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Editorial: Benchmark experiments, development and needs in support of advanced reactor design

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Editorial on the Research Topic
Benchmark experiments, development and needs in support of advanced reactor design

Advanced nuclear reactor designs will for the most part be a departure from low enrichment light water reactor (LWR) designs currently operated around the world. Such advanced designs include but are not limited to new TRISO-fueled high temperature gas reactors, heat-pipe cooled micro-reactors, fluoride salt cooled high-temperature reactors, molten salt reactors, lead cooled fast reactors, nuclear thermal propulsion concepts, and include LWR designs with advanced fuel and clad types.

Modeling and simulation methods for advanced reactors is necessary for regulators to approve license requests. However, regulators also require that modeling approaches be validated against experimental measurements. Hence, there is a crucial need for data for advanced reactor systems that will support validation of analysis methods. To this end, this Research Topic includes eleven papers organized into topical seven categories relevant for advanced reactor design.

Experimental facilities

Thompson et al. provide a review of activities at the National Criticality Experiments Research Center (NCERC). NCERC is one of few critical experiment facilities remaining in the United States and regularly performs subcritical, critical and supercritical experiments.

Measurement techniques

Two papers describe measurement techniques and uncertainties associated with measured data. Skifton describes the superposition of both inhomogeneity and drift of

thermocouple elements occurring in high-temperature irradiation-resistant thermocouples. Leclaire and Bess describe two methods to deal with the assessment of the rod positioning uncertainties in a reactor fuel lattice.

Fuel performance

Two papers describe fuel performance measurements. Keiser et al. provides the results of post irradiation examination of a TRIGA fuel element with a high assay low-enrichment uranium-zirconium hydride fuel. Paaren et al. present the results of BISON of metallic fuel against experimental measurements within two fuel experiment databases.

Thermal hydraulics

Gutowska et al. present selected data from experiments performed to fill data gaps in the characteristics pressurized and depressurized conduction cooldown transients.

Shielding

In Iwamoto et al. the validation of the Particle and Heavy Ion Transport System (PHITS) as applied to neutron-shielding experiments for fusion is described. Five sets of measurements with different shielding materials were simulated with PHITS and were found to have acceptable agreement.

Nuclear data

Bostelmann et al. describe an assessment of nuclear data used in analysis of advanced reactor concepts for which operating history is unavailable, while (van der Marck and Koning) make the case for use of fission product cross section measurements performed at the STEK facility.

Benchmark development

Two review papers describe international benchmarking activities that are resources for advanced reactor modeling. Bess et al. describe two benchmark programs: the International Reactor Physics Experiment Evaluation (IRPhE) Project and the International Criticality Safety Benchmark Evaluation Project (ICSBEP). Bess et al. expands on benchmark activities sponsored by the NEA, describing several international benchmark activities.

Summary

The Research Topic entitled *Benchmark Experiments, Development and Needs in Support of Advanced Reactor Design* provides a broad set of research results emphasizing the need for reactor physics benchmarks to support the next-generation of advanced reactors. This Research Topic includes papers on experimental facilities, measurement techniques, fuel performance, thermal hydraulics, shielding, nuclear data, all related to advanced reactor designs, combined with papers describing international efforts to develop Research Topic of benchmarks for reactor physics, criticality safety, fuel performance, spent fuel characterization, thermal hydraulics, shielding and multi-physics computational methods.

Author contributions

All authors approved the submitted version.

Conflict of interest

Author JB is employed by JFoster and Associates.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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