

A PARAMETRIC STUDY OF A CURVED NUCLEAR FUEL PLATE IN A NARROW CHANNEL USING NUMERIC FLUID STRUCTURE INTERACTION MODELING

Jerome Rivers

Dr. Gary L. Solbrekken, Thesis Supervisor

ABSTRACT

In 2004 the Global Threat Reduction Initiative (GTRI) was established by the National Nuclear Security Administration (NNSA) to quickly identify, secure, remove and/or closely monitor nuclear and radiological materials that pose a high-risk threat to the United States and the international community. Part of GTRI's mission is to convert research reactors and isotope production facilities from their current High Enriched Uranium (HEU) fuel to Low Enriched Uranium (LEU) foil based fuel. In compliance with the conversion portion of the GTRI's mission, the University of Missouri Research Reactor (MURR) is currently trying to convert the reactor fuel. The proposed design for fuel conversion significantly reduces the thickness of the fuel plate. The reduction in the thickness of the fuel plate also implies a reduction in rigidity. This reduction in rigidity coupled with the force of the water flow across the fuel plate that keeps the plate from overheating during the fission process could lead to a high deflection of the fuel plate from their vertical positions. High deflections could cause damage to surrounding fuel plates and cause a failure in the reactor. Fluid structure interaction (FSI) models have been developed to analyze all the characteristics of a thin fuel plate as the velocity of the water increases across the fuel plate. These models are analyzed by coupling CFD software STAR CCM+ with Finite Element Analysis (FEA) ABAQUS at the interface of the fuel plate and the fluid to determine the magnitude, location and direction of the deflection of the fuel plate along with other useful metrics to characterize attributes of the flow and movement of the plate. The results from these models will be compared to fluid structure interaction experiments to calibrate the models and to determine the predictive capability of the FSI modeling.