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December 18, 1984

United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. George W. Knighton, Chief
Licensing Branch 3
Office of Nuclear Reactor Regulation

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
Additional Information on Draft Safety Evaluation Report
Outstanding Issue 153 (Fuel Grid Analysis Combined LOCA and Seismic Loads)

Gentlemen:

In letter 2NRC-4-141 of September 11, 1984, Duquesne Light Company (DLC) stated that analysis was in progress to provide the information needed to resolve this issue. Letter 2NRC-4-203 of December 10, 1984, transmitted additional information in support of this issue. This letter transmits the revised FSAR pages which will be incorporated into the next FSAR amendment. This completes the DLC response on this issue.

DUQUESNE LIGHT COMPANY

By E. J. Woolever
E. J. Woolever
Vice President

KAT/wjs
Attachment

cc: Mr. B. K. Singh, Project Manager (w/a)
Mr. G. Walton, NRC Resident Inspector (w/a)

SUBSCRIBED AND SWORN TO BEFORE ME THIS 18th DAY OF December, 1984.

Anita Elaine Reiter
Notary Public
ANITA ELAINE REITER, NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1986

B001
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COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

On this 18th day of December, 1984, before me, a Notary Public in and for said Commonwealth and County, personally appeared E. J. Woolever, who being duly sworn, deposed and said that (1) he is Vice President of Duquesne Light, (2) he is duly authorized to execute and file the foregoing Submittal on behalf of said Company, and (3) the statements set forth in the Submittal are true and correct to the best of his knowledge.

Anita Elaine Reiter
Notary Public

ANITA ELAINE REITER, NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1986

4.2.3.4 Spacer Grids

The reactor coolant flow channels are established and maintained by the structure composed of grids and guide thimbles. The lateral spacing between fuel rods is provided and controlled by the support dimples of adjacent grid cells. Contact of the fuel rods on the dimples is maintained through the clamping force of the grid springs. Lateral motion of the fuel rods is opposed by the spring force and the internal moments generated between the spring and the support dimples.

Time history numerical integration techniques are used to analyze the fuel assembly responses resulting from the lateral safe shutdown earthquake, SSE, and the most limiting main coolant pipe break accident, LOCA. The reactor vessel motions resulting from the transient loading are asymmetric with respect to the geometrical center of the reactor core. The complete fuel assembly core finite element model is employed to determine the fuel assembly deflections and grid impact forces.

A comparison of the seismic (SSE) response spectrum at the reactor vessel supports versus the response spectrum of the time history indicates that the time history spectrum conservatively bounds the design acceleration spectrum curves for Beaver Valley Unit 2. The seismic analyses performed for a number of plants indicate that the maximum impact response is, in general, influenced by the acceleration level of the input forcing function at the fuel assembly fundamental mode. Thus, the data in seismic time histories corresponding to the design envelope are conservatively used for the fuel evaluation.

The reactor core finite element model consisting of the maximum number of fuel assemblies across the core diameter was used. The Beaver Valley Unit 2 Plant has fifteen (15) 17x17 8-grid (Inconel) fuel assemblies arranged in a planar array. Gapped elements simulate the clearances between the peripheral fuel assemblies and the baffle plates.

The fuel assembly finite element model preserves essential dynamic properties, such as the fuel assembly vibration frequencies, mode shapes, and mass distribution. The time history motions for the upper and lower core plates and the motions for the core barrel at the upper core plate elevation are simultaneously introduced into the simulated core model. The analytical procedures, the fuel assembly and core modeling, and the methodology are detailed in WCAPS 8236 (P), 8288 (NP), 9401 (P) and 9402 (NP). The time history inputs representing the safe shutdown earthquake motions and the coolant pipe rupture transients were obtained from the time history analyses of the reactor vessel internals.

GRID ANALYSIS

With respect to the guidelines of Appendix A of SRP Section 4.2, Westinghouse has demonstrated that a simultaneous SSE and LOCA event is highly unlikely. The fatigue cycles, crack initiation and crack growth due to normal operating and seismic events will not realistically lead to a pipe rupture (WCAP 9283). The factor applied to the LOCA grid impact load due to flashing has been demonstrated by Westinghouse to be unrealistic for Westinghouse fuel in Westinghouse plants. Therefore, this factor was not applied to the Beaver Valley Unit 2 analysis results.

The maximum grid impact forces for both the seismic and asymmetric LOCA accidents occur at the peripheral fuel assembly locations adjacent to the baffle wall. The maximum grid impact force for the safe shutdown earthquake analysis was 97 percent of the allowable grid strength. The corresponding value for the nozzle inlet break was 37 percent. In order to comply with the requirements in the USNRC 4.2 Standard Review Plan, the maximum grid impact responses obtained from the two transient analyses are combined. The square-root-of-sum-of-squares (SRSS) method is used to calculated the results. The maximum combined impact force for the Beaver Valley Unit 2 fuel assemblies was 99 percent of the allowable grid strength. The grid strength was established experimentally. It was based on the 95% confidence level on the true mean as taken from the distribution of measurements.

Non-Grid Component Analyses

The stresses induced in the various fuel assembly non-grid components are calculated. The calculations are based on the maximum responses obtained from the most limiting seismic and LOCA accident conditions. The fuel assembly axial forces resulting from the LOCA accident are the primary sources of stresses in the thimble guide tube and the fuel assembly nozzles. The induced stresses in the fuel rods result from the relative deflections during the hypothetical seismic and LOCA accidents. The stresses are generally small. The combined seismic and LOCA induced stresses of the various fuel assembly components presented in Table 4.2-1 are expressed as a percentage of the allowable limit. Consequently, the fuel assembly components are structurally acceptable under the postulated accident design conditions for Beaver Valley Unit 2.

TABLE 4.2-1

FUEL ASSEMBLY COMPONENT STRESSES
(PERCENT OF ALLOWABLE)

Component	Uniform Stresses (Direct/Membrane)	Combined Stresses (Membrane+Bending)
Thimble	78.6	64.2
Fuel Rod*	23.7	20.5
Top Nozzle Plate	----	6.0
Bottom Nozzle Plate	----	47.5
Bottom Nozzle Leg	7.7	8.9

* Including primary operating stresses

---- a negligible value