Development of Reactor Physics Benchmark Evaluations for Power Burst Facility Experiments

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ABSTRACT:

The Power Burst Facility (PBF) is a test reactor designed to perform tests on light water reactor fuels under normal, off-normal and accident conditions. The facility is located at the Idaho National Laboratory (INL) and has operated from 1972 to 1985. The PBF is capable of simulating reactivity initiated accidents, power cooling mismatch accidents, anticipated transients with and without scram, loss of coolant accidents and severe fuel damage accidents.

The PBF reactor core is comprised of a total of 121 14.9 by 14.9 by 152.4 cm square cells. Eight of these cells are control rods that are made of boron carbide with 76.5 wt.% boron. These control rods are used as the primary reactivity control. In addition, there are four transients rods made of the same boron carbide material. The transient rods are used for adjusting reactor power at various rates during transient tests. The fuel rods are comprised of urania (20.6%), zirconia (61.8%) and calcia (7.6%) fuel pellets (UO_2-CaO-ZrO_2). Fuel pellets are surrounded by CaO-ZrO_2 insulator sleeve and 304L stainless steel cladding. Active fuel length is about 114 cm. Uranium enrichment is 18 w%. The center of the core is occupied by an In-Pile-Tube (IPT) that is subjected to highest thermal flux in the core. This allows higher power densities in the test fuel compared to the core. Maximum core steady-state power is 28 MW and the maximum energy release for natural and shaped bursts is 1350 MJ.

The project will evaluate select experimental data from the PBF tests documented in PBF reports for inclusion in the International Reactor Physics Experiment Evaluation Project (IRPhEP) Handbook. These tests include experimental data regarding differential reactivity worth of the control and transient rods, shim rod worth, in-pile-tube reactivity worth, shutdown reactivity, fuel assembly reactivity worth, core void coefficients of reactivity, in-pile-tube void coefficient, and coolant temperature coefficient of reactivity.