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# FISSION GAS BEHAVIOR IN MIXED-OXIDE FUEL DURING TRANSIENT OVERPOWER AND SIMULATED LOSS-OF-FLOW TESTS

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by

E. H. Randklev and C. A. Hinman

Hanford Engineering Development Laboratory
Westinghouse Hanford Company
Richland, Washington

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A portion of the fission gases (Xe, Kr) generated during steady state irradiation of an FBR mixed-oxide fuel is retained within its microstructure, especially in the cooler regions of the fuel. Information on the behavior of these retained gases relative to their microstructural relocation and release during off-normal power and coolant flow conditions is important to the analysis and analytic modeling of fuel-pin transient and reactor core performance.

This paper discusses the steady state and transient behavior of retained fission gas relative to the geometry, microstructure, temperature, and apparent release mechanisms within selected axial and radial regions of fuel pins irradiated at medium power (7-10 kW/ft) and burnup (30-60 MWd/kgm). The specific fuel pins are from the PNL-10 and PNL-2 subassemblies irradiated in EBR-II. The transient overpower tests involved integral fuel pin static capsule experiments performed in TREAT. Loss-of-coolant flow was simulated in an out-of-reactor thermal transient testing system using axial segments of irradiated fuel pins.

The axial, radial, and microstructural distribution of fission gas retained at the end of steady state irradiation was determined from sibling fuel pins. Measured or predicted values of burnup, power and temperature are also provided in characterizing the steady state condition of the test pins and their siblings. In addition, the radial variation of fuel microstructures in the siblings was quantitatively and qualitatively characterized.

Data on fission gas release from the fuel during the transient tests is discussed relative to the thermal conditions (i.e. ramp rates, temperatures, etc.) involved. A correlation of fission gas release versus temperature in the outer (high gas content) region based on the out-of-reactor thermal transient tests is presented. A threshold temperature for rapid fission gas release is identified from these tests.

The intra and intergranular porosity developed in the fuel during release of fission gas is characterized in detail. Both quantitative and qualitative porosity data from the transient tested fuels are compared with their steady state siblings. Comparison is also made between these data for the overpower transients and the simulated loss-of-flow transients.

The fission gas release, temperature, time, and microstructural data from these tests are evaluated with respect to proposed release mechanisms. Comparison is also made between the experimental observations relating to release mechanisms and the mechanisms used in current models for transient fission gas release.