REACTOR VESSEL SUPPORT EVALUATION FOR LOCA LOADINGS

For loss of coolant conditions, the dynamic response of the reactor vessel supports was analyzed using the discrete planar model shown in Figure 1. This model was devised for the idealized structure shown in Figure 2.

The shells were represented by flexible, massless beam elements having the cross-sectional area, moment of inertia, etc. of uniform, constant-thickness cylinders. An additional rotational spring at the base of the model represented the flexibility of the vessel foundation. In general, masses were placed at points of concentration of weight in the actual structure.

The reactor vessel is represented by masses 1, 2, and 3. Mass 1 includes the weight of the vessel skirt, lower vessel head, enclosed water, and a portion of the vessel shell. Mass 2, located at the elevation of the nozzles, includes the weight of the central portion of the vessel shell, enclosed water, the plenum cover, and a portion of the core support structure shells. Mass 3 represents the upper vessel head, enclosed water, and drive nozzles.

The reactor internals are represented by masses 4, 5, and 18. Mass 4 is located at the upper grid and includes the weight of the grid, plenum cylinder, and 1/8 of the core. Mass 5, at the lower grid elevation, represents about 2/3 the weight of the core support structure; the remainder is included in Mass 2. Mass 18 is the concentrated weight of the lower grid and flow distributor, plus 1/8 of the core.

The entire core was modeled as a simply-supported beam having the natural frequency of a single fuel assembly (about 3 cps). Masses 6, 7, and 8 each represent 1/4 core weight. The other 1/4 core weight is divided between masses 4 and 18.

Masses 9 through 12 represent the distributed weight of the drive support structures (a cylinder bolted to the vessel head providing lateral support for the upper ends of the control rod drives).

The control and drives are represented by masses 13 through 17. Mass 13 is located at the fringe between the core nozzle and the drive. Mass 14 represents the drive motors. Masses 15, 16, and 17 represent the distributed weight of the drives and drive housings.

To evaluate the postulated LOCA condition, the applied thrust due to a pipe rupture was applied to the model in the form of a thrust versus time curve. The LOCA thrust force acting at the reactor vessel's outlet nozzle was analyzed using the FLASH computer code and the relationship, thrust = pressure x area. A structural dynamics computer code was utilized to calculate the dynamic response of the planar model, i.e., the displacements, velocities, accelerations, and effective static forces at each time step. The time-varying effective static forces were then used to determine the foundation loads.

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FIGURE 1

REACTOR VESSEL DYNAMIC MODEL

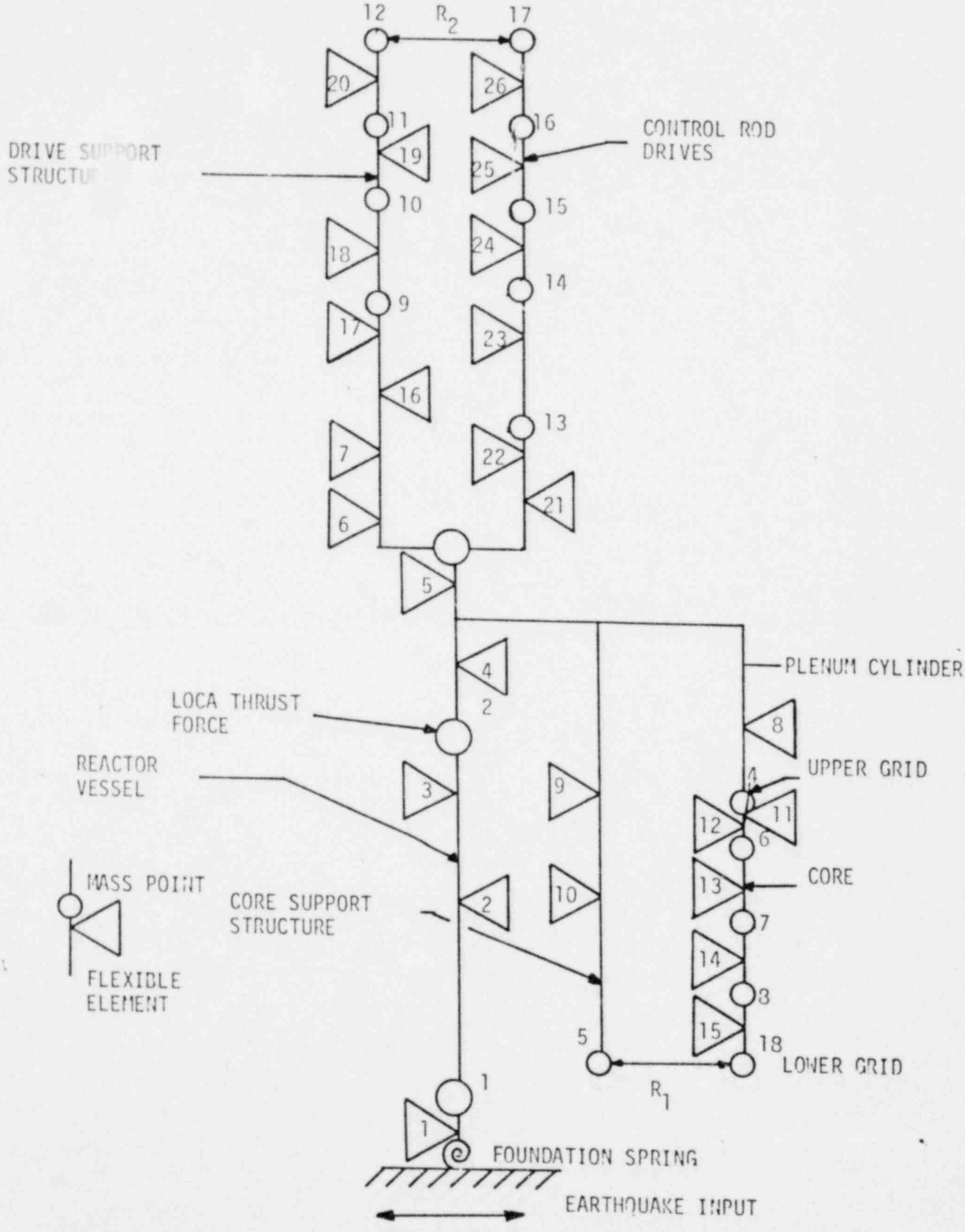

FIGURE 2

REACTOR VESSEL SCHEMATIC DRAWING