May 11, 1979

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

VEPCO'S STATEMENT OF MATERIAL FACTS
AS TO WHICH THERE IS NO GENUINE ISSUE TO BE HEARD

This annex to Vepco's Motion for Summary Disposition of May 11, 1979, sets out those material facts about which Vepco contends there is no genuine issue to be heard. These facts are arranged in the order of the contentions set out in the ASLB's "Order Granting Intervention, Providing for a Hearing and Designating Contentions of Intervenors," dated April 21, 1979. All references in parentheses below, unless otherwise indicated, are to Vepco's "Summary of Proposed Modifications to the Spent Fuel Storage Pool Associated with Increasing Storage Capacity," as amended.

THERMAL EFFECTS (CEF)

1. The Spent Fuel Storage Pool at North Anna Units 1 and 2 is equipped with a spent fuel pool cooling system to remove decay heat (§ 5.2).

2. The system is designed to (1) remove the residual heat produced by one-third of an irradiated core 150 hours after reactor shutdown while maintaining the spent fuel pit water temperature at or below 140°F with two fuel pit coolers and one associated pump and with 113.2°F component cooling water (that is, normal condition) and (2) remove the residual heat produced by one irradiated core 150 hours after shutdown and one-third irradiated core 45 days after shutdown while maintaining the spent fuel pit water at a temperature of 170°F or less wit. two fuel pit coolers and one pump with 113.2°F component cooling water (abnormal condition) (§ 5.2.1).

3. The fuel pool cooling system has two shell and tube heat exchangers and two circulating pumps, all located in the fuel building (§ 5.2.2).

4. The heat exchangers and pumps are arranged for cross-connected operation (§ 5.2.2).

5. The heat exchangers are cooled with component cooling water, with service water available as an emergency supply of cooling water (§ 5.2.2).

6. The fuel pit coolers have a design duty of 56,800,000 Btu/hr each (with tube inlet 210°F and shell inlet 105°F) and are manufactured to the ASME VIII Div. 1-1968 design code (Table 5-1).

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7. The spent fuel pit pumps have 100-horsepower motors and a capacity each of 2,700 gpm, with a head of 80 feet at rated capacity (Table 5.1); each pump is connected to a separate, independent Class I power supply.

8. The spent fuel pool cooling and purification system is designed as a Class I seismic system (§ 5.2.2).

9. All piping, valves, and components that come in contact with the fuel pit water are austenitic stainless steel and meet design codes ANSI B31.7-1969 and ANSI B31.1-1967 (§ 5.2.2, Table 5-1).

10. Redundant piping is provided from the fuel pit through the pumps and coolers to the main return header located above pool water level (§ 5.2.3).

11. The spent fuel pit cooling pumps move the water through the fuel pool coolers, and the water returns to the fuel pool at the end of the pool opposite the suction point to assure mixing (§ 5.2.2).

Discharge of Heat to the Environment

12. The spent fuel pool heat exchangers transfer the heat from the spent fuel pool water to the component cooling water (or, in an emergency, to the service water) (§ 5.2.2), and the component cooling water transfers its heat to the service water (McKay affidavit).

13. The service water, in turn, goes to the Service Water Reservoir, where the heat is transferred to the atmosphere (McKay affidavit).

14. For normal operation, the total heat discharged to the environment by Units 1 and 2 with the present system (that is, 400 stored spent fuel assemblies) is 13,713 MBtu/hr, whereas after the modification (966 stored assemblies), it will be 13,719 MBtu/hr, an increase of only about 0.04% (Table 7-2).

15. It will require a maximum of 12 gpm of make-up to dissipate this additional heat.

16. The environmental impact of this increased heat load will be insignificant (§ 10.0, § 10.1.3, Brehmer affidavit).

Spent Fuel Pool Cooling System Analysis (§ 7.2).

17. The installed spent fuel cooling system has been analyzed, taking into account the proposed increase in fuel storage capacity, for both normal and abnormal (full-core discharge) conditions (§ 7.2).

18. The following assumptions were used to determine the design basis heat load:

a. Irradiation times of 272, 544, and 816 Effective Full Power Days, which correspond to a one-, two-, and three-year fuel cycle respectively, with a load factor of 85% and an annual 45-day refueling

outage;

b. Back-to-back refuelings 45 days apart;

c. Uranium decay heat from NRC Branch Technical Position 9-2;

d. Fuel moved into the pool instantaneously 150 hours after shutdown, except for the full-core discharge case, when fuel is moved from the reactor to the pool at a rate of 20 minutes per assembly starting 150 hours after shutdown;

e. Stretch rating of 2,900 MWt for full power;

f. Maximum 966 storage locations in the pool; and

g. Component cooling water at its maximum of 113.2°F (§ 7.2).

19. Acceptable and appropriate engineering techniques were used to calculate the fuel pool temperatures based on the above assumptions (McKay affidavit).

20. The resulting fuel pool temperatures are found to be within the limits of 140°F for the normal case and 170°F for the abnormal case if one fuel pool cooling system pump and two coolers are used (§ 7.2).

21. The results of this analysis can be summarized as follows:

SPENT FUEL POOL COOLING SYSTEM
HEAT LOAD AND OPERATING TEMPERATURE
WITH THE INCREASED STORAGE CAPACITY

	Decay Heat MBtu/hr	Fuel Pool Temperature, Deg F 1 Train 1P-1Clr	1P-2Clr	2 Train 2P-2Clr
Normal	19.4	147.8	135.4	130.4
Abnormal	35.9	176.9	154.2	144.9

(Table 7-1).

22. The second heat exchanger would be required for only a period of 4-5 days, and only if a highly unlikely sequence of events were to occur:

a. Unit 1 refueled 45 days before the event;

b. Unit 2 just defueled;

c. Unit 3 or 4 loss-of-coolant accident (LOCA); and

d. Other unit cooldown (McKay affidavit).

23. The fuel pool temperatures summarized above were calculated based on very conservative and worst-case assumptions and are valid for establishing a design basis (§ 7.2).

24. Actual operating temperatures experienced at the Surry Power Station, Units 1 and 2, which are of similar design, have been significantly lower than the calculated temperatures (§ 7.2).

25. In fact, the fuel pool temperature at Surry has been maintained at about 95°F during both winter and summer using only one pump and one cooler (§ 7.2, § 5.5).

26. A failure analysis of the spent fuel cooling system has been done (§ 7.2).

27. The failure analysis confirms that boiling and any adverse effects are prevented even in the event of a postulated failure of a spent fuel cooling pump or spent fuel pool heat exchanger (§ 7.2).

28. If a spent fuel pit cooling pump failed to operate, the standby pump would be started manually (Table 7-3).

29. Once the operating pump stops, over an hour is available to start the standby pump before the pool heats up 10°F at the maximum abnormal heat load (Table 7-3).

30. If a fuel pool heat exchanger were to fail, the standby exchanger would be used (Table 7-3).

31. More than an hour would be available to realign the piping system because of the slow heat-up rate of the pool (Table 7-3).

32. The realignment would be effected by operating manual valves (Table 7-3).

33. The compone[illegible]oling water temperature could get as high as 113.2°F in the unlikely event of a LOCA in Unit 3 or

4, but the pool temperature would still be less than 177.5°F, the temperature that was used for the structural analysis of the spent fuel pool (§ 7.2, Table 7-3, McKay affidavit).

34. If the spent fuel pool cooling system became completely inoperable, installed station systems could provide sufficient make-up water to cool the fuel and to maintain sufficient water shielding over the fuel (§ 9.1).

35. There are several sources of make-up water readily available:

a. Primary grade water system;

b. Fire protection system;

c. Boron recovery system;

d. Refueling water storage tank (§ 9.1).

36. These sources could be used by changing valve lineups or implementing certain temporary measures, such as the use of temporary pumps or hoses (§ 9.1).

37. Instruments give local indication in the fuel building and the auxiliary building and alarms in the main control room (§ 5.4).

38. Unit 1 control board instruments and alarms include:

a. Fuel pit temperature indication;

b. Spent fuel pit temperature alarms at greater than 140°F and greater than 170°F;

c. Spent fuel pit high/low water level, with the low-level alarm 6 inches below normal water level (El. 289.33);

d. Start/stop switch for spent fuel pit cooling pumps, with run indication on both Units 1 and 2 main control boards; and

e. High differential pressure alarm for the refueling purification filters (§ 5.4).

39. Local indications include various flows, temperatures, pressures, and differential pressures (§ 5.4).

40. The system instruments, including the spent fuel pit level and temperature instrumentation, are calibrated periodically (§ 5.4).

<u>Leakage (§ 9.2; FSAR § 9.1.3.3.3)</u>.

41. The lowest level of pipe penetration through the fuel pool structure is at El. 285.75 feet, which provides a minimum water level of over 21 feet above the stored fuel (§ 9.2).

42. The proposed modification will not require any additional piping penetrations (§ 9.2).

43. The spent fuel pit is a reinforced concrete, seismic Class I structure lined with stainless steel plate a minimum of 1/4 inch thick (FSAR § 9.1.2).

44. If the integrity of the 1/4-inch thick stainless steel liner were violated at a welded liner seam, water could enter channels behind the liner seams.

45. These channels are connected to a common drain point, which is the fuel building sump.

46. In the event of a leak into one of these channels, water would rise in the fuel building sump, the sump pump would go on, and an alarm would sound in the control room.

47. If the puncture were at a point other than the channels and the fuel pit water were somehow to pass through the liner and reinforced concrete, it would reach the foundation material below, which is virtually impenetrable (FSAR § 9.1.3.3.3).

Thermal-Hydraulic Analysis.

48. The fuel rack base is elevated above the floor to ensure adequate flow under the rack to each fuel assembly (§ 6.6).

49. The spacing of the fuel assemblies also permits adequate downflow within the rack to each storage location (§ 6.6).

50. Analyses of the thermal-hydraulic characteristics of the high-density racks have been performed using techniques that are generally accepted in the engineering community (McKay affidavit).

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51. Those analyses show that sufficient flow is induced by natural convection to preclude local boiling in any storage location (§ 6.6).

52. Assuming a maximum bulk pool temperature of 170°F, the fuel rod surface temperature is calculated to be at least 4°F below the nucleate boiling temperature, and therefore no local boiling is predicted (§ 6.6).

53. During the full core offload (abnormal case) with the bulk pool temperature at 170°F, the maximum temperature of the water exiting from a storage location is less than 197°F, which is 44°F below the local saturation temperature (boiling point) of 241°F.

RADIOACTIVE EMISSION (CEF)

54. The fuel building is equipped with a ventilation system to provide high-efficiency filtration, heating to inhibit the buildup of condensation, and excess exhaust flow to maintain a slight negative pressure in the building to prevent outward leakage (§ 5.3).

55. The fuel building ventilation system has two supply fans, one to serve the spent fuel pit area and one for the remote equipment space (§ 5.3.1).

56. The dual exhaust, combined with a two-speed supply fan arrangement, provides step capacity control and protection against a single failure (§ 5.3.1).

57. The exhaust is continuously vented through the ventilation vent but can be selectively bypassed through the auxiliary building iodine filter bank (§ 5.3.1).

58. The exhaust is filtered continuously during irradiated fuel-handling operations to prevent the spread of any possible airborne contamination through the exhaust air system (§ 5.3.1).

59. The ventilation system in the fuel building at the Surry Station has maintained the levels of radioisotopes in the atmosphere in the building at acceptable concentrations (§ 5.5.3).

60. During normal station operations at Surry (that is, when refueling is not in progress) the gross activity above the pool water is about 10^{-11} to 10^{-10} micro Ci/ml (§ 5.5.3).

61. The principle isotopes noted are Co-58, Co-60, Cs-134, and Cs-137 (§5.5.3).

62. During refueling operations at Surry, I-131 levels above the pool of 5 x 10^{-11} to 5 x 10^{-10} micro Ci/ml have been noted (§ 5.5.3).

63. During refueling, the fuel building ventilation is directed through the auxiliary building charcoal filters, with a decontamination factor of about 100 (§ 5.5.3).

64. Since the added fuel storage represents longer term storage of well-cooled fuel, the escape of gaseous or

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volatile fission products, even with defective fuel, is expected to be negligible (§ 7.4).

65. Much of the iodine and the xenon has decayed after 100 days of cooling time (§ 7.4).

66. There is no mechanism for particulate fission products to become airborne (§ 7.4).

67. Because of the long half-life of Krypton-85 (10.76 years), Kr-85 levels remain in older fuel; however, the thermal driving force required to cause its diffusion in defective fuel is greatly reduced (§ 7.4).

68. Samples from the ventilation filter area at Surry do not show Kr-85 at detectable levels, and it is not expected to become significant as fuel storage increases (§ 7.4).

69. Therefore, increased fuel storage will have essentially no impact on concentration of radioactivity in the air of the fuel building (§ 7.4).

70. Also, since the pool temperature limits of 140°F (normal) and 170°F (abnormal) will not change with the modification, there will be no effect on the design evaporation rate of the pool (§ 7.4, § 5.3, § 5.5.3).

71. The spent fuel pool at North Anna 1 and 2 is equipped with a spent fuel pool purification system designed to remove soluble and particulate impurities from the water in the spent fuel pit, either reactor refueling cavity, and either

refueling water storage tank, in order to maintain the water optically clear and radiation levels within acceptable limits (§ 5.2, § 5.2.1).

72. Three 100% capacity purification pumps take suction at two permanently installed skimmers and pump water to a demineralizer and filters located in the auxiliary building (§ 5.2.2).

73. The 400-gpm filtering rate of the purification system results in a clean-up half-life of 27 hours and maintains suspended solids at a low concentration for optical clarity (§ 5.2.3).

74. Experience with the fuel pool purification system of similar design at Surry has been satisfactory (§ 5.5.1).

75. The system remains in operation continously (§ 5.5.1).

76. If the pressure drop across the filter or demineralizer exceeds the allowable value (15 psi and 25 psi respectively), the filter is replaced or the resin is plenished (§ 5.5.1).

77. The radiation levels of the demineralizers (which are shielded in cubicles) are usually from 1 to 4 R/hr. (§ 5.5.1).

78. The filters (which are similarly shielded) are normally changed because of high pressure drop and usually have

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radiation levels of about 100 mR/hr (§ 5.5.1).

79. The filters are normally changed prior to each refueling, that is, twice per year, assuming two units are operating (§ 5.5.1).

80. The spent fuel pool purification system removes both radioactive and nonradioactive particulates from the pool water (§ 5.5.2).

81. At Surry the purity of the pool water is normally maintained between 0 and 0.3 ppm, with a maximum particulate concentration of about 0.4 ppm (§ 5.5.2).

82. Based on the experience at Surry, no significant effect on the North Anna system due to prolonged storage of spent fuel assemblies is to be expected (§ 7.3).

83. The maximum load on the purification system occurs during refueling operations, when fuel is being moved (§ 7.3).

84. Therefore, there will be no significant increase on the purification system load due to the proposed modification, because the number and frequency of refueling operations will not change (§ 7.3).

85. Any increase in the liquid or gaseous radioactive emissions from North Anna 1 and 2 resulting from the proposed modification are expected to be negligible (McKay affidavit).

86. They will not violate NRC regulations, either during normal operation of the expanded fuel pool or under

postulated fuel handling accidents (§ 10.1.3; McKay affidavit).

Accidents (§§ 9.1-9.4)

87. As noted above, in the highly unlikely event that the spent fuel pool cooling system were to become completely inoperable, installed station systems could provide sufficient makeup water to cool the fuel and to maintain sufficient water shielding over the pool (§ 9.1).

88. Several sources of makeup water are readily available:

a. Primary grade water system;

b. Fire protection systems;

c. Boron recovery systems; and

d. Refueling water storage tank (§ 9.1).

89. These sources could be used by either changing valve lineups or implementing certain temporary measures, such as the use of temporary pumps or hoses (§ 9.1).

90. The proposed modification will not affect the leakage and shielding requirements contained in the FSAR (§ 9.2).

91. The proposed modification will not require any structural changes, and therefore the ability of the structure to withstand the effects of an earthquake or tornado will not be affected (§ 9.2).

92. Vepco's seismic analysis of the new spent fuel storage racks and the pool structure shows that the racks can be accomodated by the structure during a seismic event (§ 9.3).

93. The spent fuel storage racks are classified Seismic Category I (§ 6.5.1).

94. Vepco has analyzed the structural integrity of the fuel racks under normal, abnormal, and seismic loads and demonstrated their integrity with respect to the NRC Standard Review Plan § 3.8.4 (§ 6.5.1).

95. The seismic loading of a fuel rack module is determined from a response spectrum modal dynamic analysis (§ 6.5.2).

96. Using the calculated loads and load combination, stresses are calculated at critical sections of the racks (§ 6.5.3).

97. The techniques used are generally accepted in the engineering community (McKay affidavit).

98. The results of the structural and seismic analyses demonstrate that the fuel racks are structurally adequate and meet the design criteria (§ 6.5.3).

99. Fuel handling accidents have been analyzed, including the case where a fuel assembly is dropped onto the floor of the spent fuel pool (§ 9.4).

100. The proposed modification will not affect the consequences of the accidents analyzed, because the analysis assumes that only one fuel assembly, the one that is dropped, is damaged (§ 9.4).

101. Thus the consequences of the accident are independent of the number of spent fuel elements stored in the pool (§ 9.4).

102. The high-density spent fuel racks have been reviewed in regard to the following accidents:

a. A fuel assembly drops on the racks;

b. A fuel assembly becomes stuck in the spent fuel racks; and

c. A fuel assembly drops next to the racks (§ 9.4).

103. While minor damage may be incurred by the rack if an element is dropped on it, the stored fuel will not be affected, and subcriticality will be maintained (§ 9.4).

104. The amount of force applied to a stuck fuel assembly is limited by the capacity of the crane (§ 9.4).

105. While minor damage may be incurred by the stuck fuel assembly, the weight of the fuel rack is sufficient to prevent any motion of the rack itself (§ 9.4).

106. The surrounding stored fuel assemblies will not be damaged, and subcriticality will be maintained (§ 9.4).

107. Mechanical barriers are provided on the outside of the rack to prevent a dropped fuel assembly from being brought too close to the rack, in order to maintain subcriticality (§ 9.4).

108. Criti ality calculations show subcriticality maintained with a fuel assembly lying across the top of a rack or next to a rack (McKay affidavit).

109. With the normal concentration of boric acid in the pool water, criticality cannot be attained with any possible array of fuel assemblies (McKay affidavit).

110. In short, the safety implications of the proposed modification insofar as fuel handling accidents are concerned remain the same as those previously analyzed in the FSAR (§ 9.4).

111. The accident defined as the dropping of a spent fuel assembly onto the spent fuel pit floor and the resultant rupture of the cladding of all the fuel rods in the assembly has been analyzed in § 15.4.5.1 of the FSAR (McKay affidavit).

112. The analysis was done in accordance with NRC Safety Guide 25 (McKay affidavit).

113. The analysis shows that the accident would not result in excessive radiation exposure at the site boundary, that is, in exposures exceeding the guidelines of 10 CFR Part 100 (FSAR § 15.4.5.1; McKay affidavit).

114. Assuming as a worst case that the cladding of all rods in one entire fuel assembly fails, the offsite doses would not exceed the limits of 10 CFR Part 100 (McKay affidavit).

MISSILE ACCIDENTS (Potomac Alliance).

115. An analysis of the effect of a small tornado missile has been done in § 15.4.5.2.4 and § 9.1.2 of the FSAR, using accepted engineering techniques (McKay affidavit).

116. Stored fuel in the spent fuel pit is protected from horizontal missiles by the thick reinforced concrete walls of the pit, which extend 20 feet 10 inches above grade (FSAR § 15.4.5.2).

117. The building geometry protects the fuel elements from direct impact of missiles with angles of approach up to approximately 45° above the horizontal (FSAR § 15.4.5.2).

118. According to technical papers by D. R. Miller, W. A. Williams, and T. L. Doan, large missiles such as utility poles and automobiles (which are the design tornado missiles for North Anna 1 and 2) lack sufficient lift or velocity to clear a height of 25 feet (FSAR § 15.4.5.2).

119. These could not, therefore, strike the fuel elements (FSAR § 15.4.5.2).

120. The spent fuel elements would be protected from lighter missiles by the water covering the storage racks in the pool (FSAR § 15.4.5.2).

121. According to the paper by T. L. Doan, small fast-moving missiles traveling downwards would impact only one fuel assembly (FSAR § 15.4.5.2).

122. As noted above, a tornado missile impacting the spent fuel would not result in radiation doses that exceed the limits of 10 CFR Part 100 (FSAR § 15.4.5.2).

123. An analysis of the risk of turbine missiles has been done and is described in § 10.2.1 of the FSAR (McKay affidavit).

124. The FSAR turbine missile analysis was done with appropriate and sound calculational techniques (McKay affidavit).

125. The FSAR analysis shows that the risk of unacceptable damage to the fuel building is zero for low-trajectory turbine missiles, 1.3139×10^{-13} per unit per year for high-trajectory missiles at design overspeed, and 1.3235×10^{-10} per unit per year for high-trajectory missiles at destructive overspeed (McKay affidavit).

126. The turbine missile analysis is not changed by the proposed modification (McKay affidavit).

MATERIALS INTEGRITY (Potomac Alliance) and CORROSION (CEF)

127. Storing 966 instead of 400 fuel assemblies in the spent fuel pool will not materially increase the corrosion of, the stress upon, or other resultant problems with the fuel

cladding, the racks, or the pool liner due to higher radiation levels.

128. The amount of additional radiation to which the fuel would be exposed is insignificant in comparison to the levels in the reactor core during power operation (McKay affidavit).

129. The additional radiation will not cause significant stress or corrosion because the materials chosen for this application (stainless steel and Zircaloy) were chosen because of their low susceptibility to corrosive attack in a nuclear environment, i.e., under exposure to high temperature, high pressure, water, and radiation.

130. Increased decay heat will not materially increase the corrosion of, the stress upon, or resultant problems with the fuel cladding or the racks and pool liner, because the spent fuel pool cooling system will still maintain the fuel pool water below the FSAR limits of 140°F and 170°F, and far below the temperatures in the reactor.

131. Mr. A. B. Johnson, Jr., Staff Scientist, Corrosion Research and Engineering, Battelle Pacific Northwest Laboratories, has reported that "Fuel handling experience in the U.S., going back to 1959, has not revealed any instance where Zircaloy-clad, uranium oxide fuel has undergone observable corrosion or other chemical degradation in pool

storage. This favorable experience is corroborated by experience in other countries with the following maximum pool residence time for Zircaloy-clad fuel as of late 1977: Canada, 14 years; United Kingdom, 11 years; Belgium (MOL), 10 years; Japan, 9 years; Norway, 9 years; Karlsruhe, Germany, (WAK), 7 years; Sweden, 5 years."

132. The Zircaloy of the fuel and the 304 stainless steel of the fuel racks and pool liner are the same material no matter whether the high-density racks or the low-density racks are used.

133. The proposed modification is not expected to make the eventual removal from the pool of the spent fuel assemblies any more difficult; to the contrary, after extended storage the radiation levels and therefore the heat generated will have decayed to lower levels, so that handling and shipment of the assemblies will be easier.

134. As noted above, the spent fuel pool purification system is adequate to remove any potential incremental impurities resulting from the proposed modification; most of the impurities are released during fuel movements during refueling, and the number of fuel movements will be no greater with the high-density racks than with the low-density racks (McKay affidavit).

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OCCUPATIONAL EXPOSURE (Potomac Alliance).

135. The proposed modification will approximately double the amount of fuel to be stored in the pool (§ 9.5).

136. Depending upon whether spent fuel reprocessing is done, the fuel could be stored in the pool for about 10 years (§ 9.5).

137. During the storage of spent fuel under water, both volatile and non-volatile radioactive nuclides may be released to the water from the surface of the assemblies or from defects in the fuel cladding (§ 9.5).

138. Most of the material released from the surface of the assemblies consists of activated corrosion products such as Co-58, Co-60, Fe-59, and Mn-54, which are not volatile (§ 9.5).

139. The radionuclides released through defects in the cladding, such as Cs-134, Cs-137, Sr-89, and Sr-90, are predominantly nonvolatile, and, as with the activated corrosion product nuclides, their primary effect is their contribution to radiation levels to which workers near the spent fuel pool are exposed (§ 9.5).

140. The four primary isotopes noted in the pool water at Surry have been Cs-134, Cs-137, Co-58 and Co-60 (§ 9.5).

141. Based on measured data at the Surry Power Station, an individual continuously working around the pool would receive about 1.5 mR/hr, based on approximately 208 fuel

assemblies stored in the pool (§ 9.5).

142. This exposure will probably slightly increase when additional fuel assemblies are stored; however, because of the age of the earlier-stored fuel by the time the additional fuel reaches the pool, the increase should not be significant (§ 9.5).

143. Even if the exposure were doubled, to about 3 mR/hr, the exposure would be a relatively minor contributor to the overall exposure at the station (§ 9.5).

144. The installed purification system described above will be used to remove the corrosion and fission product nuclides (§ 9.5).

145. The removal of these nuclides will ensure that the radiation exposure to personnel will be maintained at low levels (§ 9.5).

146. The volatile fission product nuclides of most concern that might be released through defects in the fuel cladding are the noble gases (xenon and krypton), tritium, and iodine isotopes (§ 9.5).

147. Since short-lived noble gases will decay to negligible amounts, the only significant noble gas isoptope that could remain in the spent fuel pool and that would be attributable to storing additional assemblies for a longer period of time is Krypton-85 (§ 9.5).

148. It is not expected that increasing the spent fuel storage capacity will increase the Krypton-85 release rate, since the fuel discharge will continue at a 1/3 core per year per unit rate, and the release of Krypton-85 is most likely to occur during the initial year of storage (§ 9.5).

149. Iodine-131 releases will not be significantly increased by the expansion of the fuel storage capacity, because the inventory of I-131 (which has a half-life of 8 days) in the fuel will decay to negligible levels (§ 9.5).

150. Experience at Surry indicates negligible levels of I-131 in the pool water (§ 9.5); I-131 is noted only during refueling.

151. The pool water temperature will be maintained below the current design temperature; therefore it is not expected that there will be any significant change in evaporation rates or release of tritium (§ 9.5).

152. Operating experience at Surry has not indicated the presence of tritium in the fuel building (§ 9.5).

153. Based on experience at the Surry Power Station, the radiation exposure is relatively low, approximately 150 mR for a filter change (§ 9.5).

154. The demineralizer resins are currently changed about twice a year, resulting in personnel exposure of about 110 mR (§ 9.5).

155. The proposed modification is not expected to significantly increase these values (§ 9.5).

156. There have been no over-exposures associated with the Surry fuel pool (McKay affidavit).

ALTERNATIVES (Potomac Alliance).

157. The proposed modification will not alter the external physical geometry of the spent fuel pool or require additional modifications to the spent fuel pool cooling or purification system (§ 4.1).

158. The proposed modification does not affect in any manner the quantity of uranium fuel used in the reactor over the anticipated operating life of the facility (§ 4.1).

159. The rate of spent fuel generation and the total quantity of spent fuel generated during the anticipated operating lifetime of the station remains unchanged as a result of the proposed expansion (§ 4.1).

160. The approximate cost of the spent fuel racks is $2,600,000, exclusive of installation (§ 4.1).

161. The cost of installing the racks is estimated to be $100,000, for an estimated total cost of $2,700,000 (§ 4.1).

162. Based on the increased storage capacity of the spent fuel storage pool from 400 to 966 fuel assemblies, the approximate cost of the modification per added fuel assembly is $4,770 (§ 4.1).

163. Negligible additional operating costs will be incurred as a result of the modification (§ 4.1).

164. Additional storage capacity could be made available by building a new storage pool, either onsite or offsite (§ 4.5).

165. It is estimated that this alternative would cost approximately $25,000,000 (in 1977 dollars), or about $22,007 per added fuel assembly (§ 4.5).

166. Another cost resulting from this alternative would be the cost associated with double handling of the fuel (§ 4.5).

167. Also, such a facility would require 4 to 6 years to design, license, and construct (§ 4.5).

168. The alternative of physical expansion of the spent fuel pool would consist of removing one wall of the pool and expanding the pool in the direction of the removed wall (§ 4.9).

169. The fuel pool is bounded on four sides by structures necessary for the operation of Units 1 and 2 (§ 4.9).

170. The work and time involved in expanding the pool, including the moving of the structures referred to above, would exceed the work and time necessary to build a new fuel pool (§ 4.9).

171. The pool walls and liner cannot be reworked with spent fuel in the pool (McKay affidavit).

172. There is not enough time to expand the pool before the first refueling, and so the spent fuel would have to be transferred to other storage until the work was done (§ 4.9).

173. This would require finding another licensed storage facility and double handling of the fuel (McKay affidavit).

174. North Anna Units 3 and 4 are not expected to be completed until the late 1980's (§ 4.10).

175. This is too late to prevent a loss of full-core discharge capability for Units 1 and 2 in 1981 and a loss of refueling discharge capability in 1983 (§ 4.10).

176. It is difficult to accelerate the completion of the fuel building, because of its early stage of construction and because of its dependence on the service water and component cooling water systems, which will run throughout the facility (§ 4.10).

177. The need to accelerate construction and the need for double handling of the spent fuel make this alternative far more costly than the installation of the high-density racks (§ 4.10).

178. The North Anna 3 and 4 fuel pool would have to be licensed by the NRC before it could be used to store spent fuel (McKay affidavit).

179. The high-density fuel racks have already been fabricated and are at North Anna waiting to be installed (McKay affidavit).