GPU Nuclear

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Writer's Direct Dial Number:

May 30, 1984

Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing
U.S. Nuclear Generating Station
Washington, D. C. 20555

Dear Mr. Crutchfield:

Subject: Oyster Creek Nuclear Generating Station
Docket No. 50-219
Spent Fuel Pool Expansion - Additional Information

Enclosed are responses to questions forwarded to me by your letter of May 14, 1984 concerning GPU Nuclear's request to expand the capacity of the spent fuel pool.

Very truly yours,

Peter B. Fiedler
Vice President and Director
Oyster Creek

lr/0254e

cc: Administrator
Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, Pa. 19406

NRC Resident Inspector
Oyster Creek Nuclear Generating Station
Forked River, N. J. 08731

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ENCLOSURE

Question #1:

In the meeting held at the NRC office on April 16, 1984 (1), the Licensee indicated that out-of-phase motion of adjacent racks was also considered in the analysis. However, in the submittal (2), this issue was not discussed. Please clarify this point. Also, indicate how the possible impact due to out-of-phase motion was evaluated and identify the worst case (i.e. coefficient of friction, full load, half load, damping, direction of motion, and the location of possible impact).

Response:

The formulation presented in the licensing report, Section 6, is for anti-symmetric motion of adjacent racks. The term B_{212} in the L.H.S. of equation in the middle of page 6-15 will be zero for symmetric motion. The anti-symmetric motion formulation requires replacing the actual inter-rack gaps in both x and y directions by "equivalent gaps". The hydrodynamic coupling terms, eg. B_{212} in the above cited equation, are based on this equivalent gap, and Fritz's linear coupling term solutions. A condition of possible impact may exist if the maximum motion of any node on the rack exceeds 50% of the equivalent gap. The most critical node is typically a corner node at the top section of the rack. The maximum value of the coefficient of friction, 0.8 in rack analyses, is also found to produce maximum displacements. Oyster Creek plant staff has agreed to limit rack loading to symmetric loadings only, i.e. the total fuel assembly stored in any one quadrant of a rack will not deviate by more than 10% of the average of the four quadrants. The location of the fuel assembly groups in each quadrant will also maintain a reasonable level of symmetry.

Question #2

With respect to the equation of motion in Section 6 (2), it appears that the last term in the middle of page 6-15 of this section is not consistent with the second term of the equation of page 6-7. The review of a recently received report (3) did not provide further information needed to resolve this issue.

Response

The last term in the L.H.S. of the cited equation in page 6-15 represents the hydrodynamic coupling mass contribution due to motion of the plane of symmetry in anti-symmetric motion.

Question #3

Regarding the coefficients of friction, the Licensee indicated in the referenced meeting (1) that the maximum coefficient of friction (= 0.8) would produce the maximum displacement of the rack. This appears to be contradictory to the kinematic criterion given on page 6-17 (2). Please clarify this issue. Provide the technical basis and justification as to why a high coefficient of friction would result in higher displacement. Provide plots of outputs (if available) to clarify this issue.

Response

The reviewer is correct in pointing out the contradiction in the statement of the kinematic criterion on page 6-17, and the actual results. The a'priori statement on page 6-17 is being modified to bring it in accord with actual observations from analysis.

The assumed value of high coefficient of friction usually results in a greater rigid body movement due to two facts: (i) A higher coefficient of friction tends to make one leg stick, while the

other three lift off. Once such a condition is realized, inertia force is the only driving force; (ii) In our model, the support feet/pool liner interface has no rotational spring restraint. A smaller coefficient of friction, on the other hand, tends to provide extraction of energy through sliding, which is a far more effective energy removal mechanism.

Question #4

In the referenced meeting (1), the Licensee states that the results of the proposed lumped masses model have been compared with those of the WECAN computer codes (4). Please provide documents to clarify this issue.

Response

During early days of application of DYNAHIS, (c. 1980) it was benchmarked by Stone and Webster Corporation, Cherry Hill,, against ANSYS by running a highly non-linear problem on both codes. We are providing the available material on that benchmark to the reviewer (FRC).

Question #5

In the referenced meeting (1), the Licensee stated that a very small time step of integration was selected for the central difference scheme (δt = 15/100000 = 0.00015 sec). Please confirm this information. Also, provide the information necessary (i.e. plots of outputs) to verify that the possible numerical stability and convergence problem associated with the central difference scheme has been considered in the analysis.

Response

The time step for integration of the equations of motion for all Oyster Creek runs was 0.0002 sec. The stability of the results is verified by running one case with a vastly reduced time step, and comparing the output with the standard time step. Furthermore, the program checks the maximum rack displacement at each time step against a prescribed threshold value. Exceeding this threshold at any time in the computation process aborts the run.

Question #6

Please clarify whether the buoyancy effect has been accounted for in calculating the mass of the rack and fuel assembly. If not, provide justifications.

Response

Buoyancy effects are included in the analysis.

Question #7

Explain how each of the fluid coupling terms in the equation of motion in the middle of page 6-15 was evaluated. The Licensee should identify any existing experimental data to substantiate the analytical methods. Discussion of the applicability of experimental data should be given in terms of :

- o Geometrical configuration of the submerged structures (both geometry and dimension)
- o Type of input motion
- o Boundary conditions (i.e. sliding of the submerged bodies)
- o Assumption of fluid flow (i.e. incompressible potential flow.

Also, explain how the hydrodynamic mass was lumped at different elevations of the dynamic model.

Response

The fluid coupling terms are detailed in the proprietary report TM-678 submitted to FRC.

Question #8

Please provide relevant documents of the DYNAHIS computer code for review.

Response

Documentation of DYNAHIS has been provided to the reviewer (FRC).

Question #9

Please provide relevant drawings of the fuel rack and fuel pool systems for review.

Response

All relevant drawings have been forwarded to FRC on a proprietary basis.