UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Doc. Nos. 50-338 SP
VIRGINIA ELECTRIC AND POWER COMPANY	)	50-339 SP
	)	
(North Anna Power Station,	)	(Proposed Amendment to
Units 1 and 2)	)	Operating License NPF-4)

VEPCO'S ANSWERS TO POTOMAC ALLIANCE INTERROGATORIES

These are the answers of Virginia Electric and Power Company (Vepco) to the interrogatories served by intervenor Potomac Alliance on June 1, 1979.

The introductory portion of the Potomac Alliance's interrogatories asked Vepco to follow a particular format in answering the questions. Except for Part C of that format, to which Vepco objects (see Vepco's statement of objections), Vepco has provided the requested information but not in the specified format.

Where Vepco has relied upon documents in responding to these interrogatories, these documents are identified in the text of the answer. For the most part, however, Vepco has relied upon the Final Safety Analysis Report (FSAR) for North Anna Units 1 and 2, the Preliminary Safety Analysis Report (PSAR) for North Anna Units 3 and 4, the "Summary of Proposed Modifications to the Spent Fuel Storage Pool Associated with

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Increasing Storage Capacity for North Anna Power Station Unit Nos. 1 and 2," as amended ("Vepco's Application" or the "Application"), and other documents that are readily available to the Potomac Alliance in the NRC's Public Document Room. Vepco is also providing the Potomac Alliance with some additional documents, which are attached.

The Potomac Alliance has asked whether Vepco has engaged or intends to engage in further research that may affect the answers to these interrogatories. The only such research is that involved in the preparation of Vepco's written testimony, which should be filed in the next few days. To the extent this research may affect any of the answers presented below, Vepco will comply with 10 C.F.R. § 2.740(e).

Vepco's proposed witnesses for this proceeding are identified in the answer Vepco has filed to the interrogatories served on Vepco by the Citizen's Energy Forum, Inc. (CEF); this document also identifies the areas of expertise of each of these gentlemen. Since Vepco proposes to have these witnesses appear as a panel, there is no need to specify the particular witness who will answer questions on the subject matter of individual questions raised by these interrogatories.

Vepco objects to the following interrogatories posed by the Potomac Alliance: nos. 21, 44, 45, 46 and 47. As discussed in Vepco's statement of objections, these objections are, in large part, based on the fact that the interrogatories

431 280

or requests for documents are overly broad and call for Vepco to identify or produce documents that are not relevant to the contested issues in this proceeding. If requested by the Potomac Alliance, Vepco will, however, do its best to provide the Potomac Alliance with any specific documents that are responsive to the Alliance's interrogatories and relevant to the contested issues; alternatively, Vepco will arrange to have such documents made available for inspection at Vepco's offices in Richmond, Virginia. Vepco hopes that such additional discovery can be handled on an informal basis.

VEPCO'S ANSWERS

1. Provide sketches, including plans, which show the spent fuel pool (SFP) for Units 3 and 4 in relation to the surrounding structures, including Units 1 and 2. Describe the storage capacity of the SFP for Units 3 and 4 and its potential for compaction. Identify and describe all differences, in terms of both physical design and operating procedures, between the SFP for Units 3 and 4 and the SFP for Units 1 and 2.

Answer to Question 1:

The fuel building for Units 3 and 4 has not yet been constructed (see answer to Question 2(a)). The planned location of this building in relation to other structures can be seen in the North Anna Units 3 and 4 PSAR, figure 2.4-1, and the Units 1 and 2 FSAR, figure 1.2-1. The Units 3 and 4 PSAR reports a spent fuel storage capacity of 425 fuel assemblies (section 9.12.3.2). Vepco is considering the use of high-density spent fuel racks in the Units 3 and 4 spent fuel pool. Although such racks have not yet been designed, Vepco believes 1323 fuel assemblies can be accommodated.

The design of the Units 3 and 4 fuel building has not been completed; it will be similar, but not identical, to the fuel building serving Units 1 and 2. Operating procedures for the Units 3 and 4 fuel building have also not been completed. Thus, the physical design and operating procedures for the two spent fuel pools cannot be compared.

431 242

2(a). Describe the extent to which the construction of the SFP for Units 3 and 4 is completed in terms of both economic investment and physical completion.

(b). Estimate the cost of completing construction of the SFP for Units 3 and 4.

(c). Assuming that maximum possible commitment of resources is devoted to completion of the SFP at Units 3 and 4 and related essential components, what is the earliest date at which the pool could be rendered fit for storage of spent fuel?

Answer to Question 2:

(a). Only the excavation is complete for the North Anna Units 3 and 4 fuel building. Vepco's records do not distinguish the cost of excavation of the fuel building from other excavation associated with Units 3 and 4.

(b). The interaction between the fuel building and other buildings and systems makes it impossible to estimate the cost of completing construction for the SFP by itself.

(c). Vepco does not know. The related components include component cooling system, service water system, backup diesel generators, the control room and, of course, the buildings in which these systems will be installed. Construction of all systems in these areas must be completed before the spent fuel pool is used. In any event the SFP for Units 3 and 4 cannot be used prior to the issuance of a license for those units.

435 243

3. Identify any physical barriers which may prevent transfer of spent fuel between the SFP for Units 3 and 4 and the SFP for Units 1 and 2.

Answer to Question 3:

There are no physical barriers that would prevent transfer of spent fuel between the SFP for Units 3 and 4 and the SFP for Units 1 and 2.

4(a). Have you considered and analyzed the possibility of expanding the physical area of the existing SFP as an alternative to the proposed modification?

(b). If so, describe such analysis and any documents referring to this alternative.

<u>Answer to Question 4</u>:

(a). Yes.

(b). This analysis is described on page 10 of Vepco's Application. This alternative is so obviously inferior to the proposed modification that further analysis is not necessary.

431 245

5(a). Have you considered and analyzed the possibility of constructing a separate spent fuel storage pool on-site as an alternative to the proposed modification?

(b). If so, describe such analysis and any documents referring to this alternative.

Answer to Question 5:

(a). Yes.

(b). Additional storage capacity could be made available by building a new storage pool, either onsite or offsite. In mid-1977 Vepco contracted with the Nuclear Audit and Testing Company, Inc. (NATCO) to review alternative methods and costs of interim storage for Vepco spent nuclear fuel. As a part of this study, NATCO addressed the possibility of the construction of new spent fuel storage pools. The results of NATCO's study of this alternative are summarized on page 9 of Vepco's Application (section 4.5).

431 246

6(a). Have you considered and analyzed the possibility of using the SFP at Units 3 and 4 for storage of spent fuel from Units 1 and 2?

(b). If so, describe such analysis and any documents referring to this alternative.

Answer to Question 6:

(a). Yes.

(b). This analysis is summarized on page 10A of Vepco's Application. We are also attaching an internal memorandum from Sam C. Brown to W. N. Thomas, dated January 9, 1978, that discusses this alternative.

431 249

7(a). Assuming that the proposed operating license amendment is not granted, when, according to your projections, will:

(1) the first defueling of Unit 1 occur;

(2) Unit 2 begin commercial operations;

(3) the SFP be filled to capacity, less a reserve for one full core discharge;

(4) the SFP be filled completely?

(b). Describe fully the basis for the above projections, including any assumption made regarding the number of months between refuelings, the number of fuel assemblies discharged per refueling, and whether the cask loading area will be used for fuel storage.

Answer to Question 7:

(a)(1). The first refueling of Unit 1 should occur sometime after September 15, 1979.

(2). Vepco does not know. This Unit should be ready for fuel loading by the end of June 1979; of course this date is subject to change due to construction delays, licensing delay, unanticipated start-up difficulties, etc.

(3). After the Unit 1 refueling currently planned for September 1981, it is projected that 206 spent fuel assemblies will be permanently discharged into the North Anna spent fuel pool. At that time the pool would be filled to capacity, less a reserve for one full core discharge (157

431 248

assemblies), since complete normal refueling discharge of 52 assemblies could no longer be accommodated.

(4). After The Unit 2 refueling currently planned for November 1982, it is projected that 364 assemblies will be permanently discharged into the SFP. Vepco would then be unable to conduct a normal refueling of either Unit 1 or Unit 2 during 1983 because a discharge of 52 assemblies from either unit would exceed presently authorized storage capacity of the pool.

(b). The above projections are based on Vepco's current operational schedules and fuel management scheme. It is assumed that each unit will be refueled every twelve months. The first three refuelings for each unit will necessitate permanent discharge of 50, 53 and 53 spent fuel assemblies, respectively. After that each refueling will involve the permanent discharge of 52 additional spent fuel assemblies.

The placement of a spent fuel storage rack in the cask loading area is not considered operationally feasible, because once all other racks are filled and spent fuel is placed in this particular rack, no shipments of spent fuel could be made from the plant, no interchange of racks could be made, and no refuelings could take place.

The answers to Questions 7(a) and 7(b) were based in part on NFE Technical Report No. 85, Fuel Management Scheme 15, H. H. Barker and M. C. Cheok, Nuclear Fuel Engineering, Fuel

 431 249

Resources Department, Vepco, March 1979.

431 250

8(a). Assume that the proposed license amendment is not granted, and that the SFP reaches capacity. Will you have any alternative other than to shut down the plant? If so, describe such alternatives. If not, why not?

(b). Describe the environmental, health, and safety implications of each alternative identified in response to (a), and the financial cost of each.

Answer to Question 8:

(a). Assuming that the proposed amendment is not granted and that the spent fuel pool is filled to capacity, Vepco would have no other alternative than to shut Units 1 and 2 down at the time of the next required refueling. This is explained in Vepco's answer to Question 7(a)(4).

(b). Not applicable.

9(a). To your knowledge, is any private corporation or consulting group presently preparing a study on the logistics or other aspects of storing and handling spent fuel?

(b). Identify all preliminary drafts, working papers, and analyses which have been developed pursuant to such studies, and describe the substance of each document so identified.

Answer to Question 9:

(a). We assume that this question is meant to inquire whether any private corporation or consulting group is presently preparing such a study for Vepco. The answer is no. Despite installation of high density spent fuel storage racks at Surry 1 and 2 and similar expansion plans for North Anna Units 1 and 2, full core discharge capability at these units' spent fuel pools will be exceeded in 1983 and 1987, respectively. Accordingly, Vepco has established a Task Force on Vepco Spent Fuel Disposition and charged this Task Force with the responsibility of delineating the alternatives available to Vepco, including a recommended course of action with regard to the disposition of Vepco's spent nuclear fuel. The Task Force is currently in the process of hiring a consultant to provide assistance in delineating the alternatives.

(b). At this time Vepco has no documents that are responsive to this question.

10. Indicate whether, as of the date of your response to this question, any of the new fuel racks have been placed or installed in the SFP.

Answer to Question 10:

No.

431 258

11(a). What was the actual economic cost of purchasing the new racks? Provide documentation.

(b). Identify other costs in current dollars.

(c). What are the projected future costs (identify any increases due to inflation)?

<u>Answer to Question 11</u>:

(a). $1,370,336.

(b). The only other costs envisioned at this time will be those associated with the installation of the racks. Assuming the racks are installed in a dry, uncontaminated pool, Vepco estimates that the cost of installing the new racks will be approximately $100,000.

(c). Once the racks are installed, there are no projected future costs.

12(a). Have there been any changes in the NRC safety requirements relating to spent fuel pool storage since the expansion was proposed?

(b). Describe all such changes. What are the projected costs of compliance with any such requirements?

Answer to Question 12:

The NRC has not amended its applicable regulations since Vepco submitted its Application on May 1, 1978. However, the NRC has published "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications," dated July 20, 1978. Vepco's proposed modifications meet all the requirements in that position, and there will be no additional cost to Vepco.

431 255

13(a). Do you know of any proposed or pending modifications to the NRC requirements regarding spent fuel storage?

(b). Describe these modifications fully and project the cost of compliance with such requirements.

Answer to Question 13:

(a). We know of no proposed changes that will affect this application. The NRC has proposed new regulations that will pertain to Independent Spent Fuel Storage Installations. See Proposed 10 C.F.R. Part 72 (43 Fed. Reg. 46309 (Oct. 6, 1978)).

(b). Not applicable.

431 256

14. Was the fabrication of the austenitic stainless steel material used in the construction of the spent fuel storage racks monitored so as to assure compliance with the standards and regulations cited in § 2.3 of the Safety Evaluation Report (SER)? Provide supporting documentation.

Answer to Question 14:

The fabrication of the austenitic stainless steel materials used in the construction of the new spent fuel storage racks was in compliance with the requirements of (1) MTEB 5-1, dated November 24, 1975, which is the NRC's Branch Technical Position entitled "Interim Position on Regulatory Guide 1.31 - Control of Stainless Steel Welding" and (2) American National Standards Institute (ANSI) Standard N45.2.1 (1973), "Cleaning of Fluid Systems and Associated Components During the Construction Phase of Nuclear Power Plants," except as follows: there was an acceptable deviation from ANSI N45.2.1 requirements concerning impurities in the rinse water used in cleaning the spent fuel racks after fabrication. Attached is a copy of a Vendor Surveillance Inspection Report (VSIR) for the inspection and release of two of the high density spent fuel racks. Also attached is a description of the minor deviation from N45.2.1 and supporting documentation.

431 257

Questions 15 - 17 refer to the affidavit of H. Stephen McKay.

15(a). (No response required.) On p. 2 it is stated that "It will require a maximum of 12 gpm of evaporation to dissipate the additional heat discharged to the environment because of the proposed modification."

(b). Provide the facts and analysis leading to this conclusion.

Answer to Question 15:

(b). This number was generated by the NRC Staff. See Environmental Impact Appraisal, page 6.

16(a). (No response required.) On p. 2 Mr. McKay assumes a stretch rating of 2900 MWt for full power to determine the design basis heat load.

(b). Define the term "stretch rating" as used in the statement recounted in (a).

(c). Why was the assumed stretch rating not 2990 MWt?

(d). How would the calculations recounted in (a) be affected by the assumption of a higher stretch rating?

Answer to Question 16:

(b). The "stretch rating" is the maximum thermal power rating that a nuclear steam supply system (NSSS) is capable of producing. North Anna Units 1 and 2 have a stretch rating of 2900 MWt. The FSAR for North Anna Units 1 and 2 lists a power rating of 2775 MWt, which is the power level listed in the NSSS supplier's warranty.

(c). A stretch rating of 2990 MWt was not assumed, because the stretch rating is 2900 MWt. The 2990 MWt listed in Vepco's Application was a typographical error and has been corrected in the recent revision to Vepco's Application.

(d). If a higher stretch rating were used, this would increase the calculated design basis heat load.

17(a). (No response required.) At p. 2 it is stated that a temperature of 177.5°F was used for the structural analysis of the SFP.

(b). Describe all structural analyses of the SFP which have been performed and the results thereof. Identify all assumptions used, including SFP temperatures.

(c). Has a structural analysis of the SFP been performed using a temperature greater than 177.5°F?

(d). If the answer to (c) is in the negative, explain why not.

Answer to Question 17:

(b). Two structural analyses have been performed on the spent fuel pool structure. The original computations were made by hand in the period between October 1970 and April 1971 utilizing the analytical techniques contained in United States Department of the Interior, Bureau of Reclamation publication "Moments and Reactions for Rectangular Plates" by W. T. Moody. In May of 1976 these calculations were reviewed to determine if additional loads from the high density spent fuel racks could be carried by the walls if necessary. In that review a deficiency was found and was reported to the NRC as required by paragraph 50.55(e)(3) of Part 50, Title 10, of the Code of Federal Regulations. The final report on this matter was submitted to the NRC in December 1976 as part of Amendment 60 to the FSAR (Appendix O). This report has since been revised, and the revised version will be included in the next amendment of the FSAR. A copy of this revised report is attached.

(c). No.

(d). The temperature of 177.5°F was determined to be the design basis maximum temperature. The use of a higher temperature is therefore not required.

431 261

18. Identify all materials and techniques to be used to inhibit corrosion of the materials in the SFP. Discuss the ability of such materials or techniques to inhibit corrosion over the life of the SFP.

Answer to Question 18:

The spent fuel pool liner and the spent fuel racks are constructed of stainless steel which will prevent the possibility of galvanic corrosion due to the contact of dissimilar metals. The fuel assemblies themselves are constructed of zircaloy cladding rods and have a stainless steel grid support structure. Galvanic corrosion rates between stainless steel and zircaloy are very small and should not present a problem over the time period during which fuel is stored in the pool. The chemistry of the pool is also controlled by a filtration and demineralization system (fuel pool purification system) to remove possible contaminants that might induce corrosion from the fuel pool water.

Vepco believes these materials and techniques are more than adequate. They have been successfully employed by others in the nuclear industry and are disapproved in NUREG-0404 as acceptable means for inhibiting corrosion. See Vepco's answer to Question 22.

431 262

19. Based upon operating experience with zircalloy (sic) clad fuel, approximately how many of the discharged spent fuel assemblies are expected to contain defective fuel rods? Of these, what percentage of the fuel rods contained therein are expected to be defective?

Answer to Question 19:

Reactor systems are designed to accommodate cladding in one percent of the fuel rods in the core. The North Anna Units 1 and 2 FSAR states that only 0.2 percent of the fuel rods are expected to have cladding defects (FSAR § 12.2.3). Vepco's own operating experience suggests that the percentage is less than that predicted in the FSAR.

It is not possible to correlate the number of fuel assemblies containing defective fuel rods with the number of defective fuel rods in the core, and Vepco therefore has no basis to predict the number of fuel assemblies that will contain defective fuel rods.

431 263

20. Based upon your experience with and knowledge of zircalloy (sic) clad fuel, describe all types of cladding defects that have been observed to occur.

(a). For each defect type, describe the causative conditions.

(b). For each defect type, state the probable release rate of radioactive matter, in mass and activity units.

Answer to Question 20:

Vepco visually inspects all of the spent fuel assemblies at its Surry Power Station as they are removed from the core. To date only one fuel rod in one assembly has been identified as having a clad defect. This was probably a hydride failure. Vepco does not know the probable release rate from this defect.

Activity levels measured in the reactor primary coolant suggest that a few other assemblies have clad defects. No specific effort has been made to identify these assemblies, the causative conditions, or their probable release rates, since no adverse effects on reactor or spent fuel storage operations have resulted or are expected.

21. Describe all information in your possession, including personal knowledge, concerning the adverse effects (including corrosion and stress-related effects) upon:

(a). fuel rod cladding;

(b). fuel assembly materials other than fuel rod cladding;

(c). fuel storage racks; and

(d). the pool liner

as a result of exposure to environments similar to that which will exist in the SFP. The response to this question should discuss, but not be limited to, occurrences of such effects at all nuclear reactors.

<u>Answer to Question 21</u>:

See Vepco's statement of objections.

22. Describe all adverse effects mentioned in Question 21 as they may be expected to occur over the following time periods:

a) five years

b) fifteen years

c) forty years

If such information is not in your possession, is it in existence? If so, identify it. If not, why not?

Answer to Question 22:

No such effects are expected over the time periods specified. Based on present storage experience and the very low corrosion rates which would exist in the spent fuel pool environment, it is generally accepted that there is no mechanism that offers a threat to fuel cladding integrity, the integrity of the spent fuel pool or the integrity of the spent fuel racks. The fuel cladding is essentially corrosion resistant in the spent fuel pool storage environment. Fuel should easily be able to be stored in the fuel pool for a few decades or even 100 years or more. Please refer to NUREG-0404, Appendix H. Vepco has an additional paper on this subject by Mr. A. B. Johnson, Jr., entitled "Utility Spent Fuel Storage Experience," PNL-SA-6863, dated April, 1978. This document is attached.

23(a). (No respone required.) In the Original Summary it is stated that the SFP cooling and purification system is located in the auxiliary building. In the Revised Summary it is stated that the SFP cooling and purification is located in the fuel building.

(b). In which building is the SFP cooling and purification system located?

(c). If a change in the location of the SFP cooling system has been proposed, explain the nature and basis of this change.

(d). Describe any electrical, plumbing or other systems that relate to the SFP and are located in whole or in part outside of the fuel building. Provide sketches or diagrams of such systems.

Answer to Question 23:

(b). The spent fuel pool cooling system is located in the fuel building as shown in figures 5-1A, 5-1B, and 5-2 of Vepco's Application. Part of the spent fuel pool purification system is in the fuel building, and the remainder is in the auxiliary building (see figure 5-2 of Application).

(c). No change has been proposed.

(d). As is shown in figure 5-2 of Vepco's Application, part of the spent fuel pool purification system, the refueling water storage tanks, and the refueling cavity and its associated piping are located outside of the fuel building.

431 267

There are also controls and instrumentation associated with the spent fuel pool that are located in the control room. These are: (1) spent fuel pool coolant pump motor (including status indicator lights), (2) spent fuel pool temperature alarms (two) and temperature indicator, (3) fuel building sump level alarm, (4) spent fuel pool level alarms (two) and (5) spent fuel pool filter and demineralizer high differential pressure alarm.

431 269

24(a). Identify any NRC regulatory limitations on the temperature of the water in the SFP.

(b). Is it Vepco's position that it may permit the water in the SFP to exceed the regulatory limit identified in question (a) above? See Table 7-3, p. 52, Summary of Proposed Modification to the Spent Fuel Pool Associated with Increased Storage Capacity for North Anna Pool Storage Units 1 and 2 (April 1978), hereinafter cited as Original Summary.

<u>Answer to Question 24</u>:

(a). There is no regulation that gives a specific limitation; however, please refer to 10 C.F.R. Part 50, Appendix A, General Design Criteria 44, 61, 63.

(b). No.

431 267

25(a). (No response required.) In Table 7-3 of the Original Summary at p. 52 it is stated that in the event of failure of a SFP cooling pump of exchanger, standby pumps or exchangers will be started manually within an hour after failure.

(b). What guarantee is there that the malfunction will be noticed by plant operators within this time?

(c). What would be the consequences if such a failure were not noticed within (i) five hours or (ii) fifteen hours?

(d). Describe the procedures necessary to manually start a standby pump or exchanger.

(e). Describe the procedure necessary to enable one of the SFP cooling pumps to pump water through two heat exchangers.

(f). Describe the procedure necessary to enable both of the SFP cooling pumps to pump water through one of the heat exchangers if this is possible.

Answer to Question 25:

(b). If a fuel pool cooling pump were to fail, it would then be noted by the control room operator. The controller for these pumps includes status indicator lights that show whether the pump is operating or not. The operator might also be alerted to the pump failure by the fuel pool temperature alarms (140 and 170°F).

431 270

The only type of heat exchanger failure that is credible would be a leak in the heat exchanger tubing. If such a leak were to occur, component cooling water, which is at a higher pressure than the water from the spent fuel pool, would leak into the spent fuel pool cooling system. Such a leak would not go unnoticed, because the level in the component cooling water head tank would decrease, causing an alarm to sound in the control room. Another alarm would also sound if the leak was of sufficient magnitude to increase the water level in the fuel pool six or more inches.

(c). The consequences after 5 or fifteen hours of an undetected pump failure are dependent upon the temperature of the spent fuel pool at the time of the failure and the heat load generated by the spent fuel. The temperature of the fuel pool would increase at a rate of approximately 5.5°F per hour for the "normal case" heat load and approximately 10.5°F per hour for the abnormal case.

In the event of an undetected leak in a heat exchanger, the level of the water in the spent fuel pool could rise; the rate of this increase in pool level would be dependent on the size of the leak. Such a leak would have no effect on pool temperature.

(e). Assuming one pump and one heat exchanger are in operati , three valves in the spent fuel building must be opened to place a second heat exchanger in operation. Please

431 271

refer to the piping diagram in figure 5-2 of Vepco's Application.

(f). Assuming one pump and one heat exchanger are in operation, a second pump can be used to deliver water to the heat exchanger by opening three valves in the fuel building and by starting the pump. Please refer to figure 5-2 of Vepco's Application.

26(a). (No response required.) In § 5.2.2 of the Original Summary at p. 15 it is stated that the fuel pool cooling and purification system has two 100% capacity shell and tube heat exchangers, two 100% circulating pumps, and three 100% capacity purification and two 100% circulating pumps.

(b). (No response required.) In § 5.2.2 of the Revised Summary it is stated that the fuel pool cooling and purification system has two shell and tube heat exchangers and two circulating pumps.

(c). Why was this portion of the Original Summary amended?

(d). What is meant by the term "100% capacity"?

(e). What is the capacity of the circulating pumps?

(f). What is the capacity of the shell and tube heat exchangers?

(g). For each piece of equipment described in (e) and (f), what capacity is required under the technical specifications?

<u>Answer to Question 26</u>:

(c). In April 1979 LER 79-044 was submitted to the NRC detailing a change in the maximum component cooling water temperature from 105°F to 113.2°F. Calculations of the spent fuel pool temperature showed that in the presence of the design basis heat loads it was no longer possible to maintain 140°F (normal case) and 170°F (abnormal case) with the combination of

431 273

one pump and one cooler assuming the component cooling water temperature was 113.2°F. Part (d) to this question defines the term "100% capacity." Because of the increased component cooling water temperature, the term "100 capacity" no longer applies to the combination of one cooling pump and one heat exchanger. For this reason the portion of the application referenced in part (a) of this question was amended.

(d). The term "100% capacity" referred to the ability of the combination of one SFP cooling pump and one SFP heat exchanger to maintain the SFP temperature below 140°F for the "normal case" heat load and below 170°F for the "abnormal case" heat load, assuming component cooling water temperature was 105°F.

(e). The capacity of each of the circulating pumps is 2,750 gallons per minute at design conditions (see page 16 of Vepco's Application).

(f). Each of the heat exchangers is designed to remove 5.6×10^{7} Btu/hr assuming tube inlet temperature of 210°F and shell inlet temperature of 105°F (see page 16 of Vepco's Application).

(g). The technical specifications do not specify capacities for this equipment.

431 279

27 How are the Unit 1 control room instruments and alarms including the spent fuel pit monitoring system and alarms mentioned on p. 2 tested?

(a). How often are these tests performed?

(b). Describe any documentation of this testing and the results.

<u>Answer to Question 27</u>:

(a). These instruments are usually recalibrated every 18 to 24 months. This is done by instrument technicians, who simulate a signal calling for a particular controller or indicator response; the actual response is then compared with the desired response and the equipment adjusted as may be necessary. A data sheet is kept at the station to document the calibration of each instrument at the station.

431 275

28. Describe the engineering techniques used to measure and record fuel pool temperatures.

Answer to Question 28:

The spent fuel pool temperature is measured by resistance temperature detectors (RTD's). An instantaneous readout of spent fuel pool temperature is provided by an indicator in the control room. The temperature is not recorded continuously but is logged every four hours.

431 226

29. In the event of a leak in the SFP as described at p. 3 of the McKay affidavit, how would such a leak likely be discovered and what would be the likely consequences if:

(a). the sump pump failed

(b) the alarm system failed

(c). the pump and the alarm system failed?

Answer to Question 29:

(a). Water from the leak would run to the fuel building sump, triggering the sump alarm. If the sump pump failed, the sump would overflow. Any water lost from the pool would be replaced via normal makeup systems.

(b). If the sump alarm failed, the water could drain undetected until the fuel pool low level alarm sounded, which would occur if the fuel pool level dropped six inches. As in (a), any leakage would go to the fuel building basement sump. When the fuel pool level alarm sounded, an operator would be sent to the fuel building to investigate the cause of the alarm. The sump pump would then be turned on and makeup water would be provided to the pool.

(c). The scenario would be the same as (b), except that if the sump pump did not start, temporary pumps would have to be used to remove water from the basement of the fuel building.

30. (No responses required for parts a and b.)

(a). At p. 48 of the Revised Summary it is stated that the service water has a "design maximum" of 110°F.

(b). At p. 1 of the Attachment to Licensee Event Report (LER) 79-044/01T-0 (April 17, 1979) it is stated that the service water has a "normal maximum" of 95°F.

(c). Define and distinguish the terms "normal maximum" and "design maximum" as used in the statements recounted in (a) and (b) and elsewhere.

(d). What is the "design maximum" temperature for the service water?

(e). What is the "normal maximum" temperature for the service water?

(f). Describe any limitations on the service water temperature imposed by the NRC or by Vepco.

(g). If the difference in the temperatures used in the statements recounted in (a) and (b) reflect any change or changes in circumstances, assumptions, or in Vepco's operating procedures or sepcifications, describe such changes and the reasons therefor.

Answer to Question 30:

(c). "Normal maximum" refers to the maximum allowed service water temperature under normal operating conditions. The reactors must be shut down if this temperature is exceeded. The "design maximum" temperature is the maximum service water temperature under design basis conditions. The "design maximum" temperature assumes the worst expected weather conditions, a loss of coolant accident with minimum safeguards in Unit 3 or 4 and a rapid cooldown of the other unit.

(d). 110°F.

(e). 95°F.

(f). Technical Specification 3.7.5.1 requires that Unit 1 reactor be shut down if the service water temperature is 95°F or greater.

(g). The difference between normal and design conditions is explained in the answer to 30(c) above. The two figures are not inconsistent.

431 279

31. (No response required for parts a, b, and c.)

(a). At p. 48 of the Original Summary it is stated that the component cooling water has a "design maximum" of 105°F.

(b). At p. 1 of the Attachment to LER 79-044 it is stated that the component cooling water will have a "peak temperature" of approximately 120°F.

(c). At p. 48 of the Revised Summary it is stated that the circumstances there described will yield a component cooling water temperature of 113.2°F.

(d). Define and distinguish the terms "design maximum temperature" and "peak temperature" as used in the statements recounted in (a) and (b).

(e). What is the "design maximum" temperature for the component cooling system?

(f). What is the "peak temperature" for the component cooling system?

(g). If the difference in the temperatures used in the statements recounted in (a), (b), and (c) reflects a change in circumstances, assumptions, or Vepco's operating procedures or specifications, describe such changes and the reasons therefor.

(h). Define the term "design basis heat load" as used in § 7.2 of the Revised Summary at p. 47.

Answer to Question 31:

(d). In the referenced LER 79-044 "peak" temperature means "design maximum" temperature. "Design maximum" has the same meaning as for the service water system. See response to Question 30(c).

(e). 113.2°F.

(f). 113.2°F. The 120°F figure was the initial rough estimate. The 113.2°F figure was based on more precise calculations that were performed after the submission of the initial report.

(g). The increase in the design maximum temperature from 105°F to 113.2°F is due to the revised design maximum temperature of the service water temperature. This is further explained in Vepco's March 8, 1979, letter to the NRC (serial number 237D).

(h). The heat load is the heat to be removed by the cooling system. The assumptions used to calculate the design basis heat load are enumerated on page 47 (section 7.2) of Vepco's Application. The design basis heat load is 19.4 MBtu/hr for the normal case (immediately after refueling) and 35.9 MBtu/hr for the abnormal case (immediately after a full-core discharge).

32. When answering all subparts of this question, assume the existence of the factual circumstances set forth in § 7.2 of the Revised Summary at p. 47 (including service water temperature of 110°F and "abnormal (full core discharge) conditions").

(a). Can the service water cooling system maintain the component cooling system water at a temperature of 113.2°F?

(b). Describe the amount of heat, in BTU/hr., which will be transferred from the component cooling system to the service water cooling system if the water temperatures of those systems is (sic) maintained at 113.2°F and 110°F, respectively.

(c). If the component cooling water temperature is 113.2°F, at what temperature can the SFP water temperature be maintained where:

(i) both SFP heat exchangers and both SFP cooling pumps are functioning normally;

(ii) one SFP heat exchanger is not functioning and both SFP cooling pumps are functioning normally;

(iii) one SFP heat exchanger is not functioning and one SFP cooling pump is not functioning; and

(iv) both SFP heat exchangers are functioning normally and one SFP cooling pump is not functioning.

Describe the bases for your answer.

(d). In (c)(i), (ii), (iii), and (iv) describe the amount of heat, in BTU/hr., which would be transferred from the SFP water to the component cooling system water.

<u>Answer to Question 32</u>:

(a). Yes.

(b). The Btu/hr transferred from the component cooling water to the service water is described in section 7.2, Table 7-2, of Vepco's Application. Vepco has not calculated the temperature of the pool assuming two pumps and one cooler are functioning, because the fuel pool temperature can be maintained below the structural design basis temperature (177.5°F) with one pump and one cooler (see Vepco's Application, Table 7-1).

(c). The answers to items i, iii, and iv are in Vepco's Application in section 7.2, Table 7-1.

(d). Once the temperature in the pool has stabilized, the amount of heat transferred in all four cases is listed in Table 7-1 of Vepco's Application.

33(a). (No response required.) In § 7.2 of the Revised Summary at p. 48 it is stated that the SFP water temperature would be maintained within the limit of 140°F for the "normal case."

(b). Define the term "normal case" as used in the statement recounted in (a).

(c). Identify the source of the 140°F limit.

Answer to Question 33

(b). The term "normal case" refers to the transfer of approximately 1/3 of a core to the spent fuel pool (e.g., a normal refueling). The component cooling water temperature is assumed to be at its design maximum of 113.2°F.

(c). The 140°F limit is a carryover from the Surry 1 and 2 fuel pool design criteria.

431 284

34(a). (No response required.) In § 7.2 of the Revised Summary at p. 48 it is stated that, on the basis of certain assumptions, the SFP water temperature would be maintained within the 170°F limit in the "abnormal case" if one SFP cooling system pump and two SFP coolers are used.

(b). (No response required.) In § 7.2 of the Original Summary it is stated that, on the basis of the assumptions referred to in (a), the SFP water temperature would be maintained within the 170°F limit in the "abnormal case" if one SFP cooling system pump and one SFP cooler were used.

(c). Discuss any changes in circumstances, assumptions, and Vepco's operating procedures or limitations reflected in the disparity between the statements recounted in (a) and (b).

(d). Define the term "abnormal case" as used in the statement recounted in (a).

(e). Define the term "abnor[illegible] case" as used in the statement recounted in (b).

(f). Define the term "full core discharge case" as used in assumption #4. § 7.2 at p. 47 of the Revised Summary.

(g). Define and distinguish the terms "fuel pit coolers" as used in Table 7-3, p. 52 of the Revised Summary with the term "spent fuel pool heat exchangers" as used in the McKay affidavit at p. 2. If these terms refer to the same equipment, list all other terms which in the past have been or

131 295

in the future will be used by Vepco to describe the same equipment.

(h). What is the probability of failure of a fuel pool cooling system pump?

(i). What is the probability of failure of a fuel pool heat exchanger?

<u>Answer to Question 34</u>:

(c). The changes in circumstances between these two standards are discussed in LER 79-044, a copy of which has been forwarded to the Potomac Alliance.

(d). The term "abnormal case" refers to the discharge of a full core to the spent fuel pool, assuming that the component cooling water temperature is at its design maximum of 113.2°F.

(e). Same as part (d) except the component cooling water temperature is assumed to be 105°F.

(f). In assumption #4 on page 47 of Vepco's Application it is assumed that a fuel assembly is added to the pool every 20 minutes until 157 assemblies (a full core) have been discharged to the fuel pool. This fuel transfer is assumed to begin 150 hours after the unit is shutdown, as it takes approximately seven days to make the necessary preparations for fuel transfer operations.

(g). The "fuel pit coolers" and the "spent fuel pool heat exchangers" are the same pieces of equipment.

431 286

(h). Vepco does not know.

(i). Vepco does not know.

35(a). (No response required.) In § 3.3.2 of the Final Safety Analysis Report for the North Anna Station it is stated that a tornado could generate a missile, such as a utility pole measuring 40 feet in length, 12 miles (sic) in diameter, and weighing 50 pounds/ft.3, travelling in a vertical direction at 150 m.p.h.

(b). Does the statement recounted in (a) reflect your current expert opinion? If not, explain.

(c). (No response required.) In § 9.1-4 of the Final Safety Analysis Report (FSAR) it is implied that the 40 foot missile described in (a) would lack sufficient velocity to clear a height of 25 feet.

(d). Does the statement recounted in (c) reflect your current expert opinion? If not, explain.

(e). Are the statements recounted in (a) and (c) inconsistent in any way? Explain your answer.

Answer to Question 35:

(b). No. The FSAR does not say that a tornado could generate such a missile. It assumes that a tornado could generate such a missile. Certain buildings and structures at North Anna were designed so they would not fail if struck by such a missile. Based on the discussion in the FSAR and the technical papers cited therein, Vepco does not believe such a missile is credible.

431 288

(d). Yes.

(e). No.

431 289

36. Describe the most destructive (1) tornado and (2) turbine missiles which could conceivably be expected to enter the SFP.

Answer to Question 36:

(1) The most destructive tornado missile is a slender object that enters the pool with a minimum cross-sectional area after being accelerated by the tornado acting on its maximum cross-sectional area.

(2) The most destructive turbine missile would be one-quarter of the last (largest) turbine disk entering from a high trajectory (lob shot).

431 290

37(a). What is the probability that the missiles mentioned in question 38 would be expected to enter the SFP over the life of the station?

(b). What would be the radiological consequences of such missiles?

(c). Assuming that the proposed modification is not permitted, what is the probability that such missiles would strike directly more than one fuel assembly?

(d). Assuming that the proposed modification is permitted, what is the probability that such missiles would strike more than one assembly?

<u>Answer to Question 37</u>:

(a). The probability of a turbine missile entering the fuel building is discussed in FSAR section 10.2.1. It is the 1.32 x 10-10 per year or about 4.2×10^{-9} for the life of the station (the license expires in 2011).

In section 2.3.1.3.2 of the FSAR the probability of a tornado strike is conservatively calculated as 3.3×10^{-5} per year. This is 1 x 10-3 for the life of the station. This is only the probability of a tornado strike; the probability of a tornado missile entering the SFP would be much less.

(b). The radiological consequences of the turbine missile strike have not been calculated due to the very low probability of such an accident. The consequences of the tornado missile have been calculated; assuming the cladding

431 297

failure of all rods of one fuel assembly, the dose at the site boundary would be 70 Rem to the thyroid and 3.4 Rem to the whole body (see FSAR § 15.4.5.2), which would be within limits specified in 10 CFR Part 100.

(c). Vepco has never calculated this probability.

(d). Vepco has never calculated this probability.

4354- 292

38. Is it your opinion that the distance between assemblies stored in the SFP is relevant to the question whether more than one assembly is likel, to be struck by a missile or a utility pole? Explain your answer.

Answer to Question 38:

It is logically relevant but immaterial. The probability of a turbine missile strike is so low that the consequences need not be evaluated. A tornado missile could not damage more than one fuel assembly even with the more compact configuration.

39. Describe the damage that would have to be sustained by the fuel in the SFP in order to exceed the limits established in 10 CFR Part 100.

<u>Answer to Question 39</u>:

This question cannot be answered without making assumptions about (1) the exposure history of the fuel assemblies while in the reactor core and (2) the amount of time that has elapsed since the reactor was shut down and the assemblies discharged to the spent fuel pool.

431 294

40(a). (No response required.) At § 9.1.4 of the FSAR it is stated that vertically moving missiles would strike no more than one fuel assemblies (sic).

(b). (No response required.) At § 4.2.3.2 of the Draft Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel (March 1978)(NUREG-0404) it is stated that a tornado entering a SFP could impact a 45 foot row of assemblies.

(c). Justify the discrepany between these estimates.

(d). What would be the radiolocial consequences if a 45 foot row of assemblies were damaged by a tornado or turbine missile at the North Anna SFP?

Answer to Question 40:

(c). The referenced statement in part (a) is from section 9.1.2 not 9.1.4. There is no discrepancy between these two statements. The FSAR discusses a vertical missile, while NUREG-0404 describes a missile entering the pool at an "optimum angle" so that a 45-foot row of fuel assemblies could be impacted. A missile travelling vertically would not impact a 45-foot row of fuel assemblies.

(d) Vepco has not evaluated the radiological consequences of such an accident.

41. Assume that the proposed modification of the SFP is not permitted and that the SFP is filled to its capacity of 400 fuel assemblies.

(a). Describe all employee activities within the fuel building which involve a risk of radiation exposure, including but not limited to:

(i) changing filters and resin cartridges

(ii) other maintenance, including equipment maintenance

(iii) cleaning operations

(iv) surveillance

(v) fuel loading and unloading

(vi) preparing spent fuel for shipment offsite

(b). Describe the magnitude of the radiation exposures, in person-rems, involved in these activities, including the radiation levels at all relevant locations and the person-hours of activity at those locations.

<u>Answer to Question 41</u>:

(a). The activities that take place within the fuel building are as follows:

1. Fuel movement for refueling.
2. Receipt of new fuel.
3. Loading of spent fuel shipping casks.
4. Operator inspection tours (daily).

431 296

5. Cleaning the edge of the spent fuel pool (weekly).

6. Fuel building maintenance.

7. Spent fuel inspections.

The changing of filters and demineralizer resins does not take place in the fuel building as the filters and demineralizer are located in the auxiliary building. The radiation exposure for these items is described in our application on page 22.

(b). Based on experience at Surry, the personnel exposure could be expected to be as follows:

1. Fuel Movement (refueling) -- Requires a crew of 3 workers who work in a field of approximately 1.5 mR/hr. It takes approximately 180 man-hours of work in the fuel building. The total exposure for this activity is 0.270 man-Rem.

2. Receipt of New Fuel -- Receipt of sufficient fuel for a normal refueling requires a crew of 4 workers who work in a field of approximately 1.5 mR/hr. It takes approximately 200 man-hours of work in the fuel building The total exposure for this activity is approximately 0.300 man-Rem.

3. Operator's Inspection Tour -- This inspection tour takes approximately 30 minutes. The average field on the operating level of the fuel building is approximately 1.5 mR/hr, and the field in the basement of the fuel building is approximately 25-50 mR/hr. The operator spends approximately equal time on each floor of the fuel building. The total

man-hour time for this activity is 0.5 man-hours. The total exposure for this activity is a maximum of 0.013 man-Rem.

4. Cleaning the Edge of the Spent Fuel Pool -- Requires a crew of four workers who work in a field of 1-3 mR/hr. It takes approximately 16 man-hours to perform this activity. The total exposure is approximately 0.048 man-Rem.

5. Maintenance -- The exposure rates and man-hours required vary with the task. To date very little maintenance has ever been required in the spent fuel pool at Surry.

6. Spent Fuel Inspections -- Inspection of spent fuel requires a crew of two workers who work in a field of 1.5 mR/hr. It takes approximately 120 man-hours of work in the fuel building. The total exposure for this activity is approximately 0.180 man-Rem.

7. Loading Spent Fuel Casks -- This has never been done at Surry, but Vepco estimates that it would require about 150 man-hours to load a multi-element cask. The field for this operation would be approximately 1.5 mR/hr. The total exposure for this activity is approximately 0.225 man-Rem.

42. Assume that the proposed modification is permitted, and that the pool is filled to its capacity of 966 fuel assemblies.

(a). Describe all employee activities within the fuel building which involve a risk of radiation exposure, including but not limited to:

(i) changing filters and resin cartridges

(ii) other maintenance, including equipment maintenance

(iii) cleaning operations

(iv) surveillance

(v) fuel loading and unloading

(vi) preparing spent fuel for shipment offsite

(b). Describe the magnitude of the radiation exposures, in person-rems, involved in these activities, including the radiation levels at all relevant locations and the person-hours of activity at those locations.

Answer to Question 42:

(a). The activities to be pertained would be the same as described in Vepco's answer to Interrogatory 41(a).

(b). It is not expected that the exposures for 966 fuel assemblies will differ significantly from the estimates given in Vepco's answer to Interrogatory 41(b) (see page 56 of Vepco's Application).

431 299

43. In § 9.1 of the Revised Summary at p. 54 it is stated that in the event that the SFP cooling system were to become completely inoperable, installed station sources would provide sufficient makeup water to cool the fuel and to maintain sufficient water shielding over the pool. These sources are described as

(1) primary grade water system

(2) fire protection system

(3) boron recovery system

(4) refueling water storage tank

(a). Describe the procedures to be followed in order to render each of these systems able to cool the SFP.

(b). Describe the ability of each of these systems to cool the SFP. Include in this description an expression of the cooling ability of each system in Btu/hr.

Answer to Question 43:

(a). Please refer to Vepco's answer to Interrogatory 1-7(d) in Vepco's Answers to CEF Interrogatories.

(b). None of these systems have the capability to remove heat from the pool. Rather, in the unlikely event that the spent fuel pool's cooling system should become inoperable, cooling water from these systems can be added to the fuel pool to replace any water that may boil away. The spent fuel pool purification pumps each have the capacity to provide approximately 135 gallons of primary grade water per minute

431 300

from the primary grade storage tanks, the boron recovery system or the refueling water storage tank. The fire protection system has the capacity to supply approximately 2,500 gallons of water per minute. The maximum amount of water that would be required for makeup in the pool is approximately 85 gallons per minute. Thus, each of these systems is capable of supplying more cooling water then would ever be required to provide makeup to the pool.

44. Identify all correspondence between Vepco and the NRC concerning the proposed modification of the SFP.

<u>Answer to Question 44</u>:

See Vepco's statement of objections.

431 302

45. Identify all memoranda and written summaries or transcripts of other communications between Vepco employees concerning the proposed modification of the SFP.

Answer to Question 45:

See Vepco's statement of objections.

46. Identify all memoranda and written summaries or transcripts of other communications between Vepco employees and others, including legal counsel, concerning the proposed modification of the SFP.

Answer to Question 46:

See Vepco's statement of objections.

47. Identify all correspondence between Vepco and the United States Department of Energy, its constituent agencies, or its predecessor agencies, concerning spent nuclear fuel.

<u>Answer to Question 47</u>:

See Vepco's statement of objections.

431 305

I prepared the answers to Questions 10, 11, 14, 15, 16, 17, 18, 22, 23, 24, 25, 26, 27, 28, 29, 32, 33, 34, 39, 40, 41, and 42 above. They are true and correct to the best of my knowledge and belief.

H. Stephen McKay

H. Stephen McKay, Associate
Engineer, Vepco

COMMONWEALTH OF VIRGINIA.

City of Richmond, to-wit:

The foregoing instrument was acknowledged before me this 20th day of June, 1979, by H. Stephen McKay.

My commission expires Oct. 10, 1982.

[signature]

Notary Public

I prepared the answers to Questions 1, 2, 3, 4, 6, 8, 12, 13, 30, 31, 35, 36, 37, 38, and 43 above. They are true and correct to the best of my knowledge and belief.

Robert M. Neil

Robert M. Neil, Associate
Engineer, Vepco

COMMONWEALTH OF VIRGINIA,

City OF Richmond, to-wit:

The foregoing instrument was acknowledged before me this 20th day of June, 1979, by Robert M. Neil.

My commission expires Oct. 10, 1982.

Notary Public

I prepared the answers to Questions 5, 7, 9, 19, and 20 above. Information concerning the answers to Questions 7 and 19 were provided by Marvin L. Smith. Information concerning the answers to Question 20 was provided by Clark P. Sanger. They are true and correct to the best of my knowledge and belief.

Dennis R. Fishback, Engineer,
Vepco

COMMONWEALTH OF VIRGINIA,

City OF Richmond, to-wit:

The foregoing instrument was acknowledged before me this 20th day June, 1979, by Dennis R. Fishback.

My commission expires Oct. 10, 1982.

Notary Public