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THE WHOLE-CORE LEU U_3Si_2-AL FUEL DEMONSTRATION IN THE 30-MW OAK RIDGE RESEARCH REACTOR

by

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ABSTRACT

The ORR Whole-Core LEU Fuel Demonstration, conducted as part of the U.S. Reduced Enrichment Research and Test Reactor Program, has been successfully completed. Using commercially-fabricated U_3Si_2-Al 20%-enriched fuel elements (4.8 g U/cc) and fuel followers (3.5 g U/cc), the 30-MW Oak Ridge Research Reactor was safely converted from an all-HEU core, through a series of HEU/LEU mixed transition cores, to an all-LEU core. There were no fuel element failures and average discharge burnups were measured to be as high as 50% for the standard elements and 75% for the fuel followers. Experimental results for burnup-dependent critical configurations, cycle-averaged fuel element powers, and fuel-element-averaged ^{235}U burnups validated predictions based on three-dimensional depletion calculations. Calculated values for plutonium production and isotopic mass ratios as functions of ^{235}U burnup support the corresponding measured quantities. In general, calculations for ^{60}Co and ^{198}Au reaction rate distributions, differential and integral control rod worths, prompt neutron decay constants, and isothermal temperature coefficients were found to agree with corresponding measured values. Experimentally determined critical configurations for fresh HEU and LEU cores radially reflected with water and with beryllium are well-predicted by both Monte Carlo and diffusion calculations.