VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

W. L. STEWART
VICE PRESIDENT
NUCLEAR OPERATIONS

December 6, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. James R. Miller, Chief
Operating Reactors Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 456B
PSE&C/HSM/lmf/0829C
Docket Nos. 50-338
50-339
License Nos. NPF-4
NPF-7

Gentlemen:

ADDITIONAL INFORMATION
PROPOSED OPERATING LICENSE AMENDMENT NPF-4 AND NPF-7
NORTH ANNA POWER STATION UNIT NOS. 1 AND 2

In our letters of September 13, 1983 (Serial No. 456) and October 28, 1983 (Serial No. 456A), we provided answers to NRC's requests for additional information regarding the proposed spent fuel capacity expansion. Answers to additional questions (A.4, A.6, and B.3) are enclosed with this letter.

If you require further information on this matter, we would be pleased to meet with your staff at their convenience.

Very truly yours,

W. L. Stewart

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cc: Mr. James P. O'Reilly
Regional Administrator
Region II
U. S. Nuclear Regulatory Commission
Atlanta, Georgia 30303

Mr. M. B. Shymlock
NRC Resident Inspector
North Anna Power Station

A001
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Question A.4:

Provide a detailed description of the analysis of the spent fuel pool structure for the new rack loads; in particular describe the seismic loading and analysis. Describe the methods of analysis of the liner and liner anchors. Describe how impact of the racks on the pool floor was considered. Provide key calculations and numerical results of key calculations comparing actual and allowable values of stresses or load for all pertinent cases.

Answer:

SEISMIC LOADING AND ANALYSIS

The spent fuel pool structure has been analyzed to determine the effect of additional weight of new racks and stored fuel on the structure under static and dynamic conditions. See Attachment 1 for the maximum floor load summary of new rack loads to mat provided by Nuclear Energy Services.

LINER AND LINER ANCHORS

The leak-tight integrity of the spent fuel pool liner, with the new fuel rack foot loads, was analyzed using finite elements with the ANSYS computer program. A considered worst-case model of the as-built floor liner plate, bounded by anchors, was subjected to simultaneous maximum horizontal and vertical rack foot loads. Plasticity and large displacement behavior of the Type 304 stainless steel floor liner plate were included.

The resultant maximum liner plate strain was calculated to be .02 in./in. Maintenance of leak-tight integrity of the liner was therefore indicated by the small calculated maximum strain (this strain is less than 50 percent of the uniform ultimate strain of the Type 304 stainless steel liner material).

The adequacy of the spent fuel pool floor liner plate anchors (embedment plates), with the new fuel rack foot loads, was determined with the new rack arrangement in the pool. Maximum horizontal adjacent rack foot loads were conservatively summed at each embedment plate. The summed loads were then compared to the shear capacity of each associated embedment. The worst-case result obtained was a combined total 57.50 KIP horizontal rack foot loads applied at two embedment plates with an allowable shear capacity of 62 KIPS.

IMPACT OF RACKS ON POOL FLOOR

The effect of the vertical rack loads on the mat was calculated by evaluating the bearing stress produced in the concrete versus the allowable. As the mat is supported on concrete fill on rock the vertical loads from the racks are transmitted directly to the rock and have

negligible effect on the flexural analysis of the mat. In the horizontal direction, the mat was evaluated for the new rack loads. The results of this calculation are summarized in Table 1 along with the bearing stress evaluation for vertical rack loads. No loads are transmitted to the fuel pool walls from either the existing racks or the new racks. The racks contribute vertical and horizontal reactions at the top of the mat only. Vertical loading is either zero or downward so that vertical loads are transmitted directly to rock by bearing in the concrete mat. The horizontal reactions result from the friction between the rack feet and the liner. This results in a contribution to the net shear load in the structure sliding stability check. OBE and DBE have been considered. Reactions from the new racks are acceptable.

With the new fuel racks, the stresses in the structure due to thermal loading are not affected. This is based on a separate analysis which indicates that by revising the design basis line-up of one fuel pool pump and one fuel pool cooler to one fuel pool pump and two fuel pool coolers, the transient peak pool water temperature remains below 177.5°F at which the original structural analysis of the fuel pool was performed.

TABLE 1

RESULTS OF STRUCTURAL CALCULATIONS
FOR NEW FUEL RACKS

ITEM	RESULTS
1) Maximum Liner Strain - DBE	.02 in/in < ultimate strain
2) Maximum Shear on Liner Embedment Plate - DBE	57.5 kips < 62 kips (allowable)
3) Concrete Bearing Stress From Rack Pad	2.47 ksi < 3.47 ksi (allowable)
4) a) N-S Total Horizontal Rack Loads - DBE	1204 kips
b) E-W Total Horizontal Rack Loads - DBE	2523 kips
c) N-S Horizontal Rack Loads & Fuel Building Structure - DBE	5842 kips
d) E-W Horizontal Rack Load & Fuel Building Structure - DBE	5965 kips
e) Shear Resistance Due to Friction Between Bottom of Mat and Rock or Concrete Fill	11,622 kips
5) Minimum Factor of Safety Against Sliding For The Fuel Building	$\frac{11,622}{5965}$ = 1.95 > 1.1 (allowable per SRP)

Question A.6:

Describe the methods used to account for fluid inertia effects in the following analyses:

a) Fuel bundle/rack impact analysis
b) Rack sliding/tipping analysis
c) Seismic design of the rack structure
d) Seismic analysis of the pool structure

Answer:

a) Fuel Bundle/Rack Impact Analysis

The analysis is described in section 7.1 of the Non-Linear Time History Seismic Analysis Report which was previously provided as an attachment to our letter dated September 13, 1983 (Serial No. 456).

b) Rack Sliding/Tipping Analysis

This analysis is described in section 8.1 of the Non-Linear Time History Seismic Analysis Report which was previously provided as an attachment to our letter dated September 13, 1983 (Serial No. 456).

c) Seismic Design of the Rack Structure

This analysis is described in section 7.1.4 of the Structural Analysis Design Report which was provided as an attachment to our letter dated September 13, 1983 (Serial No. 456).

d) Seismic Analysis of the Pool Structure

The analysis of the fuel pool structure that has been performed is described in the answer to question A.4. No additional analysis of the effects of "water sloshing" in the pool was performed as it has been determined that the sloshing effects only take place in the top 10 feet of the water in the pool. The tops of the fuel racks are well below the sloshing zone and are therefore unaffected.

Question E.3:

Please provide an estimate of the weight, compacted volume, and radioactivity (curie content) of the racks to be removed, cut-up and disposed of as solid radioactive waste.

Answer:

As we described in our letter of June 16, 1983 (Serial No. 450B) Vepco is presently considering two methods of disposing of the existing spent fuel racks.

1. Decontamination of the fuel racks
2. Cutting up (volume reduction) for off-site disposal.

The required estimated information for both of these methodologies is listed below:

1. Decontamination *

Weight	3800 lbs.
Volume	2000 ft^3
Curie Content	4 - 5 Ci

*Assumes only the portion of the rack which cannot be decontaminated and actively removed from the remainder of the rack will be disposed of.

2. Volume Reduction

Weight	33,000 lbs.
Volume	10,000 ft^3
Curie Content	4 - 5 Ci