Experimental Breeder Reactor II Benchmark Evaluation

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ABSTRACT:

The project will develop a reactor physics benchmark evaluation of the Experimental Breeder Reactor II (EBR-II) suitable for inclusion in the International Reactor Physics Experiment Evaluation Project (IRPhEP) handbook. EBR-II was a sodium-cooled, metal fueled, fast neutron spectrum reactor with a thermal power rating of 62.5 MW. The evaluation will focus on the reactor core configuration associated with EBR-II Run 138B. This reactor configuration was selected for reactor physics benchmark evaluation because it was used for several important experiments associated with the Shutdown Heat Removal Test program. These tests investigated the behavior of the reactor under severe accident scenario conditions including loss of primary coolant flow without reactor scram and loss of reactor heat sink without reactor scram. Candidate reactor physics measurements to be evaluated include approach to critical measurements, critical configuration measurements, reactor scram measurements and reactor physics measurements related to the safety tests and transient overpower tests.

Uncertainty quantification will be the central and most difficult part of the benchmark evaluation process. The parameters that will be the subject of uncertainty quantification will include count rate measurements, control rod positions, material compositions, component dimensions, and temperature. Additionally, fuel element and assembly dimension quantification will need to include the effects of irradiation induced swelling in the fuel slug, cladding, and hexagonal flow duct.

After faithful benchmark models are prepared and the corresponding benchmark experimental values have been suitably adjusted to account for any biases introduced by the simplifications required to produce the benchmark models from the true as-built models, the benchmark models can be used to test the nuclear data.

Given the renewed worldwide interest in fast neutron spectrum reactors as a means of extending resources and reducing the quantity of used light water reactor fuels, the EBR-II reactor is an excellent candidate for integral benchmark evaluation. Results of the benchmark evaluation will be of great interest to reactor design efforts underway in the US and South Korea. Additionally, the French-US research collaboration related to the French ASTRID reactor would benefit from this EBR-II benchmark evaluation.