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June 19, 1984

Mr. Harold R. Derton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

✓Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Reference: McGuire Nuclear Station
Docket Nos. 50-369, 50-370

Dear Mr. Denton:

Please find attached additional information concerning the McGuire Nuclear Station spent fuel pool two region rerack modifications. This additional information was requested by a June 11, 1984 telecopy from Franklin Research Center to Duke Power which concerns the spent fuel pool structural analysis.

Very truly yours,

H.B. Tucker

Hal B. Tucker

WHM:glb
Attachment

cc: Mr. J. P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Suite 2900
101 Marietta Street, NW
Atlanta, GA 30323

Mr. W. T. Orders
Senior Resident Inspector
McGuire Nuclear Station

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DUKE POWER COMPANY
MCGUIRE NUCLEAR STATION
Spent Fuel Pool Rerack Modifications
Additional Information

1. Question:

The licensee stated that 'STRUDL finite element program' was used for the spent fuel pool analysis. Detailed information is requested on the finite element model used for static and dynamic analyses, and the loading systems.

Answer:

The high density racks are designed and analized as free-standing units. No static or dynamic rack loads are applied directly to the spent fuel pool walls. The Unit 1 pool slab spans between the pool walls and across deep beams normal to the walls. The slab area with the greatest clear span and largest load/area ratio was analyzed as the most critical case. The slab was modeled as a mesh composed of beam elements. The model boundaries are located at the centerlines of the pool walls and of the deep beams supporting this area. Member flexural properties vary depending upon nodal spacing and local reinforcing ratios.

Static dead and live loads are derived from assumed densities of water and concrete of 62.4 and 150 pounds per ft^3 respectively, and from static rack loads given in Westinghouse rack module data tables. Dynamic loads are obtained from OBE and SSE spectra curves for McGuire Nuclear Station and from dynamic rack loads given in Westinghouse rack module tables.

2. Question:

The licensee mentioned the use of original plant response spectra and damping values for the seismic loadings Futher information is requested relative to the response amplifications on the dynamic analysis for the rack impact loads under seismic event.

The racks impact loads cause high localized stresses on the concrete underneath the rack legs. Please indicate the stress levels and justifications if necessary.

Answer:

The rack support pads are purposely sized large to limit localized stresses in the pool floor concrete due to vertical rack loads. These stresses are limited to the allowable stress for bearing, in accordance with the ACI Code. Bearing stresses associated with rack impact are minimal, due to negligible rack support pad liftoff during a seismic event. The design margin for this case is greater than 1.25.

3. Question:

The licensee has stated that the thermal gradients were determined by the use of 'ANSYS finite element computer code,' for analysis by 'STRUDL program.' Please indicate if the analysis was based on uncracked or cracked sections, and provide sample calculations.

3. Answer:

Thermal gradients are determined via ANSYS thermal analysis as indicated in Section 3.1 of the license submittal. Thermal gradients then are used to derive thermal growth and rotational distortions. It is then determined what moments must be applied to result in zero net end rotation. These moments are applied step-wise. Reduced flexural stiffness is accounted for if moment in the member exceeds that required to cause cracking. The final moment required to obtain zero net end rotation is applied to the structure through member end loads.

Sample Calculation

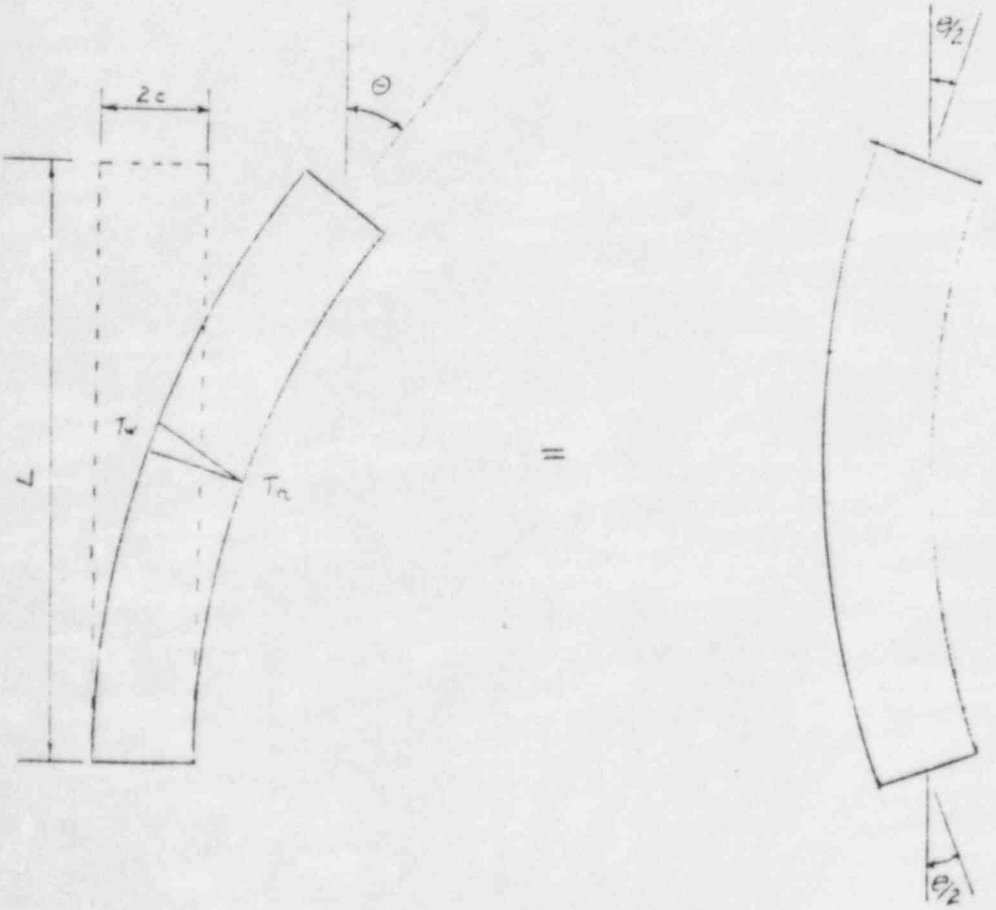
T water = Tw   T air = Ta

T initial = To

α = thermal expansion coefficient of concrete

Calculate end rotation of cantilever member

$$= \frac{\alpha \times (Tw-Ta)}{2c} (L)$$



Rotate ends until $\theta = 0$ allowing for varying stiffness as cracks propagate through the member.

The Moment - end rotation relationship is obtained by creating a beam model in STRUDL composed of short beam segments all initially with equal member properties. As ends are rotated, a moment develops in the beam segments until $M = Mcr$. Beyond this point, additional rotation results in cracking of the beam at constant moment = Mcr, until the entire member is cracked. This phenomenon is accounted for by changing the properties of individual beam segments as the end rotations are increased in step-wise fashion. Once the entire member is cracked, further end rotation results in increasing Moment at a reduced rate. Thus a given thermal rotation, restrained by end fixity can be related to an applied end moment.