TU ELECTRIC

Log # TXX-95235
File # 916 (5.6)
10010

September 14, 1995

C. Lance Terry
Group Vice President, Nuclear

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 AND 50-446
SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION ON LICENSE AMENDMENT REQUEST 94-022, SPENT FUEL STORAGE CAPACITY INCREASE

REF: 1) TU Electric letter logged TXX-94325, from C. L. Terry to the NRC, dated December 30, 1994
2) NRC Letter from Timothy J. Polich to C. Lance Terry, dated May 23, 1995
3) TU Electric letter logged TXX-95187, from C. L. Terry to the NRC, dated July 28, 1995

Gentlemen:

TU Electric transmitted License Amendment Request 94-022 (Reference 1) which revises the specification for fuel storage to authorize usage of the high density fuel storage racks, to increase the spent fuel storage capacity, and to adopt the wording, content, and format of the Improved Standard Technical Specifications. The NRC transmitted (Reference 2) a Request for Additional Information (RAI) regarding the subject License Amendment Request. TU Electric provided an initial response to the RAI in Reference 3. The Attachment herein contains TU Electric's updated responses for RAI No. 8 and 11. With these updated responses, TU Electric has provided complete responses to all the requests in the NRC's RAI.

The information provided in the Attachment does not affect the proposed Technical Specification changes, the safety analysis of those changes, or the determination that the proposed changes do not involve a significant hazard consideration (provided by Attachments 2 and 3 of Reference 1).

Energy Plaza 1601 Bryan Street Dallas, Texas 75201-3411

D029 1/1

Should you have any questions, please contact Carl B. Corbin at (214) 812-8859 or David A. Bersi at (817) 897-8134.

Sincerely,

C. L. Terry

By: D R Woodlan
D. R. Woodlan
Docket Licensing Manager

CBC/cbc

Attachment: Response to Request for Additional Information Regarding Spent Fuel Pool Storage Increase

c - Mr. L. J. Callan, Region IV
Mr. T. J. Polich, NRR
Mr. D. F. Kirsch, Region IV
Resident Inspector, CPSES

Mr. D. K. Lacker
Bureau of Radiation Control
Texas Department of Public Health
1100 West 49th Street
Austin, Texas 78704

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING SPENT FUEL POOL STORAGE INCREASE

NRC RAI # 8:

With respect to the fuel pool structure analyses, a table in the submittal (Reference 2) shows a safety margin of 1.02 for the South Wall. TU Electric concluded that the pool structure maintains its structural integrity during a critical loading combination since the safety margin is larger than 1.0. However, the calculated factor of safety is very marginal, and it could be changed depending on analytical methodologies used and other parameters (i.e., material properties used in the analyses, etc.). Submit the input and output of the pool structural analyses of the slab and South Wall for different critical loading conditions including the physical dimensions and locations of the reinforcement of the pool structure. Any technical assumptions made during the analyses should be discussed in detail.

TU ELECTRIC RESPONSE TO RAI # 8:

TU Electric provided a response to RAI # 8 in Reference 1. As a result of subsequent discussions with the NRC staff regarding the safety margin for the south wall, additional information is provided below.

The data points for forces and moments on the South wall elements under critical load combinations are within the interaction curve, with the exception of element 303. The axial force and bending moment in the horizontal and vertical directions were averaged with the adjacent elements of element 303. This averaged value was used to determine the safety margin for element 303. The safety margin was determined as follows. The distance of the line joining the data point on the interaction diagram with the origin was taken as L1. The distance of the intersection point of the above line with the interaction curve from the origin was taken as L2. The ratio L2/L1 was taken as the safety margin. The computed safety margin was 1.23.

In the initial submittal of Licensing Amendment Request 94-22 (TXX-94325), no stress averaging was done for element 303 of the South wall. The safety margin was computed as follows. For the axial force in the element, bending moment capacity (Mu) was obtained from the interaction diagram. The ratio of Mu/M, where M is the bending moment on the element, was taken as the safety margin. The computed safety margin was 1.02.

In summary, the improvement in the safety margin for the South wall is attributable to:

1) Stress averaging with the adjacent elements

2) More standard determination of the Safety Margin.

NRC RAI # 11:

TU Electric indicated that the rack design is controlled by the results of the single rack analysis. Provide justification that the results of a single rack analysis are more conservative than the results of a whole pool multiple rack (WPMR) analysis, or provide comparison of results from a single rack and WPMR results.

TU ELECTRIC RESPONSE TO RAI # 11:

A whole pool multiple rack (WPMR) analysis has been performed for the high density rack arrangement to be used in Comanche Peak spent fuel pool 2. This evaluation is a supplement to the single rack analysis, previously performed and documented in the CPSES Fuel Storage Licensing Report (References 1 and 2), which has demonstrated acceptable loads, displacements, and stresses for the fuel rack modules. The WPMR analysis includes all nine rack modules as well as the hydrodynamic effect of the surrounding fluid. Thus, the interactions between the individual rack modules, the surrounding fluid, and the pool structure are fully represented. The results obtained from the WPMR analysis confirm that the single rack analysis results previously reported well represent the limiting response of the racks.

A series of evaluations were performed in the process of completing the WPMR analysis. The key steps in the process are:

1. Develop a reduced element (reduced degree of freedom) single rack model.

2. Perform a fluid structure interaction analysis to determine the fluid coupling hydrodynamic mass matrix for the pool and all nine racks.

3. Based on steps 1 and 2, create the WPMR model with nine racks modeled and incorporating the whole pool fluid coupling hydrodynamic mass matrix.

4. Perform WPMR time history seismic analyses for both SSE and OBE for cases with friction coefficients equal to 0.8 and 0.2.

5. Determine the maximum rack displacements and stresses for the WPMR analysis and compare to the results previously calculated for the single rack analysis.

Each of these steps is discussed below.

In order to perform the WPMR analysis, a reduced element, i.e. reduced degree of freedom (DOF), finite element model for a single rack has been developed. Figure 11-1 shows the full DOF model (2-D view of the 3-D model) used in the single rack analysis, while Figure 11-2 provides the same 2-D view of the 3-D reduced DOF model used to represent an individual rack in the WPMR evaluation. Both models represent the rack in a similar manner, with the elements representing the rack base and support pads being the same in both models. The major difference between the full DOF and reduced DOF

models is a decrease in the number of elements used to represent the cell and fuel beams, the number of fuel to cell impact elements, and the number of elevations at which hydrodynamic fluid coupling mass matrix elements are used.

The reduced DOF model has been qualified by applying both SSE and OBE loadings using the same sets of acceleration time histories as in the full DOF single rack analysis. For both seismic loading conditions, evaluations were made for friction coefficients of 0.8 and 0.2. The results from the evaluation demonstrate that comparable displacements and loads are obtained for the reduced DOF model when compared to those of the full DOF single rack model. It is concluded, therefore, that the use of the reduced DOF model to represent an individual rack in the WPMR analysis is acceptable.

Having developed an acceptable single rack reduced DOF model, the WPMR model is compiled by combining nine such single rack models in a 3x3 array using the same rack-to-rack spacing as in the Comanche Peak spent fuel pool. Each single rack model within the WPMR model has the appropriate mass and stiffness properties for the rack size (either 11x14 or 12x14) it represents. The WPMR finite element model is shown in Figure 11-3.

The hydrodynamic effect of the water surrounding the fuel rack modules is incorporated into the WPMR model as 20x20 mass matrices. The twenty rows and columns represent two horizontal DOF's for each of the nine fuel rack modules plus the pool wall. Since the mass matrix is fully populated, the hydrodynamic interaction effects, both rack-to-rack and rack-to-wall, are included in the analysis. Three such mass matrices are used over the height of the WPMR model.

The hydrodynamic mass matrix is calculated using a two-dimensional finite element analysis in which a horizontal cross-section of the entire pool fluid area is meshed with pressure elements bounded by fluid-structure interface (FSI) elements. The finite element model is shown in Figure 11-4. The FSI elements, not depicted in the figure, serve to account for the interactions between the fluid pressure and the in-plane structural accelerations. By using the substructuring capabilities of the finite element code, the hydrodynamic mass matrix is obtained by substructural elimination of the pressure DOF's, retaining only two in-plane (horizontal) acceleration DOF's for each fuel rack plus the pool wall. The result is a 10-node, 2-DOF "superelement" which is included in the WPMR finite element model to incorporate the 20x20 hydrodynamic mass matrix into the overall system mass matrix.

The WPMR model is evaluated for both SSE and OBE by applying the same acceleration time histories as were used in the single rack analysis. Analyses have been performed for friction coefficients equal to 0.8 and 0.2 for both seismic loading conditions. The stress results for the limiting locations from the WPMR analysis are summarized in Table 11-1 along with the corresponding results from the single rack analysis. An inspection of this table reveals that, in all cases, larger margins are obtained for the WPMR analysis versus the single rack analysis. The displacement results, summarized in Table 11-2, show that the maximum relative displacement between adjacent racks is smaller for the WPMR analysis than for the single

rack analysis, thus indicating larger margin against rack-to-rack collision. The maximum individual rack displacement is slightly higher for the WPMR analysis than for the single rack analysis, but ample margin exists against rack-to-wall collision. Therefore, it is concluded that both the single rack analysis and the WPMR analysis demonstrate acceptable loads, displacements, and stresses for the Comanche Peak fuel racks.

Table 11-1

Comparison of Single Rack and WPMR Analysis Stress Results

Location	OBE Minimum Margin to Allowable*		SSE Minimum Margin to Allowable*	
	Single Rack	WPMR	Single Rack	WPMR
Support Pads	0.35	0.79	0.82	0.96
Cells	0.09	0.42	0.38	0.49
Cell to Base Plate Weld	0.51	1.28	0.95	1.58
Cell to Cell Weld	0.13	0.41	0.45	0.64
Cell Seam Weld	0.26	0.64	0.58	0.79
Cell to Spacer Weld	0.26	0.71	0.25	0.54

* Note: Margin to Alowable $= \frac{\text{Allowable Stress}}{\text{Applied Stress}} - 1$

Table 11-2

Comparison of Single Rack and WPMR Analysis Displacement Results

	Single Rack	WPMR
Maximum Individual Rack Displacement (inches)	0.29	0.30
Maximum Relative Displacement Between Adjacent Racks (inches)	0.58**	0.28

**Conservative value was reported based on the assumption that adjacent racks move completely out of phase.

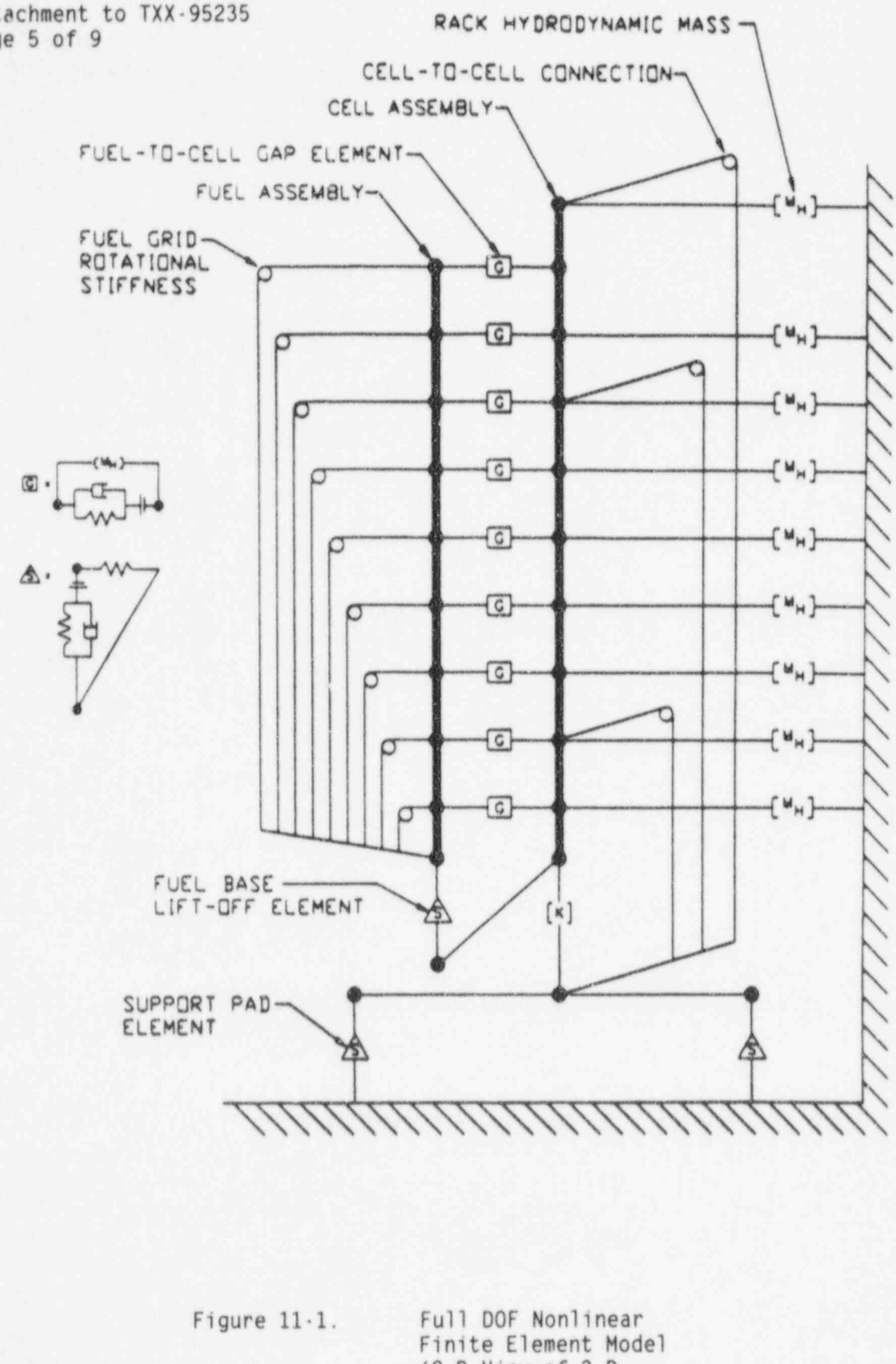

Figure 11-1. Full DOF Nonlinear Finite Element Model (2-D View of 3-D Model)

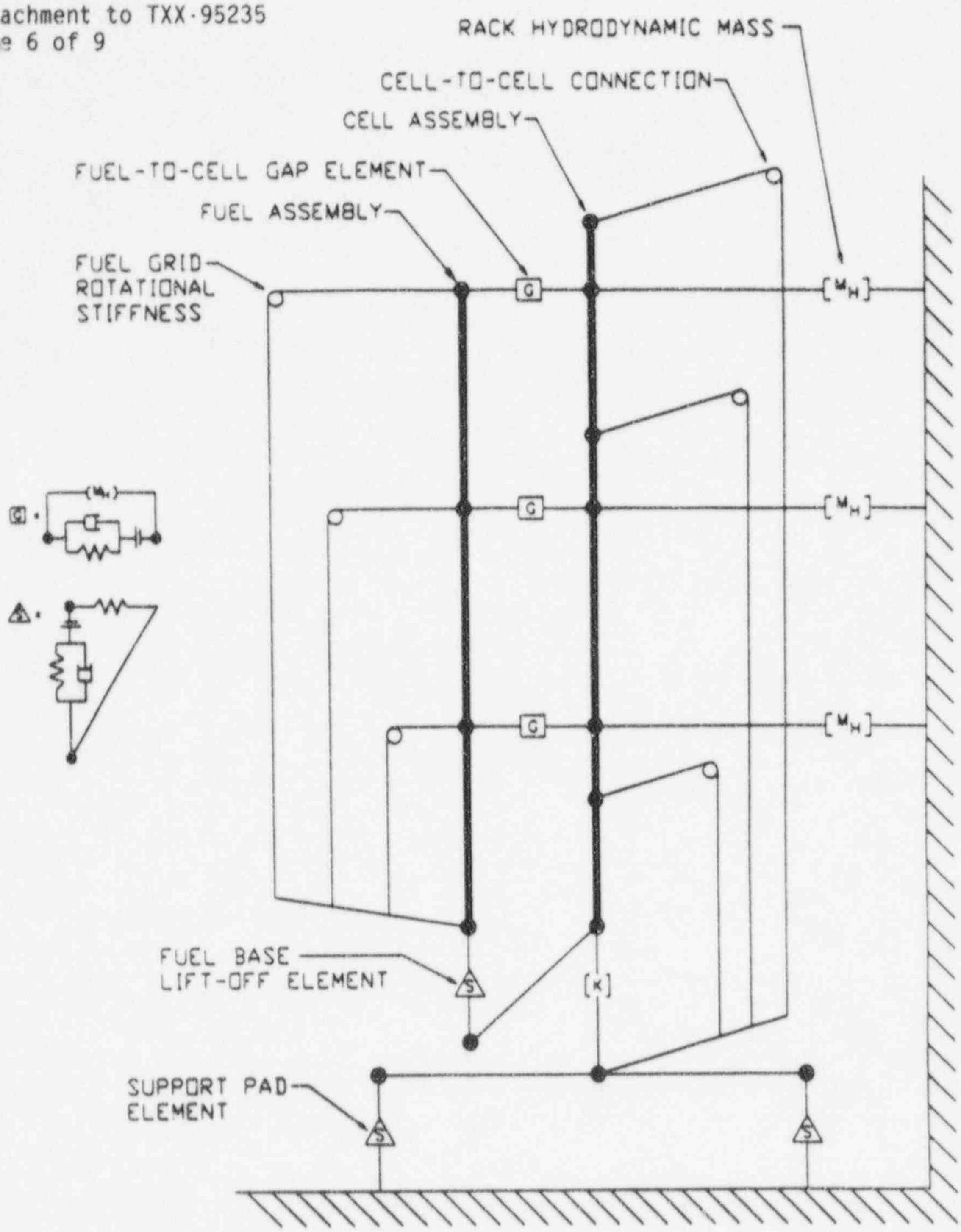

Figure 11-2. Reduced DOF Nonlinear Finite Element Model (2-D View of 3-D Model)

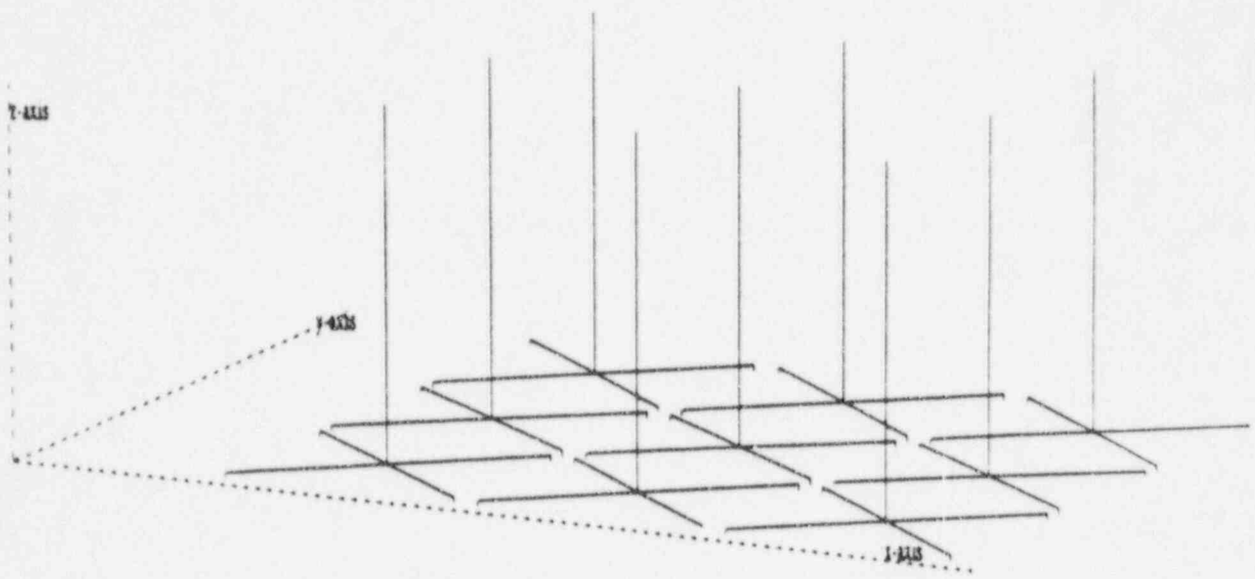

Figure 11-3. WPMR Finite Element Model

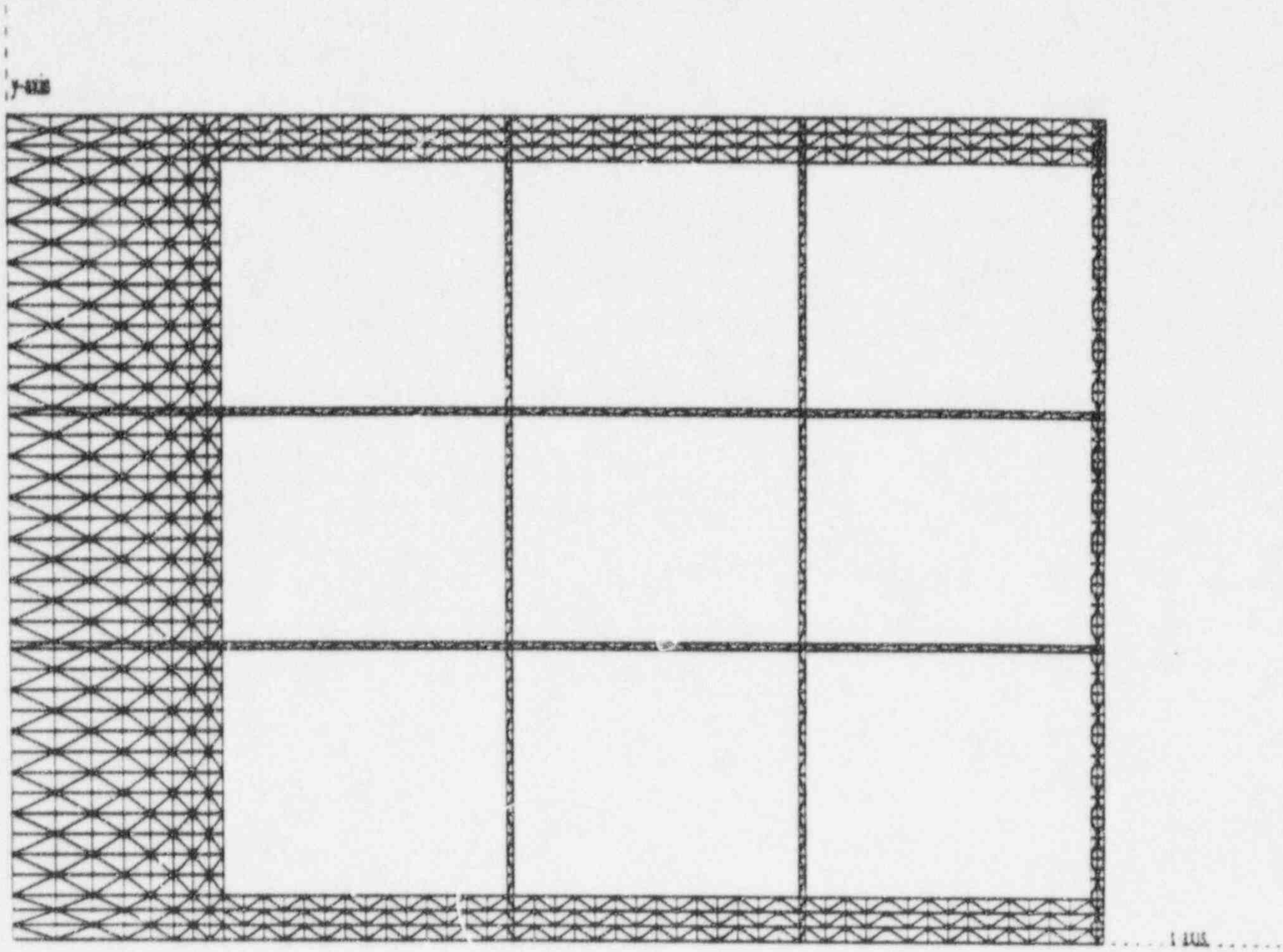

Figure 11-4. WPMR Hydrodynamic Mass Finite Element Model

References:

1. "Comanche Peak Steam Electric Station (CPSES), Docket Nos. 50-445 and 50-446, Response to Request for Additional Information on License Amendment Request 94-022, Spent fuel Storage Capacity Increase," letter logged TXX-95187, dated July 28, 1995, from TU Electric to U.S. NRC.

2. "Comanche Peak Steam Electric Station (CPSES), Docket Nos. 50-445 and 50-446, Submittal of License Amendment Request 94-022, Spent fuel Storage Capacity Increase," letter logged TXX-94325, dated December 30, 1994, from TU Electric to U.S. NRC.