# Validating Numerical Models for Seismic FSI Analysis of Advanced Reactors Using Data from Earthquake Simulator Tests

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To ensure that submerged safety-critical components in nuclear reactors remain functional in the event of earthquake shaking, a detailed dynamic analysis that considers the effects of the fluid is necessary. Available analytical solutions using different hydrodynamic theories cannot be applied to complex structural shapes and boundary conditions, multiple directions of seismic input, and moderate-to-severe earthquake shaking. Physical testing of advanced reactor vessels and their internals is not feasible given their size and cost. As advanced reactor designs move towards standardization of equipment to reduce associated costs, design and risk assessment calculations will have to rely on the use of verified and validated numerical models that are capable of capturing the interaction of internals with the surrounding fluid (fluid-structure interaction: FSI) over a wide range of three-component earthquake shaking. A two-phase experimental program was performed on a 6 degree-of-freedom earthquake simulator at the University at Buffalo to generate data for supporting validation of numerical models for FSI in commercial finite element codes. A scale model of a base-supported reactor vessel and simplified representations of reactor vessel internals (RVIs) were tested to generate hydrodynamic response histories for a range of seismic inputs. The effects of seismic (base) isolation on the dynamic responses of RVIs were investigated using numerically generated input motions simulating a virtual isolation system. The data generated from the experiments is being used for validating previously verified FSI solvers: Arbitrary Lagrangian and Eulerian and Incompressible Computational Fluid Dynamics in LS-DYNA.