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The fluid structure interaction of narrow gaps between thin-wall coaxial structures in fast reactors

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In order to protect the key equipment from high temperature in fast reactor, main pumps and main vessel is shielded by single or multiple hot screens, forming narrow fluid gaps. However, these fluid gaps bring some difficulties in seismic analysis by introducing the fluid structure interaction effect. Added mass, a simplified but important parameter of fluid structure interaction effect, is much larger than the structure's mass itself especially when the gap between two coaxial cylinders is narrow. Moreover, the 2D beam-model based added mass formula generally used in engineering design is over conservative, making the structure burden large extra mass, however, there is no specific added mass guideline for such thin-wall and narrow-gap structure available. To study the fluid structure interaction of main pumps and main vessel with its hot screens, a series of dynamics/seismic experiments of coaxial cylinders with different gap sizes and height-radius ratios are carries out. The fluid pressure and acceleration distribution of such structures under different modal shapes are measured. A data processing method is established to transfer experimental results to added mass. Finally, the correlation between added mass and parameters like gap sizes and height-radius ratios are obtained, which can be useful in structural assessment of key equipment with fluid structure interaction effect.

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