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Modeling and Simulation of an Operational VVER-1000 Benchmark with NESTLE

The Russian state-owned nuclear energy company ROSATOM is rapidly expanding the VVER-1000/1200 reactor technology with 9 reactors under construction in Russia and 29 reactors in various stages of planning and construction in more than a dozen countries. Approximately two-dozen VVER-1000 reactors are operational in Russia, Ukraine, Bulgaria, the Czech Republic, and China. Consequently, there is a growing interest in the accurate modeling and simulation of VVER-1000 reactors and in the experimental validation of these calculations against operational or measured data. This study aims to evaluate the spatial- and time-dependent neutronic and thermal-hydraulic conditions of a Ukrainian VVER-1000 reactor based upon its actual operational conditions by using a modern version of the NESTLE nodal-diffusion simulator that is maintained and developed at the University of Tennessee. Accordingly, a full-core 3-dimensional NESTLE model of the VVER-1000 Khmel'nitsky Unit 2 cycle 1 core was created and validated against benchmark data published by the Atomic Energy Research Symposia on VVER Reactor Physics.