UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

VEPCO'S ANSWERS TO CEF INTERROGATORIES

These are the answers of Virginia Electric and Power Company (Vepco) to the interrogatories served on the company June 1, 1979, by intervenor Citizens' Energy Forum, Inc. (CEF). Before responding to the interrogatories, Vepco will address several matters raised in the introductory section of CEF's request.

Vepco proposes to have a panel of witnesses present its testimony in this proceeding. At this time Vepco plans to have the following witnesses participate on that panel: (1) Dr. Morris L. Brehmer, (2) Mr. Henry H. Barbour, (3) Mr. Robert W. Calder and (4) Mr. H. Stephen McKay. The professional qualifications of Mr. Barbour are attached; qualifications of the other gentlemen have already been supplied to the intervenors. If for some reason one or more of the individuals

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identified above will not be able to participate, or if Vepco finds it necessary to add an additional witness to the panel, Vepco will notify CEF as soon as possible.

Because many of the issues overlap, the participants on Vepco's panel will be generally familiar with all the intervenors' contentions. When a question calls for expertise in a particular area, the members of the panel will decide who is best able to answer the question. Mr. McKay has general knowledge of all the issues involved in this proceeding. Mr. Calder has expertise in the area of materials integrity and corrosion. Dr. Brehmer will be prepared to discuss the non-radiological environmental impacts of the proposed action. Finally, Mr. Barbour will be prepared to answer questions about alternatives to the proposed action, particularly those having to do with the storage and disposition of spent nuclear fuel.

At this time Vepco has not completed its written testimony and is therefore unable to provide a summary of that testimony. Any documents Vepco relies upon to support its presentation will be identified in the written testimony. This testimony should be filed within the next few days.

Vepco objects to CEF's request for production of detailed drawings of the new spent fuel pool racks (see Question 5-1). As explained in Vepco's statement of objections, these drawings are considered proprietary to the

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vendor of the racks. Vepco will permit the CEF to review these drawings in Vepco's offices.

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VEPCO'S ANSWERS

Contention 1: Thermal Effects

1-1 Describe in detail, and provide sketches to illustrate, the spent fuel pool cooling system; specifically,

a. its relation to the component cooling system,

b. its relation to the service water cooling system, and

c. its relation to the pumphouse.

Vepco answer 1-1

The spent fuel pool cooling system takes water from the pool, pumps it through the tubes of the shell and tube heat exchangers (or coolers, and returns it to the pool. Heat is transferred through the heat exchanger tube walls to component cooling water on the shell side of the heat exchanger. Similarly, the component cooling system has pumps and heat exchangers that transfer heat to the service water. Service water is pumped from the service water reservoir by pumps in the service water pump house to various heat exchangers in the Station, including those in the component cooling system, and then back to the service water sprays in the service water reservoir. The sprays transfer heat to the air as the water droplets fall back into the reservoir.

A more detailed description, including a diagram of the spent fuel pool cooling system, is in section 9.1.3 of the

North Anna Units 1 and 2 FSAR, which is in the NRC Public Document Room. The component cooling and service water systems are described in sections 9.2.2 and 9.2.1, respectively. The general layout can be seen in FSAR figures 1.2-1 and 1.2-10 through 1.2-18. There is also a diagram (figure 5-2) in Vepco's Application.

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1-2 On page 54 of the Summary of Proposed Modifications to the Spent Fuel Storage Pool Associated with Increasing Storage Capacity for North Anna Power Station Unit Nos. 1 & 2 (hereafter referred to as Application) is stated "the existing cooling system has sufficient design margin to remove the additional heat load when uranium fuel is stored in the pool." What is the basis for this statement? What tests have been conducted (e.g. in other operating plants) to assure that this is the case?

Vepco answer 1-2

The basis of this statement is calculations performed using the assumptions in section 7.2 (pages 47 and 48) and Table 7-1 of the Application.

No specific tests have been conducted to assure that this is the case, but the operating experience of the spent fuel pool at Surry Power Station, presented in section 5.5.1, page 21, of the Application is an indication of the conservatism that is included in both the amount of heat assumed to be generated by the spent fuel and in the design of the spent fuel pool cooling system. The conservatism inherent in these calculations is also discussed in NUREG-0404 on pages D-6 through D-8.

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1-3 What is the volume of water that will be kept in the spent fuel pool at all times, both in level and in volume? At what rate and force (psi) does the cooling water flow into the spent fuel pool? At what temperature is the cooling water upon entrance to the pool, in the pool, and at exit from the pool?

Vepco Answer 1-3

The water level that will be maintained in the spent fuel pool is shown in Figure 5-1B of the Application as elevation 289'10". The bottom of the pool is at elevation 249'4", which results in a water depth in the pool of 40'6". As described on page 20 of the Application, if the water level drops six inches below the normal level, the high/low water level annunciator will alarm in the control room. The volume of water in the pool at its normal operating level is 4.932×10^5 gallons. The operating characteristics of the fuel pool cooling pumps are shown on page 16 of the Application.

The temperature of the cooling water entering and leaving the pool depends upon (1) the temperature of the component cooling water, (2) the amount of heat transferred to the water from spent fuel, and (3) the number of components of the spent fuel pool cooling system that are in operation. Without making assumptions about these variables, it is impossible to calculate the entrance and exit temperatures of

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the water. The bulk temperature of the water in the pool is the same as the temperature of the water as it exits the pool.

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1-4 What heat is generated per fuel assembly at the time of initial storage in the pool? What total heat is generated at the time of refueling (150 spent fuel assemblies)? Define stable temperature conditions as they apply to spent fuel assemblies. How long does it take spent fuel assemblies to reach stable temperature after reactor shutdown?

Vepco answer 1-4

The heat generated by a spent fuel assembly is a function of two factors: the amount of exposure the fuel has received while in the reactor core and the amount of time that has passed since the reactor was shut down and the fuel was removed from the core. A rough estimate of the heat generated by one assembly can be calculated by dividing the heat generation rates in Table 7-1 of Vepco's Application by the number of assemblies involved (i.e., 53 for the normal case and 157 for the abnormal case). Note, however, that the two answers will not be the same, because the bases for the numbers are different. For the normal case it was assumed that the fuel had seen 816 effective full-power days (EFPD) at a load factor of 85% and that these assemblies were all discharged to the pool 150 hours after unit shutdown. The abnormal case assumes a full core discharge with each one-third of the core having 272, 544, and 816 EFPD, respectively, a load factor of 85% and all the fuel assemblies in the pool 252 hours after

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3/6

unit shutdown, as described in section 7.2 of Vepco's Application. To calculate the exact estimated heat generation rate for a given fuel assembly, consult the NRC's Branch Technical Position 9-2 of the Standard Review Plan.

The temperature of a spent fuel assembly actually never stops decreasing. However, the rate of temperature change decreases with time (see Branch Technical Position 9-2).

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1-5 Describe the effect, if any, of the spent fuel pool building ventilation system on maintaining an acceptable temperature in the spent fuel pool. In the event of an accident, would the ventilation system be relied upon to maintain acceptable spent fuel pool temperatures? If so, how?

Vepco answer 1-5

The fuel pool building ventilation system is not designed to control the temperature of the spent fuel pool. However, as it does remove air (and thereby moisture in the air) from the fuel building atmosphere, it removes heat that is removed from the pool through evaporation. This heat is not considered in the SFP cooling calculation, and it would not be relied upon for cooling the pool in the event of an accident.

1-6 Provide an analysis of the flow of water in the pool with filled and partially-filled high-density racks. Show anticipated water temperatures throughout the pool, identifying areas of highest and lowest temperatures under normal and emergency conditions, assuming 1/3 core in the pool 150 hours after reactor shutdown.

Vepco answer 1-6

A thermal-hydraulic analysis of the flow of water in and around the new spent fuel rack structure has been performed by NUS Corporation, the rack vendor, and is summarized in section 6.6 of Vepco's Application. This analysis assumed that the racks were fully loaded with spent fuel and demonstrated that sufficient flow would be induced by natural convection to preclude local boiling in the hottest storage location. This analysis is considered proprietary by NUS Corporation and is not being produced (see Vepco's statement of objections). A thermal-hydraulic analysis of partially filled racks has not been performed.

To address the question of anticipated water temperatures throughout the fuel pool, a fuel building temperature study was performed in November 1976 during the refueling at the Surry Power Station. Temperatures at different locations and depths in the fuel pool were measured periodically during the fuel transfer operation. Throughout this test the temperature of the water in the fuel pool was relatively uniform (within 1 or 2°F). A copy of the special test procedure and the data sheets are attached.

The area of highest spent fuel pool temperature would be in the storage cell containing the fuel assembly with the highest heat generation rate. The lowest temperature in the fuel pool would be where the fuel pool cooling water enters the fuel pool from the fuel pool coolers.

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1-7 (a) Provide detailed information on the makeup and cooling water systems specifically mentioned on page 54 of the Application, including a description of the relationship to one another of the four systems mentioned. (b) How would diversion of water from these systems affect other components of the plant? (c) Are any of these systems also relied upon as back-up systems to other plant components? (d) What type of changes in "valve lineup" or other "temporary measures, such as the use of temporary pumps or hoses" would be required in order to make use of these makeup and cooling water sources? How would such changes be accomplished? Would these changes be manual, or automatic? In the event of a release of excessive radioactivity in the spent fuel pool area, would it be possible to make these changes? (e) What are the "number of installed station systems" cited on page 55 of the Application that could provide makeup and cooling water if needed, and how would their diversion to the spent fuel pool affect other plant components?

Vepco answer 1-7

(a) Primary grade water is stored in the two primary grade water tanks. Interconnections with these tanks are shown on FSAR figure 9.3.5-3.

The fire protection system uses water from either the lake or the service water reservoir. It is described in detail in FSAR section 9.5.1.

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The boron recovery system is used to remove boric acid from reactor coolant and purify the water. This purified water can be used as makeup. A detailed description is in FSAR section 9.3.5.

The refueling water storage tanks are described in FSAR section 6.2.2.2. They receive makeup water from the primary grade water system through the boric acid blender.

(b) The effect that diversion of water from one of these systems would have on other components of the plant would depend on the particular demands on that system at the time. If diverting water from one system would have an adverse effect, Vepco would simply obtain makeup from another system.

(c) Yes.

(d) Each of the four water sources can be introduced by manual changes in the valve lineup. The valve lineup for use of water from the primary grade water system, boron recovery system, or refueling water storage tank can be seen in FSAR figures 9.1.3-1 and 9.3.5-3. The valve lineup for use of the fire protection system can be seen in FSAR figure 9.5.1-1. Normal makeup is done in accordance with procedure 1-OP-16.5. (attached). Under abnormal conditions procedure 1-AP-27 is used (attached). Makeup water can be introduced even in the event of an accident in the fuel pool, because the valves involved are outside the fuel building.

(e) The installed systems mentioned on page 55 of the Application are those listed on page 54.

Contention 2: Radioactive Emissions

2-1 What systems currently exist to notify Louisa County officials and residents, as well as persons in surrounding counties, in the event of an unusual release of radioactivity from the spent fuel pool? If no such systems exist, are plans underway for their development?

Vepco answer 2-1

The procedures for notification of the Louisa County officials in the event of unusual release of radioactivity are set forth in the North Anna Power Station Emergency Plan. Notification of residents is provided in the Commonwealth of Virginia, and the County of Louisa Radiological Emergency Response Plans. These documents may be found in the NRC Public Document Room. Notification procedures are also discussed in considerable detail in the record of the North Anna 1 and 2 operating license hearing held November-December 1976; the transcripts and exhibits should be in the NRC Public Document Room.

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2-2 Answer for each of the following: Lake Anna, groundwater, air and land surrounding the North Anna Power Station. (a) How often are these monitored for radiation levels, to what distance from the plant are they monitored, and by whom are they monitored? (b) Are the results of such monitoring reported to the public? If so, how? If not, why not? (c) What is the normal background radiation level for each? What is the current average dosage above background for each?

Vepco answer 2-2

(a) Monitoring frequencies and locations are listed in the Environmental Technical Specifications, which are Appendix B to the North Anna Unit 1 operating license and may be found in the NRC Public Document Room. Vepco does the monitoring.

(b) Yes. The results are reported to the NRC in the Environmental Radiological Monitoring Report, which may be found in the NRC Public Document Room.

(c) Background levels and doses can be determined from the Environmental Radiological Monitoring Reports.

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2-3 What would the effect be on the pool and racks, and on the keff in the pool, if seismic conditions were to cause two or more racks to slide closer together than the planned 14" center-to-center spacing? How far, and in what directions, are the racks designed to slide under seismic conditions?

Vepco answer 2-3

The spent fuel racks are restrained by embedment clips on the fuel pool embedment plates and are not free to slide together such that two storage cells in adjacent racks could be closer than 14". Vepco has therefore not analyzed these effects.

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2-4 In the sentence "Mechanical restriction will be provided to prevent an unprotected fuel assembly from being brought closer than 5" to the side of any rack assembly in the side water channel.", found on page 45 of the Application, what is meant by the terms "mechanical restriction" and "side water channel"?

Vepco answer 2-4

The term "mechanical restriction" refers to a metal plate that protrudes from the top of certain spent fuel racks that are adjacent to the pool walls. It physically prevents bringing the fuel assembly closer than 5 inches from a side of the spent fuel rack.

The term "water channel" refers to the region between the spent fuel rac and the fuel pool wall.

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2-5 In the Application, an accident is assumed in which a fuel assembly is dropped so it is "parallel to and at the same level as the stored fuel in rack assemblies." Has an accident been postulated to involve the dropping of a spent fuel assembly so that it is not parallel, but rather perpendicular to, the spent fuel assemblies in the racks? If so, provide details and results. If not, explain why not.

Vepco answer to 2-5

Yes. An accident involving a fuel assembly dropped on top of the racks, perpendicular to the stored fuel assemblies, is discussed in section 6.7.1 of the Application.

431 328

2-6 When were the two new embedments added to the spent fuel pool? Provide copies of documents to and from the Nuclear Regulatory Commission requesting and approving, respectively, the addition of the new embedments.

Vepco answer 2-6

The two new embedments in the spent fuel pool were added in the spring of 1977.

There was no such correspondence.

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2-7 Has the potential exposure of the populace within a 10-mile radius (or other such radius) of the North Anna Power Station in the event of an accident in the spent fuel pool that releases radiation, been analyzed? If so, provide the results of any such analysis. If not, explain why not.

Vepco answer 2-7

Yes. The results of an analysis of potential exposure due to an accident in the spent fuel pool are discussed in FSAR section 15.4.5.

2-8 In a letter from Sam C. Brown, Jr. to Harold Denton, dated September 7, 1978, and responding to requests for additional information regarding expansion of spent fuel capacity for North Anna Units 1 and 2, is the statement:

> If the spent fuel racks become contaminated, they will be removed from the spent fuel pool by the overhead crane and taken to the decontamination building where they are decontaminated to the lowest possible level. The racks are then moved to a tent in a suitable location, cut up, packaged in wooden boxes, and shipped off-site for burial.

(a) What is the "lowest possible level" of contamination, in terms of measured radiation? (b) Where is a "suitable location"? (c) What special provisions are taken in constructing the tent and wooden boxes mentioned, to insure that they will contain any residual contamination? (d) What exposure to the public is anticipated from such activity? How is this expected exposure arrived at? (e) If such activity is necessary, where will the cut-up racks be shipped for burial?

<u>Vepco answer 2-8</u>

(a) The term "lowest possible level" means lowest possible level given existing decontamination techniques. At this time we cannot quantify what this level will be.

(b) A "suitable location" would be an area within the Station's restricted area that is accessible by the fuel building overhead crane.

(c) The tent would be constructed of wood and herculite with a filtered ventilation system that would draw a slight negative pressure on the tent so that any leakage would be inleakage, thereby preventing a release of contamination.

(d) The exposure to the public from this activity should be negligible. As discussed in the previous answers, the decontamination procedures and the use of a tent should prevent any offsite exposure to radiation.

(e) A licensed burial site, such as the facility in Barnwell, South Carolina.

2-9 Section 7-4 of the Application states "the escape of gaseous or volatile fission products from even defective fuel is expected to be negligible". Define the word negligible in this case. What is the procedure by which negligible amounts of radioactivity are quantified.

Vepco answer 2-9

Webster's New Collegiate Dictionary defines negligible as "so small or unimportant or of so little consequence as to warrant little or no attention." In this application these releases are negligible in comparison to releases resulting from normal station operation, which in turn are well within NRC regulatory limits.

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Contention 5: Corrosion

5-1 Provide detailed drawings of the proposed new spent fuel pool racks, clearly noting all dimensions (including weight). Include all partitions from side to side, support structures, projections, and points of attachment to the pool or liner.

Vepco answer 5-1

See Vepco's statement of objections. The detailed engineering drawings referred to in this interrogatory are considered proprietary to NUS Corporation, the rack supplier.

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5-2 Given the additional amount of corrosion and fission products to be found in the spent fuel pool in light of the proposed modification, what will the effect be on worker exposures incurred in maintaining the fuel pool purification system (e.g., changing of filters) over the lifetime of the pool?

<u>Vepco answer 5-2</u>

A discussion of the personnel exposures experienced at Surry Power Station for the operation and maintenance of a spent fuel pool is contained in Vepco's Application in section 5.5 and in our letter of September 7, 1978 to the NRC in response to question number 5 in its letter of August 17, 1978. Vepco expects similar exposures at North Anna. A copy of this letter is attached.

5-3 What will be the effects of the heat load increase in the spent fuel pool on the rate of corrosion of the zirconium alloy cladding of the spent fuel assemblies? What will be the effect on the corrosion rate of the stainless steel racks? Provide references to studies which support your answers.

Vepco answer 5-3

The corrosion rate of materials is temperature dependent. Even with the slightly increased heat loads, however, the temperature of the spent fuel pool will be roughly the same as it would have been without the additional storage capacity. Thus, the corrosion rate of the zirconium cladding and the stainless steel racks will be unaffected. Please refer to NUREG-0404, Appendix H.

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5-4 (a) What possible contaminants may be released in the spent fuel pool by defective spent fuel assemblies? (b) What number of defective rods may be stored in the pool without overloading the capacity of the pool filtration system to maintain water purity? (c) What will be the effect of defective rods stored in the pool on the rate of corrosion of the zircalloy (sic) cladding of the spent fuel assemblies to be stored in the pool?

Vepco answer 5-4

(a) The "contaminants" that would be released to the spent fuel pool would be the fission product inventory that is in the "gap" between the fuel pellets and the cladding. A list of these isotopes is contained in section 15.4.5 of the FSAR.

(b) Vepco does not know. A large number of defective fuel assemblies should not overload the spent fuel pool purification system but might require more frequent filter and demineralizer resin changes.

(c) Defective fuel rods will have no effect on the rate of corrosion of zircaloy cladding. Zircaloy was chosen because it is compatible with reactor fuel materials and fission products.

431 337

5-5 Much of the information in VEPCO's Application draws upon operating experience at the Surry Power Station. Provide the answers to the Nuclear Spent Fuel Questionnaire, dated November, 1977, to Congressman John Moss' Subcommittee on Oversight investigation concerning the Surry spent fuel pool.

Vepco answer 5-5

These answers are attached.

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5-6 What is VEPCO's defective rack detection mechanism?

<u>Vepco answer 5-6</u>

After the new racks were manufactured but before they left the factory, a "dummy" fuel assembly was inserted in each storage cell to ensure the proper fit. Once the new racks are installed, they will be tested again in the same manner. If a rack suffers some damage after it is installed, it will be rechecked in the same manner. Other than these checks, Vepco has no program for in-service inspection of spent fuel racks.

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5-7 If installed, how will any defective racks be corrected and/or removed from the spent fuel pool?

Vepco answer 5-7

If defective storage locations are identified, the affected rack will not be repaired or removed. Any defective storage location will not be used.

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5-8 Were the proposed high-density type 304 austenitic stainless steel racks fabricated by Brooks and Perkins?

<u>Vepco answer 5-8</u>

No.

5-9 What was the basis for VEPCO's determination not to use boron panels or borated water in the spent fuel pool. What are the advantages, both economically and otherwise, for not using either or both? What are the disadvantages?

Vepco answer 5-9

No determination was made not to use boron panels. Boron panels were not necessary to meet the NRC's criteria for maintaining subcriticality. The advantage of these panels is that they permit closer spacing of fuel assemblies while maintaining subcriticality, which in turn permits storage of more spent fuel in a given space. The principal disadvantage of such panels is that they add additional cost to the expense of purchasing the racks, and in Vepco's case, without any benefit to the proposed modification.

We do intend to use borated water in the spent fuel pool. Borated water is required in the refueling canal, which is connected to the spent fuel pool during refueling (see Technical Specification 3.9.1). A boron concentration this high makes criticality impossible even with the fuel in its most reactive configuration. The disadvantage is the potential for dilution or inadvertent filling of the pool with unborated water. This is why all our criticality analyses assume unborated water to calculate the maximum possible effective multiplication factor (keff).

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I prepared Vepco answers 1-2, 1-3, 1-4, 1-5, 1-6, 2-3, 2-4, 2-6, 2-8, 2-9, 5-2, 5-3, 5-4, 5-6, 5-7, and 5-8 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

Beverly M. Hill
Notary Public

I prepared Vepco answers 1-1, 1-7, 2-5, 2-7, and 5-9. They are true and correct to the best of my knowledge and belief.

Robert M. Neil
Robert M. Neil, Associate
Engineer, Vepco

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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

Beverly M. Hill
Notary Public

I prepared Vepco answers 2-1 and 2-2. They are true and correct to the best of my knowledge and belief.

James East
James East, 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 James East.

My commission expires Oct. 10, 1982

Beverly M. Hill
Notary Public

I located the documents for Vepco answer 5-5.

Dennis R. Fishback
Dennis R. Fishback, Engineer, Vepco

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COMMONWEALTH OF VIRGINIA.

City OF Richmond, to-wit:

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

My commission expires Oct. 10, 1982

Notary Public

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