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EBR-II SHRT-17 and SHRT-45R Benchmark Analyses

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In 2012, the International Atomic Energy Agency (IAEA) established a coordinated research project (CRP) on EBR-II Shutdown Heat Removal Tests (SHRT). The objectives of the CRP, which concluded in 2016, were to improve design and simulation capabilities in fast reactor neutronics, thermal hydraulics, plant dynamics, and safety analyses through benchmark analysis of two landmark tests performed during the EBR-II SHRT program. The selected tests were SHRT-17 and SHRT-45R, the most severe protected and unprotected loss of flow tests performed during the SHRT program, respectively. Nineteen organizations representing eleven countries participated in the CRP.

The benchmark was performed in two phases. During the first phase, participants had no access to the recorded data from either test. Once all phase 1 calculations were completed in February 2014, phase 2 was initiated with participants receiving experimental data.

In addition to its role as the lead technical organization for the CRP, Argonne also performed analyses as a participant in the CRP. Argonne simulated the SHRT-17 and SHRT-45R tests using the sodium fast reactor safety analysis code SAS4A/SASSYS-1. Although Argonne's SHRT-17 simulation during the blind phase of the CRP predicted similar trends as the measured test data, overpredicted flow rates after the beginning of the test led to underpredicted temperatures. Predictions of the SHRT-45R flow rates through the core inlet piping agreed much better with the measured data for SHRT-45R than for SHRT-17.

Argonne's modeling efforts during Phase 2 focused primarily on improving the predicted flow rates for SHRT-17. During phase 1, the initial shape of the flow curve was well matched but the magnitude of the flow rate was too high. This discrepancy was corrected during phase 2 by properly accounting for the resistance of the locked pumps and the circumstances under which the pumps were assumed to lock.

For SHRT-45R, additional analyses were performed with the reference power level used as a boundary condition to assess the performance of the systems model, allowing for more accurate analysis of the primary system model without power discrepancies affecting predicted flow rates and temperatures. This poster will present the analyses performed by Argonne during the two phases over the four-year duration of the CRP. Argonne's contributions to the neutronics component of the SHRT-45R benchmark will also be presented.

Note: EBR-II Benchmarks CRP Invited Poster Session

Country/Int. Organization

USA

Author: Dr SUMNER, Tyler (Argonne National Laboratory)

Co-authors: Dr MOISSEYTSEV, Anton (Argonne National Laboratory); Dr WEI, T. Y. C. (Argonne National Laboratory); Dr FEI, Tingzhou (Argonne National Laboratory)

Presenter: Dr SUMNER, Tyler (Argonne National Laboratory)

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