An Evaluated, Transient Experiment based on Simultaneous, 3-D Neutron-Flux and Temperature Measurements

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ABSTRACT:

It is proposed to evaluate existing and near-term experimental data acquired at the University of Wisconsin Nuclear Reactor (UWNR) for inclusion in the International Reactor Physics Experiment Evaluation Project (IRPhEP) handbook. The data to be evaluated include compositions from a recent fuel replacement as part of an LEU conversion, a number of critical, fresh-fuel configurations, fuel temperature measurements at fresh-fuel configurations, and data from approximately one decade of operations. Moreover, a number of steady-state and transient experiments are scheduled for June of 2018. Up to 28 small fission chambers and/or 18 RTD will be deployed for simultaneous measurement of the neutron flux and temperature between fuel elements.

UWNR is a 1-MW thermal reactor loaded with TRIGA fuel. UWNR was selected for the planned experimental campaign because it was loaded with fresh fuel in 2009 as part of the LEU conversion program and, hence, has a composition that can be determined with relatively high accuracy. Substantial effort has been made to understand the initial compositions, slug by slug, based on manufacturer documentation and discussions with groups who have analyzed similar fuel. A variety of fresh-core critical configurations were analyzed upon reloading, with fuel temperatures measured at each location. Data acquired over nearly a decade of operations provide the necessary inputs for modeling the effects of depletion.

The proposed work would lead to a first-of-a-kind evaluation of transient, spatially-dependent reaction rates. To perform the evaluation, the existing scripted UWNR model developed by UW and KSU will be extended to include support for SCALE 6.2 for treatment of steady-state and depletion uncertainty quantification. The MAMMOTH and Rattlesnake tools of INL will be used to model the transient experiments, building on the growing expertise at INL to analyze and characterize uncertainty of TREAT experiments.