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EXPLORATORY MODEL STUDIES OF REACTOR PLATFORM MOTIONS. I UNPROTECTED DEEP WATER SITES*

by

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Although the continental shelf on the eastern coast of the United States appears to provide adequate shallow water (depth < 100 ft) locations where floating reactor platforms can be protected by breakwaters, the situation on the west coast is not so favorable.[1] Consequently, the wave induced motion experienced by a platform moored in deep water will have to be taken into account in the design of offshore plants for some coastal regions. A freely floating platform has three natural motions: heave, roll, and pitch with gravity as the restoring force. When the platform is moored there are three additional motions possible: surge, sway, and yaw with the restoring force being the cable weight (including the sinker under extreme sea conditions) and the elasticity of the mooring cable.

We have made exploratory studies of the motion of small scale (1:200 and 1:400) reactor platform models in scaled water depths of greater than 300 ft. The scaled dimensions of the platform were 400 ft x 400 ft x 48 ft with a scaled weight of 138,000 tons. Approximately 32% of the total weight was concentrated at the center of the platform in a container with scaled dimensions of 130-ft height by 50-ft diameter to simulate the containment vessel and nuclear steam supply system. About 6% of the total weight was divided into four equal amounts and located on the deck to simulate the turbine generators and auxiliary systems. Among mooring

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configurations which have been studied are (1) conventional ship anchorage with riser line 1.5 times water depth and a ground line six times the water depth, (2) a mooring with a riser line 1 3/4 times the water depth with a sinker weight located 70% of the water depth below the surface, and (3) a single point mooring with the line running through a pulley to a weight chosen to balance the wave drag on the platform.

The studies were made in a wave tank 40-ft long and 4-ft wide with a water depth of 20 in. Stainless steel demister mesh was used as a wave absorber and waves were generated with a wedge type generator. The wedge was driven by a 5-HP motor with a magnetic clutch which permitted continuous variation of wave period over a wide range.

Typical platform motions with type 2 mooring are shown in Figure 1. This figure shows the amplitude of platform motion non-dimensionalized by the wave amplitude plotted versus wave period divided by the natural pitch period of the platform. For very long period waves the motion was virtually pure surge with maximum platform motion ~30 times the wave height (the extent of surge motion was of course limited by the length of mooring line). As the wave period was decreased the surge motion was transformed to heave with just the amplitude of the incident waves. As the natural pitch period of the platform was approached, heave motion was replaced by pitching; the maximum platform pitch was about twice that of the incident waves. As the platform pitch approached its maximum value, the platform once again began to surge; although Dean and Harleman[2] have reported similar surge motion with substantially the same peak amplitude it is not clear whether our surge results were due to "cross waves"[3] generated by the wedge or to the incoming sinusoidal waves. Finally, for very short wave periods the pitching and surging motion died out almost completely and was replaced by a yawing motion.

Of the six possible platform motions we have observed all except sway and roll with mooring types 1, 2, and 3. Of the motions observed in this study, clearly the pitching motion would produce the largest accelerations and consequently would have the most adverse effect on dynamically balanced system components.

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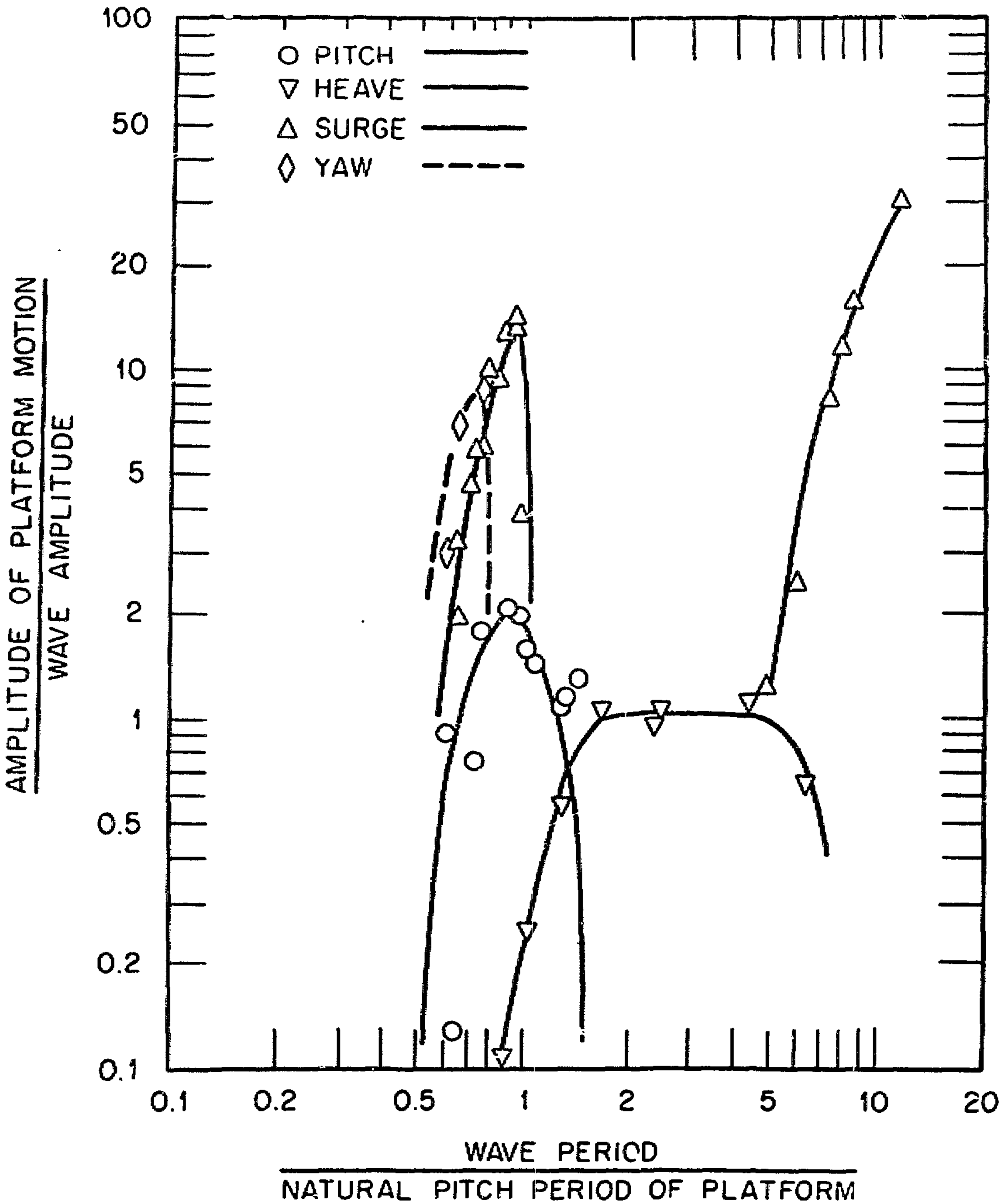

Fig. 1 . Platform Motion as a Function of Incident Wave Period.