INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE

Experimental and Analytic Study on the Core Bypass Flow in a Very High Temperature Reactor

PI (U.S.): Richard Schultz, Idaho National Laboratory (INL)

PI (ROK): Min-Hwan Kim, Korea Atomic Energy Research Institute (KAERI)

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Project Abstract

Core bypass flow is a key issue in the very high temperature reactor (VHTR) design for core thermal margins and target core exit temperature. In the prismatic modular reactor (PMR) design, the core bypass flow is determined by the flow through the control element holes and through the radial and axial gaps between the graphite blocks for manufacturing and refueling tolerances. Bypass flow varies over core life due to irradiation swelling/shrinkage and thermal expansion of the graphite blocks. In a VHTR core consisting of stacked graphite blocks, the core bypass flow behavior occurs in a complicated, multidimensional way and it could be a significant proportion of the total core flow. Thus, an accurate prediction of the bypass flow and measures for its minimization are of major importance in assuring core thermal margins during both normal operation and accident conditions. Despite this importance, there has not been much effort in quantifying and accurately modeling the effect of the core bypass flow.

The objectives of this project are to 1) generate experimental data for bypass flow as a function of the inter-block gap size and block combination, 2) assess the thermo-fluid analysis tools for their accuracy and model improvements, and 3) identify and assess measures for reducing core bypass flow.