DEVELOPMENT AND EXPERIMENTAL BENCHMARKING OF NUMERIC FLUID STRUCTURE INTERACTION MODELS FOR RESEARCH REACTOR FUEL ANALYSIS

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ABSTRACT

As part of the Global Threat Reduction Initiative (GTRI) reactor conversion program, five U.S. High Performance Research Reactors (HPRRs) are currently studying a novel Low Enriched Uranium (LEU) foil based fuel to replace their current High Enriched Uranium (HEU) dispersion fuel. The proposed changes in the plate design have led to a need to characterize the structural response of the plates in presence of high velocity flow.

To generate experiment data, a flow loop and test section have been constructed for studying plate deflection and channel pressure drop under a variety of fluid flow conditions. The work presented here differs from earlier efforts by intentionally offsetting the plate and creating fluid channels of different thickness. This offset effectively simulates manufacturing tolerances of a real fuel assembly.

A method for generating 'As-Built' numeric models of the experiment geometry is presented. These As-Built numeric models have been shown to dramatically improve matching between experiment and numeric solutions. At higher flow rates, the experiment exhibited a dynamic 'snap' behavior that could not be replicated numerically. Additional interrogation of the boundary conditions revealed a possible explanation for this snap, however numeric methods do not yet exist for recreating this behavior. In the numeric and experimental work presented here, plate deflection behavior at low to mid-range flow rates is qualitatively consistent with theoretical expectations.