HYDRO-MECHANICAL ANALYSIS OF LOW ENRICHED URANIUM FUEL PLATES FOR UNIVERSITY OF MISSOURI RESEARCH REACTOR

As part of the Global Threat Reduction Initiative (GTRI) Reactor Conversion program, work is underway to analyze and validate a new fuel assembly for the University of Missouri Research Reactor (MURR). The Low Enriched Uranium (LEU) design currently under investigation is a significant departure from the current High Enriched Uranium (HEU) design. This includes a change in the fuel meat from U-Al dispersion to a monolithic U-10Mo composition. Additionally, the proposed LEU plates are 25% thinner than the current HEU plates. These design changes increase the potential for coolant flow induced deflection of the fuel plates which could lead to a local loss of coolant, and therefore a hot spot on a plate. If the temperature on a fuel plate rises too high, there is a risk of fuel plate rupture and fission gas release into the coolant system.
Previous methods for assessing fuel plate deflection have relied heavily on analytic and experimental techniques. With the continued advancement of computational codes, new options are emerging to assess structural stability. This research explores the potential of explicitly coupled fluid-structure interaction (FSI) numeric modeling. Work was completed to evaluate a method for coupling a computational fluid dynamics (CFD) code with a finite element analysis (FEA) code. After coupling the codes and understanding the deficiencies in the coupling technique, additional research was completed on methods to improve the stability and efficiency of coupled simulations. Pressure ramping, material damping, and mesh refinement were successfully used on simulations of high aspect ratio geometries to increase simulation stability and decrease total runtime. This research has successfully provided a way to analyze the complex interactions of fluid and structural systems. These techniques will be invaluable in evaluating the proposed LEU fuel plate structure for MURR. Additionally, proposals for future and ongoing work to validate results against fresh experimental and analytic models are provided.

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