

NRC PUBLIC DOCUMENT ROOM

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)	
)	Docket 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)

POTOMAC ALLIANCE RESPONSES TO THE NRC STAFF'S
INTERROGATORIES AND REQUEST FOR THE PRODUCTION OF DOCUMENTS



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Contention 3: Missile Accidents

3-1 (a) At this time the Alliance has yet to secure firm commitments from qualified experts regarding participation in this proceeding. If and when this occurs the parties will be notified pursuant to 10 CFR §2.740(e).

(b) Not applicable.

3-2 Not applicable.

3-3 Safety Evaluation Report Related to the Operation of the North Anna Power Station, Units 1 and 2 (June 1976) (NUREG-0053) (Hereinafter NUREG-0053).

Final Safety Analysis Report, North Anna Nuclear Power Station, Units 1 and 2 (May 1973, as amended) (Hereinafter FSAR).

Safety Evaluation by the Office of Nuclear Reactor Regulation Relating to Modification of the Spent Fuel Storage Racks, Facility Operating License NPF-4, Virginia Electric and Power Co., North Anna Power Station, Units 1 and 2 (January 29, 1979) (Hereinafter SE).

Draft Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel (March 1978) (Hereinafter NUREG-0404).

Environmental Impact Appraisal of the Office of Nuclear Reactor Regulation Relative to a Proposed Increase in Storage Capacity of the Spent Fuel Pool,

North Anna Power Station, Units 1 and 2. (April 2, 1979).
(Hereinafter EIA).

3-4 See answer to 3-3.

3-5 Documents supplied by Applicant or the NRC deficient
in regard to matters raised in Contention 3 include:

(1) The FSAR is inconsistent at §§3.3.2 and 9.1-4.

At §3.3.2 (see also §3.5.4) it is assumed that a
tornado could generate a missile 40 feet in length,
12 inches in diameter, weighing 2000 pounds and
moving in a vertical or horizontal direction at
150 mph. At §9.1-4 the FSAR states that such missiles
could not rise above a height of 25 feet. On the
basis of the latter statement it was concluded that
such a missile could not strike a fuel assembly.

(2) The FSAR is deficient at §§3.3.2 where it is
stated that large missiles could not exceed a
height of 25 feet and could not therefore damage the
fuel elements. This conclusion is unacceptable in
light of the fact that the structural protection for
the pool does not exceed a height of 20 feet,
10 inches. (See FSAR at p.9.1-3).

(3) The SE is deficient in several places in that:

(a) There is no explanation or justification for
the assertion at §3.5 that "the facility was

designed...(such that)...tornado-generated missiles shall not cause damage to (a) more than one spent fuel assembly within the spent fuel pool..." As we have argued above, the Applicant's reliance on the adequacy of the structural protection for the spent fuel pool is unjustified.

(b) At 9.1.2, the design of the spent fuel pool building was accepted "based on similarity with the Fermi-2 plant", which in turn had been accepted "based on the low probability of [a missile] damaging sufficient fuel assemblies to cause offsite doses in excess of 10 CFR 100 and the advanced stage of plant construction." It is unacceptable (1) that this probability is not quantified, (2) that the similarity or difference between the two buildings are not discussed, and (3) that the acceptance of one building design based on an "advanced stage of plant construction" was so casually adopted for another at a less advanced stage of completion.

(4) The SE (January 29, 1979) is deficient at §2.4:

(a) in that it simply repeats the assertion from the SE at §§ 3.5 and 9.1.2 that the building design is such that no more than one fuel assembly could be damaged in a tornado

missile accident; as argued above this assertion is unsubstantiated and contradicts other assertions made in the Applicant's Summary as well as NUREG-0404;

(b) in that it also repeats the unsupported assertion in the SE of the "low probability" of a serious tornado missile accident;

(c) in that it asserts that the "design provisions for protection from tornado missiles are unaffected by the proposed modifications and are, therefore, acceptable," when in fact (See answer to 3-7) the proposed compaction of fuel assemblies will make it more likely [both] that more than one fuel assembly could be struck by a missile entering the pool and that the consequences will be greater in terms of potential radiological consequences.

- 3-6 The nature and cause of the accident involving missiles referred to in Contention 3 is an accident involving a vertical or horizontal missile, generated either by a tornado or by a turbine in proximity to the spent fuel pool, which strikes and damages one or more of the fuel assemblies stored in the pool.

This accident is described or discussed in:

NUREG-0053, p.9-2

FSAR 3.3.2 and 9.1-4 and Supplement, vol.II

§9.2-1 Comment 9.2

SER §9.1.2.

SE at p.2.

NUREG-0404 Sec. 4.2.3.2

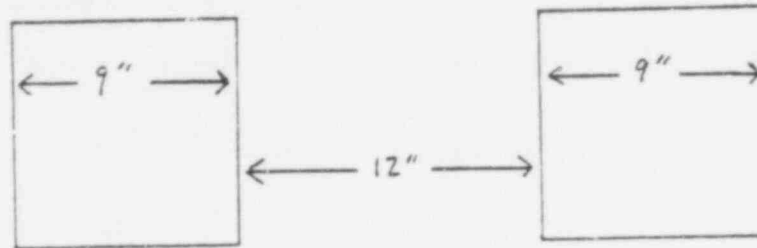
3-7 The basis for the claim in Contention 3 that the proposed modification will increase both the likelihood and the consequences of an accident involving missiles is the fact that storing the spent fuel assemblies closer together (i.e. with 14" center spacing rather than 21" center spacing) will increase:

- (a) the probability that a missile entering the pool area will strike one or more of the assemblies and
- (b) the probability that more than one assembly will be struck by any given missile entering the pool area

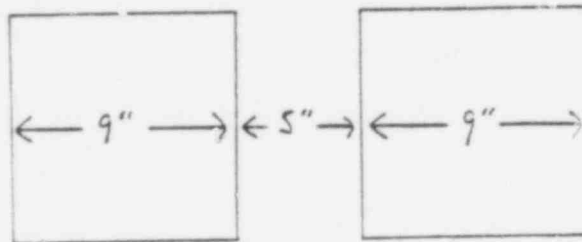
with consequent increases in the likelihood of all subsequent effects.

Consider the following diagram:

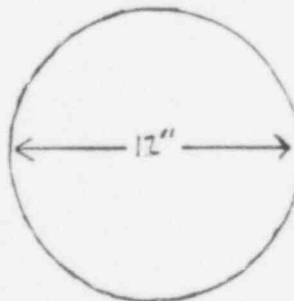
RACK CONFIGURATION BEFORE MODIFICATION:



RACK CONFIGURATION AFTER MODIFICATION:



HYPOTHETICAL TORNADO MISSILE:



Assuming one of the missile entry angles with least potential for striking one or more fuel assemblies, namely a vertical angle of entry, it is obvious that in the original pool design such a missile angle could conceivably result in no fuel assemblies being struck, or at most one assembly if no deflection should occur. The new pool design would, however, make it exceedingly difficult for even a perfectly vertical missile entering the fuel assembly storage configuration to avoid striking more than one assembly. The same line of reasoning would apply to a missile entering at an "optimum" angle of approach: the consequences would be increased even further as the angle of approach nears the "optimum".

3-8 The basis for the claim in Contention 3 that the Applicant has not demonstrated that the modified pool will withstand such accidents is that:

(1) The Applicant has not demonstrated that the spent fuel pool roof or building will prevent such missiles from entering the pool:

(a) The roof is explicitly not designed to provide tornado missile protection (See NUREG-0053, p.9-2; FSAR Table 3.2.1-1), even though a vertical tornado missile is explicitly considered as one possible

cause of spent fuel pool accidents. (FSAR 3.3.2).

(b) The Applicant has contended that the SFP walls will protect the spent fuel from horizontal tornado missiles, and from "missiles with angles of approach up to approximately 45° above the horizontal" (FSAR 9.1-3). But according to FSAR 3.3.2, "it is assumed that a tornado could generate either a:

- (i) missile equivalent to a wooden utility pole 40 feet long, 12 inches in diameter weighing 50 pcf, and traveling in a vertical or horizontal direction at 150 mph, or a
- (ii) missile equivalent to a one ton automobile traveling at 150 mph not more than 25 feet above ground grade and with a contact area of 30 square feet."

Since the fuel building wall is only 20'10" above ground grade and since Applicant has nowhere asserted that large tornado missiles cannot reach a height greater than 20'10", Applicant has not demonstrated that the modified pool will withstand such accidents. Furthermore, NUREG-0404 explicitly considers a tornado-generated utility pole accident in these words:

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"Assuming that the missile entered the pool at an optimum angle, a 45' row of fuel assemblies could be impacted if the missile was not deflected..." so that "a total of 20 MT" of fuel could be impacted. (§ 4.2.3.2).

Applicant has nowhere demonstrated that the modified pool will be able to withstand an accident caused by a missile entering at such an "optimum angle".

(2) The Applicant has not demonstrated that any other structure within the pool, such as the fuel racks, will prevent such missiles from striking one or more fuel assemblies. Applicant has specifically eschewed the need for any temporary cover over the pool for this purpose. (See FSAR Supplement vol. II, §9.2-1 Comment 9.2).

(3) Applicant has admitted (Summary §9.0) that "The proposed expansion of the spent fuel storage capacity could affect the offsite radiological consequences of an incident because of the additional increment of long-lived fission products stored in the pool."

3-9: 10 CFR pt. 100.

Regulatory Guide 1.13 (rev. 1, December 1975).

The answers to the interrogatories concerning missile accidents were answered by Fred Millar with the assistance of James Dougherty.

Contention 4: Materials Integrity

4-1 (a) At this time the Alliance has yet to secure firm commitments from qualified experts regarding participation in this proceeding. If and when this occurs the parties will be notified pursuant to 10 CFR §2.740(e).

(b) Not applicable.

4-2 Not applicable.

4-3 NUREG-0404;

Summary of Proposed Modifications to the Spent Fuel Storage Pool Associated with Increasing Storage Capacity For North Anna Power Station Units 1 and 2, Virginia Electric and Power Company (revision 1, May 11, 1979) (Hereinafter cited as Summary);

SE;

NUREG-0053;

A.B. Johnson, Jr., "Behavior of Spent Nuclear Fuel in Water Pool Storage," (September 1977), BNWL-2256, UC-70 (hereinafter cited as Johnson study);

A.S. Benjamin, et. al., "Spent Fuel Heatup Following Loss of Water During Storage," Sandia Laboratories, (September 1978) (Draft) (Hereinafter cited as SAND-1371);

Z.A. Munir, "An Assessment of the Long-Term Storage of Zircaloy Fuel Rods in Water," University of California at Davis, #154-036, (October 1977) (Hereinafter cited as Munir study);

D.R. Mash, Affidavit filed in Garrett v. U.S. Nuclear Regulatory Commission, (D. Ore., March 27, 1978) (Hereinafter cited as Mash affidavit).

4-4 Same as answer to question 4-3.

4-5 Documents prepared by the Applicant and the NRC Staff which are deficient with regard to the Materials Integrity contention include:

a. The Summary is deficient at §6.3.1 in that it asserts that "stainless steel has... been shown to be compatible with spent fuel pool water and the stored assemblies." This statement implicitly denies that there is a possibility of corrosion or stress-corrosion cracking, either with stainless steel or with zircaloy.

b. The SE is deficient at §2.3 in that it asserts that corrosion of pool components will be "negligible." To the extent that this statement acknowledges the possibility of long-term materials integrity problems, it offers no analysis of such problems. Furthermore, it

is contradicted by NUREG-0404 at §§3.1.1-3.1.4, which specifically identifies corrosion as a problem to be overcome when placing stainless steel and zircaloy in aqueous environments. NUREG-0404 further suggested that long-term storage, such as that entailed in the proposed modification, might result in "stress-corrosion cracking, intergranular corrosion, and hydrogen absorption and precipitation by the zirconium alloys." (§3.1.4.). The Staff's assertion of the long-term integrity of the pool materials paints over the gross inadequacy of existing testing experience with such long-term effects.

- 4-6 The basis for the claim in Contention 4 that the proposed modification will increase the corrosion of, the stress upon, and resultant problems concerning the components of spent fuel pool is that there are well-documented, serious problems which may arise in connection with the long-term storage of spent fuel. These problems "have potential significance principally in the event that pool storage were to be extended into the 20-to-100 year time frame." (Johnson study). Dr. Johnson has also stated that "[i]t is not now clear how long pool storage of spent fuel may be extended." (Johnson study at p.3).

These problems flow from the fact that the proposed modification will increase the total amount of decay heat present in the pool, thereby increasing the stress on the fuel rod cladding, and will increase the radiation experienced by the fuel rod cladding, the fuel racks, the liner and other pool components. In addition, these effects become more serious over extended time frames. As the NRC has stated (NUREG-0404): "corrosion effects that might occur after longer storage periods need to be examined in much greater detail, so that effects such as accelerated corrosion, microstructural changes, or alterations in mechanical properties can be determined." (§3.1.4). The Johnson study and others have pointed out that radiation exacerbates such effects.

Existing experimental data on the storage of spent fuel rods in long-term aqueous environments is based on short-term (less than 15 years) experience and on inadequate methods of observation. (Munir study, Johnson study). For example, the rate of fuel rod failures is unknown. (Mash affidavit). The U.S. Court of Appeals for the District of Columbia Circuit has recently commanded the NRC to weigh carefully the long-term implications of this method of spent fuel storage. This ruling is based on the court's finding that to date the Commission has

failed to do so. VEPCO's analysis has obviously been no less inadequate.

Numerous malfunctions in spent fuel pool facilities have been identified by the NRC, including leaks of unknown cause in the Turkey Point #3 pool, cracks in the liner at Millstone #1, and breach of the liner at G.E. Morris. (Mash affidavit).

The phenomenon of stress-corrosion cracking is not well understood, but studies indicate that stainless steel fuel racks and liners will be likely to experience such cracking to a greater extent in the environment of the modified pool than in the existing pool. Factors tending to increase such cracking include radiation (Johnson study) and temperature ("heat transfer, as from a fuel rod, intensifies stress-corrosion problems") (Mash affidavit).

4-7 Among the "resultant problems" envisioned in this contention are

- Liner leakage due to stress-corrosion cracking, leading to potential releases to the environment.
- Cladding leakage releasing radioactivity into the pool water and potentially to the environment.
- Increased radiation exposures for workers involved in repair, fuel handling, and routine occupational functions.

4-8 The term "potential problems" is intended to be synonymous with the term "resultant problems." See answer to question 4-7.

4-9 The bases for the assertion in this contention that the proposed modification will result in increased radiation levels include:

a. VEPCO's Summary states: "Storing additional spent fuel in the pool will increase the amount of corrosion and fission product nuclides introduced into the pool water." The proposed modification will "increase the amount of radioactivity stored in the pool." (pp. 56-58).

b. Occupational radiation exposures will increase. (Summary at p. 56).

c. The proposed modification will lead to an increase in the Keff (SE at p. 1-2; Summary at §6.4.3)

4-10 See answers to questions 4-7, 4-8.

The answers to the interrogatories concerning materials integrity were answered by Peter Lichtner with the assistance of James Dougherty.

Contention 6: Occupational Exposure

- 6-1 (a) At this time the Alliance has yet to secure firm commitments from qualified experts regarding participation in this proceeding. If and when this occurs the parties will be notified pursuant to 10 CFR §2.740(e).
(b) Not applicable.
- 6-2 Not applicable
- 6-3 Environmental Impact Appraisal of the Office of Nuclear Reactor Regulation Relative to a Proposed Increase in Storage Capacity of the Spent Fuel Pool. North Anna Power Station, Units 1 and 2. (April 2, 1979). (Hereinafter cited as EIA).
Safety Evaluation Relating to Modifications of the Spent Fuel Storage Racks, North Anna Power Station, Units 1 and 2. (January 29, 1979). (Hereinafter cited as SE).
Summary of Proposed Modifications to the Spent Fuel Storage Pool Associated with Increasing Storage Capacity (rev. 1, May 11, 1979). (Hereinafter cited as Summary).
- 6-4 See answer to 6-3.
- 6-5 EIA, §§4.4.6 and 7.1.2
These sections are deficient in that they do not specify assumptions as to occupancy patterns and dosage rates that underlie their conclusions.

There is no substantiation for the conclusion that the proposed modification would add less than one percent to the total annual occupational radiation exposure burden of the facility. Employee exposure was not analyzed by a breakdown as to particular tasks, including but not limited to changing filters and resin demineralizers. This type of analysis is required in order to fully grasp the impact of expanding the SFP on occupational dosages, and to insure that it falls within NRC regulatory limits.

SE § 2.6, 3.0(3)

These sections provide an inadequate evaluation of the increased occupational exposure. As in the EIA, the analysis is not broken down by individual tasks and associated dose rates. It is admitted by VEPCO in the Summary, p. 56, that expansion of the fuel pool will result in increased generation of "crud" and corrosion products, thus requiring more man-hours to clean and maintain the pool. In addition these tasks will have to be performed in an environment with substantial increased radiation levels. The Staff has failed to demonstrate that it has fully considered the effects of expansion on individual workers.

§2.6 does not specify what radiation protection design features were evaluated nor by what means.

Summary §9.5

§9.5 bases its assumptions upon the experience at Surry Power Station where there are only 208 fuel assemblies as opposed to the projected 966 fuel assemblies planned for North Anna. This experience is too remote from the projected expansion to provide meaningful comparison. There is no evidence in this document that appropriate calculations have been made of potential occupational exposure according to individual tasks to be performed. Exposures are cited in terms of mR/hr. without reference to the duration of the exposures on the total doses received. Such estimates do not respond to the question whether total exposures exceed NRC limits.

- 6-6 In the Summary at page 56 it is stated that "Storing additional spent fuel in the pool will increase the amount of corrosion and fission product nuclides introduced into the pool water. The proposed modification will approximately double the amount of fuel to be stored in the pool." Increased corrosion will result in a greater number of person-hours of cleaning, maintenance and related activity. Removal

of spent fuel from a pool emitting greater radiation will necessarily expose workers to increased radiation dosages. In sum, the contention that occupational radiation doses will increase is based on logic.

6-7 10 CFR §§20.101 - 20.103.

6-8 Since the analysis of the increase in occupational exposure was so limited in scope, it is highly conceivable that a proper analysis of job duties by particular tasks could demonstrate that some workers may be exposed to levels of radiation exceeding those permitted by NRC regulations. As always, the Applicant has the burden of proving otherwise.

The answers to the interrogatories concerning occupational exposure were answered by Fred Millar with the assistance of Gloria Gilman.

Contention 7: Alternatives

7-1 (a) At this time the Alliance has yet to secure firm commitments from qualified experts regarding participation in this proceeding. If and when this occurs the parties will be notified pursuant to 10 CFR \$2.740(e).

(b) Not applicable.

7-2 Not applicable.

7-3 EIA

Summary

7-4 Same as answer to 7-3.

7-5 Section 6.0 of the EIA, relating to alternatives, is deficient for failure to consider the alternatives of physically expanding the spent fuel pool, building a new pool onsite, or accelerating construction of the spent fuel pool at Units 3 and 4. These alternatives are reasonable, particularly in contrast to several alternatives which were given fuller treatment in the EIA (e.g., "shutdown of the plant" and "reduced plant output"), yet were completely disregarded in the EIA in violation of the Staff's obligations under the National Environmental Policy Act. The SE, to the extent it is held out as evidence of the Staff's adequate consideration of alternatives, is similarly deficient.

The Summary also provides a deficient analysis of the alternatives propounded by the Alliance. Section 4.5

of that document baldly states that an offsite pool would cost roughly \$25,000,000, and then apportions that cost on a per-assembly basis to the nearest dollar. The figures are not substantiated and no basis is provided for the implicit assumption that the offsite pool would have a capacity of 1137 assemblies. Like the Staff, the Applicant has not assessed the safety or environmental implications of this alternative.

In §4.9 of the Summary it is stated that the alternative of physically expanding the pool will involve too much work, time and money. No estimates are provided of the amounts of these resources required to implement this alternative, thus making it impossible for the Board, the Intervenors, or the public to assess the merits of this alternative. The Intervenors plan to challenge the assertion that the decontamination building on the south side of the pool prevents its expansion in that direction. There has been no analysis of the environmental and safety implications of this alternative by either the Applicant or the Staff.

Section 4.10 of the Summary constitutes a four sentence dismissal of a promising alternative to the proposed modification. The Applicant there states that it is "too late" to implement this alternative because it is "difficult" to accelerate the completion of the spent fuel pool at Units 3 and 4. All of the alternatives

facing the Applicant are difficult. The question of their relative difficulties, e.g., cost, safety, and environmental implications, have been totally disregarded by the Staff and the Applicant.

7-6 Yes. The construction of another spent fuel pool onsite would permit all spent fuel from North Anna to be stored under conditions optimizing the Keff of each pool by maintaining the 21 inch distance between centers of the fuel racks. Continued reliance on the 21-inch center design would prevent significant dangers to stored fuel from missile accidents, and would not create the more hostile conditions under which fuel assemblies would be stored according to the proposed modification. Depending on the assumptions employed regarding the storage capacity of such an onsite pool, its cost might be very low on a per-assembly basis.

7-7 Yes. By physically expanding the current pool and maintaining the current distance between centers of 21 inches, all of the environmental benefits identified in the answer to question 7-6 could be obtained. Similarly, differing assumptions regarding the capacity of the expanded pool would result in favorable cost/assembly estimates.

7-8 Yes. By maintaining the current distance between centers of 21 inches in the pool now under construction at Units

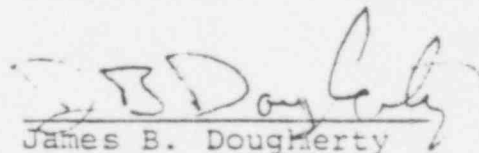
3 and 4, all of the safety and environmental benefits identified in the answer to question 7-6 could be obtained. Significantly, the alternative of accelerating completion of the pool at Units 3 and 4 appears to offer the most cost-effective means of achieving the Applicant's objective. Faster construction of this pool need not involve the commitment of resources which would otherwise not be spent, but would require only that the construction schedule for Units 3 and 4 be modified slightly. Since completion of the pool and Units 3 and 4 by 1983 may well be within the wherewithal of the Applicant, this alternative may offer substantial economic advantages over the proposed modification.

The documents and studies referred to herein are hereby expressly made available to the NRC Staff at the offices of counsel for the Potomac Alliance, 1346 Connecticut Ave., N.W., Suite 627, Washington, D.C. 20036, by appointment.

Respectfully submitted,

Of counsel:

Gloria M. Gilman, Esq.


James B. Dougherty

Counsel for the
Potomac Alliance

Dated this 30th day
of May, 1979.

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing POTOMAC ALLIANCE RESPONSES TO THE NRC STAFF'S INTERROGATORIES AND REQUEST FOR THE PRODUCTION OF DOCUMENTS have been served by deposit in the United States Mail, First Class, this 30th day of May, 1979, to the following:

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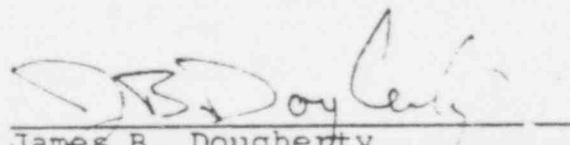
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