respect to Mr. Mosbaugh's statement on pages 17-19 of his prefiled testimony that GPC committed to ANSI/ISA S7.3-1975 in the FSAR and in the GPC response to Generic Letter (GL) 88-14 (Intervenor Ex. II-13).

ANSWER

Mr. Mosbaugh's interpretation differs from that of the Staff. The Staff understood GPC's commitment in Intervenor Ex. II-13 to ANSI/ISA S7.3-1975 to be with respect to the compressed air system, not with the DG air start system. The compressed air system (sometimes referred to as the instrument air system) has no safety basis and is the system that provides air to service air outlets located throughout the facility and for pneumatic devices used in maintenance and other activities (see FSAR 9.3.1). FSAR § 9.5.6 does not contain a commitment to Regulatory Guide (RG) 1.68.3, Preoperational Testing of Instrument and Control Air Systems (Staff Ex. II-3), which address guidance for compressed air systems. The recommendations of this RG are not directed to the DG air start system.

GPC responded to GL 88-14 (Staff Ex. II-68) in correspondence to the NRC, dated January 16, 1989, and February 17, 1989. While these responses include a discussion of DG air start system, GPC indicated that qualitative air requirements were not specified by the Transamerica Delaval Owners Group. GPC did state that the maximum dew point acceptance criteria for the DG air start system had been established at 50°F at system pressure by FSAR Table 9.5.6-1. GPC did not commit to the cited ISA standard with respect to the DG starting air system.

Q6. What are the potential adverse consequences of inadequate dew point control at Vogtle?

ANSWER (Tomlinson)

Inadequate or no dew point control could have two possible consequences. The first could be very humid air (i.e., at or near saturation) in the DG air start system. This could result in corrosion of ferrous metal system components, but is unlikely to have any adverse impact on the operation of the pneumatic control system. This is because all portions of the pneumatic control system would see the same quality air and, at worst, all pneumatic control functions might slow down. In my opinion, however, this is highly unlikely.

The second adverse consequence could be formation of free water in the starting air receivers. In the unlikely event that this happens, and assuming that blowdowns were never performed on the air receivers, it is theoretically possible that water could accumulate until the level reached the discharge line from the air receiver to the air start system (approximately at the 8 ft. elevation in the receiver). This scenario is unlikely given that it would require over 1000 gallons of accumulated water before it could spill into the starting air piping. The free water would then have to fill approximately 160 feet of 3-inch inside diameter steel piping before free water would enter the control air tubing.

A subset of this second consequence could be formation of free water in the pneumatic trip lines from condensation of water vapor. Should this happen, the time required to pressurize the trip lines on a DG start would decrease because the free water would effectively reduce the volume of the trip lines. A decrease in the time required to pressurize the trip lines would not have an adverse impact on the pneumatic logic functions on a DG start. The presence of free water in the trip lines could, however, increase the time to trip the DG in response to an out-of-tolerance monitored DG parameter. When a Calcon sensor trips, it becomes a small orifice for venting of air. Since the trip signal is provided by a venting of air through the sensor, it would take longer to vent an air-water mixture or a water volume through the orifice. In my opinion, there would be no impact on the pneumatic logic functions because free water will not get into this logic circuitry, except if, as discussed above, the entire starting air system were to be flooded.

For water to flood the entire air system, water would have to fill the receiver, pass through two strainer elements in each of the 3-inch lines, and fill this 3-inch piping up to the level of the top of the DG. It would then fill the two supply lines that run horizontally and vertically along the side of the DG, pass through a trench and up into the bottom of the instrumentation cabinet before entering the pneumatic portion of the system. The water would then have to pass through the 5-micron filter in the cabinet, through the reducer (250-60 psig), into the vertical portion of the control cabinet and up approximately 6 feet to fill the pneumatic logic boards. It would then be directed into the numerous sensing lines in the bottom of the cabinet. Finally, it would fill each of the various 50 linear-foot (approximately) sensing lines back up to the DG in numerous locations on the DG. Flooding the entire system or the selective routing of water is not considered credible by the Staff.

Q7. Is accumulation of free water likely to occur in Vogtle's DG air system?

ANSWER (Tomlinson)

No. Maintaining a starting air dew point in accordance with the SRP ($\leq$ 50°F) provides assurance that free water will not accumulate in the air receivers. Maintaining a dew point in accordance with the SRP will also ensure that the air in the pneumatic control system will always be substantially above this dew point. This is due to the fact that the Vogtle starting air is at 250 psig. Before this air reaches the pneumatic control system, the pressure is reduced to 60 psig. This pressure reduction significantly reduces the air's dew point. Because of this, the dew point in the starting air system could be 50°F or even higher without causing a moisture problem in the control air system.

Q8. If free water had accumulated in Vogtle's DG air system in March 1990, would that have caused the DG malfunctions which occurred on March 20?

ANSWER (Tomlinson)

No. Based on my knowledge of the DG starting air system configuration and the DG pneumatic control system configuration and location, I find it unlikely that free water in sufficient quantities to cause the alleged malfunctions was present in the pneumatic control system in March 1990 or at any other time. Even had such water been present, it would have to have been selectively deposited in specific pneumatic lines (i.e., two high jacket water temperature sensing lines), and not in the .006 orifice timer in the trip arming circuit, for it to have caused the two DG trips that occurred on March 20. The physical properties of water, combined with the system configurations, make the chance of such selective deposition remote. Absent this selective deposition of water, the 70 and 80 second delays observed on the two failed DG starts on March 20 would have been greater. Accordingly, I do not believe that the water in the DG air start system caused the DG malfunctions of March 20.

Q9. What is the Staff's position with respect to the allegation that low temperatures at the Vogtle site during the March 1990 time frame contributed to moisture condensing in the DG instrument lines and thereby causing the formation of water in these lines?

ANSWER (Skinner)

The Staff concludes that the allegation has not been substantiated. The relevant concern is the temperature inside the DG building. As noted in the FSAR § 9.4.7, the DG building ventilation system is designed to maintain the building temperature between 120°F and 50°F. Ten unit heaters in the DG building are set to energize if temperature decreases to 60°F. If a temperature of 50°F occurs in the DG room, an alarm occurs in the control room and actions are taken to correct the low temperature condition. In addition, the cabinet which houses the pneumatic logic boards and numerous pneumatic lines is maintained at a temperature of approximately 90°F by internal heating elements. There is no indication that the temperature inside the DG building has been maintained inconsistent with these parameters. Thus, it is unlikely that the alleged condensation would have occurred under these conditions.

Q10. What has the Staff done to determine the validity of Mr. Mosbaugh's allegations that moisture has formed in the DG starting air system?

ANSWER

The Staff reviewed the issue of water in the pneumatic control system as part of an allegation review effort. In Board Notification 95-08, dated April 14, 1995, the Staff transmitted enclosure 2 (Memo, C. A. Casto to Bruno Uryc, dated June 20, 1994)(Staff Exhibit II-5) which addressed allegations related to air quality that were raised by Intervenor. An inspection was conducted between May 9-20, 1994, as documented in Inspection Report (IR) Nos. 50-424,425/94-12, dated June 9, 1994 (Staff Exhibit II-10) (i.e., possible water in the pneumatic control system). The Staff found the following:

1. In Staff Exhibit II-5, the Staff documented a technical review of Mr. Mosbaugh's allegation that causes other than those specified by GPC in its communication with the NRC caused the 1A DG failure during the SAE. The Staff did an extensive review of work documentation related to the 1990 failures, equipment histories for the DGs and related equipment, an evaluation to determine the impact of water contamination on the system function, and an evaluation of the potential of introducing water into the lines. The Staff found that the pneumatic system does not function in the manner described in the allegation and concluded that condensation in the supply air in the control cabinets did not occur. Interviews were held with three instrumentation technicians, one plant equipment operator and two engineers that had been involved in DG maintenance in 1990. None of these personnel recalled evidence of water in the air lines. In addition, a review of the

maintenance documentation, specifically the work orders associated with the troubleshooting activity in 1990, did not identify evidence of water in the pneumatic lines.

2. The Staff also determined that if water was inside the control modules and pneumatic lines, there would be corrosion or other indications caused by the water contamination. Review of documentation did not identify corrosion or other indications of water having been present in these components.

3. The Staff reviewed dew point documentation and identified numerous examples of out-of-specification dew points. The Staff found no evidence of actual water formation in the lines.

The Staff has further determined that the air pressure at the DG during a start is only present for a brief period (5 seconds or less) during the start. At all other times, the air start system at the DG is depressurized. During a DG start cycle, the system is pressurized to approximately 250 psig with air from the starting air system until the DG reaches approximately 260 rpm or for 5 seconds, whichever occurs first. At this point, starting air pressure at the DG is isolated, and the pressure in this portion of the system drops to 0 psig. If an assumption is made that the starting air is at 250 psig and 85°F dew point when the DG is started, the air pressure reduction to 0 psig would result in a dew point considerably below 50°F. Consequently, any free water that may have been deposited in the DG air start piping during the start cycle will quickly vaporize in a 50°F room environment. In addition, a large portion of the air start piping is located on or adjacent to the DG, which is generally maintained at greater than 150°F. The elevated temperature of the DG, and attendant pressure drop in the air start piping provide additional assurance that any free water that may have accumulated during the start cycle in this piping will quickly vaporize.

For the above reasons, the potential for the presence of free water in the air start or pneumatic control system, even under the extreme conditions assumed above, is considered to be minimal. Absent free water, there is no potential for the type of component degradation and attendant DG failure alleged by Mr. Mosbaugh. Therefore, the Staff concludes that there is no basis to the allegation that moisture in the pneumatic lines to the DG 1A sensors was the cause of the DG not performing its function on March 20, 1990.

Q11. What is the significance of out-of-specification dew point readings identified by Mr. Mosbaugh on Intervenor Exhibit II-169?

ANSWER

The out-of-specification dew point readings on Intervenor Exhibit II-169 do not appear to be significant to safety. During the six months preceding the SAE on March 20, 1990, there was only one out-of-specification reading on DG 1A and one on DG 2A air receivers. In addition, GPC's practice was to perform daily blowdowns on the air receivers which would remove any accumulated moisture if present in the receivers. There were no failures of any DG during this time attributed to moisture problems. Inspections were conducted of the air filters and the interior of one DG 1A receiver, and the out-of-specification dew point conditions were corrected. The NRC Resident Inspection Staff has subsequently observed that when an out-of-specification dew point is identified, the associated receiver is normally isolated and removed from service to minimize the potential for the introduction of moisture into the system until the out-of-specification condition is corrected. Given the corrective actions taken and the absence of corrosion, the high dew point readings do not appear significant.

Q12. The Calcon vendor's brochure (Board Ex. 1) for temperature sensors specifies the use of clean dry air. What does the NRC understand "clean dry air" to mean?

ANSWER (Tomlinson)

Absent specific manufacturers requirements, the Staff would interpret the term "clean dry air" to mean air that has been compressed and subsequently dried sufficiently to produce a dew point at least 10°F lower than the lowest anticipated temperature to which the compressed air system will be exposed, consistent with SRP § 9.5.6. The NRC would expect a licensee to meet SRP guidance or the manufacturer's specific requirements for filtering and dew point. The use of a 25 micron filter would be advisable as it would filter material greater than .001 inch. This would normally be acceptable to protect most pneumatic devices from particulate contamination..

Q13. What is the Staff's position with respect to the cause of the air admission valve problem (e.g., weak air rolls) that was identified at Vogtle in July 1990?

ANSWER (Skinner)

The Staff finds that it is reasonable to conclude that this problem was caused by a combination of root cause conditions, i.e., a close tolerance design fit between the piston and cap and possible bore distortion occurring when the cap is tightened to the valve body and cylinder head. This conclusion is consistent with Energy Services Group correspondence to NRC dated July 19, 1990, as identified by the 10 C.F.R Part 21 notification #154 (GPC Exhibit II-166, OwYoung and Johnson Ex. C).

Q.14. What is your overall conclusion with respect to Intervenor's allegation concerning the role of air quality in the March 20, 1990 event?

ANSWER

The Staff has found no evidence that moisture (free water) was in the pnuematic lines at the time of the SAE in March, 1990 and, therefore, does not believe that it caused that event. This conclusion is based on the Staff's knowledge of compressed air characteristics, the configuration of the DG starting air system, and the DG pnuematic control system configuration and location. As discussed above, the Staff does not believe that free water could accumulate in quantities sufficient to cause malfunctions in the pneumatic control system, particularly since the water would have to selectively enter specific pneumatic lines and not enter other parts of the control system in order to cause the March 20 failures. Thus, the Staff does not find that Intervenor has offered a credible scenario for the March 20 event.

Edward B. Tomlinson

U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Education:	Graduated from U.S. Merchant Marine Academy Bachelor of Science U.S. Coast Guard Marine Engineer License, Steam & Diesel

Experience:

1981 - Present	U.S. N.R.C. - Office of Nuclear Reactor Regulation Various positions as Reactor Engineer and Senior Reactor Engineer. Principal focus during this time was Emergency Diesel Generators and related matters. Responsibilities included investigation and resolution of diesel generator issues at operating nuclear facilities. Specific examples include 1.) member of TDI Task Force which was responsible for establishing the acceptability of TDI diesel generators for nuclear service, 2.) onsite investigation of catastrophic DG failures at South Texas and Fermi, 3.) participation in numerous special DG inspections, 4.) conduct of DRQR reviews for plants with TDI DGs, and 5.) relaxation of license conditions at plants with TDI DGs. Also, responsible for conducting licensing reviews of diesel generators and support systems for new plants, and license amendments involving diesel generators and related systems at operating plants. Current responsibilities include development and implementation of Improved Standard Technical Specifications relating to offsite and onsite (OG) electrical power systems. Member of ANS 59.5 Working Group responsible for development of standards for diesel generator supporting systems including fuel oil, lubricating oil, combustion air, and starting air. Also, regularly represent the NRC staff at DG Owners Group meetings.
1977 - 1981	National Oceanic & Atmospheric Administration Marine engineer with National Ocean Survey. Responsibilities included developmental preventive maintenance programs for main propulsion and auxiliary diesel engines, investigation of diesel engine problems, and selection of replacement diesel engines for main propulsion and auxiliary service.
1975 - 1981	USNRC - Office of Nuclear Reactor Regulation Reactor systems engineer responsible for licensing review of plant systems, including diesel generator support systems.

1970 - 1975 Northrop Services, Inc.
Provided support to U.S. Navy for developing interfaces between the numerous systems required in support of Deep Submergence Rescue Vehicle mother ships. Interfaces included power, life support, and vehicle retrieval systems.

1968 - 1970 International Business Machines, Inc.
Responsible for design, installation, and operation of a diesel generator power plant to support classified government operations.

1962 - 1968 American Telephone & Telegraph Co.
Responsible for design, installation, and initial operation of mechanical and electrical systems in new telecommunications buildings. Systems included automatic emergency diesel generator systems. Responsible for converting an existing diesel generator system with 3 busses to a two bus system with the third DG as an automatic spare for the other two.

1960 - 1962 Military Sea Transport Service
Shipboard engineer responsible for operation of ships main propulsion and auxiliary equipment, including compressed air systems.

Pierce H. Skinner

U.S. Nuclear Regulatory Commission
Atlanta, Georgia 30323

Education:	Robert E. High School, Montgomery, Alabama Various Military and Civilian Technical Courses
Experience:	
1991 - Present	Section Chief, Division of Reactor Projects Responsible for the oversight of Georgia Power Company's Nuclear Facilities: Hatch and Vogtle
1987 - 1991	Senior Resident Inspector, Oconee Nuclear Station Responsible for the NRC inspection program at this three unit nuclear facility
1983 - 1987	Senior Resident Inspector, Catawba Nuclear Station Responsible for the NRC inspection program during preoperational testing and initial startup of this two unit nuclear facility.
1980 - 1983	Operations Inspector, Region II Performed inspections as directed by Regional Management
1977 - 1980	Startup Supervisor, Mississippi Power & Light Co. Responsible for establishing the startup test program for Grand Gulf Nuclear Station
1968 - 1977	Chief/Shift Nuclear Test Engineer Responsible for nuclear submarine propulsion plant testing on overhauled nuclear submarines in a private shipyard.
1959 - 1967	U. S. Navy Qualified Reactor Operator/Technician on an operating submarine and EOOW watchstander and instructor at a U. S. Navy prototype, also served as an Atomic Energy Commission representative on the oversight staff at the prototype