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Experimental investigation of the fluid-structure interaction effect between adjacent equipment supports in a fast reactor

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The equipment supports are in constricted arrangement in the main vessel of the fast reactor. Under the condition of earthquake, equipment supports may sustain damage caused by the interaction between equipment supports and fluid, therefore, the evaluation of the fluid-structure interaction effect is an important aspect of the structural safety assessment of fast reactors. Using the added mass to assess the fluid-structure interaction effect is a more common method. ASME standard gives the added mass's formula for a single cylinder immersed in an infinite fluid domain. However, this formula is not suitable for the complex arrangement of equipment supports in the annulus region of main vessel. To investigate the added mass of equipment supports in fast reactor, in this paper, a number of experiments are carried out. A simplified and scaled model of fast reactor was designed, containing a main pump support cylinder, two intermediate heat exchanger (IHX) support, and two independent heat exchanger (DHX) support. Through the modal experiment and the sine wave experiment of the shaking table, the circumferential and axial pressure distribution data under different arrangements are recorded. For the purpose of assessing the fluid-structure interaction effect between equipment supports and fluid, the additional mass matrix of the support cylinders is derived according to the experimental results. The experiments provide a reference and basis for the arrangement of the equipment supports in the annular region of the fast reactor and the correction of the additional mass formula.

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