8. SUMMARY AND CONCLUSIONS

Although the Oak Ridge Research Reactor was permanently shut down before the planned completion of the Whole-Core LEU Fuel Demonstration, the primary objectives of the program were met. In summary, it was found (Ref. 44) that:

1. All 68 of the commercially-fabricated U_3Si_2-Al LEU fuel elements (4.8 g/cc U in fuel meat) as well as the 8 LEU fuel followers (3.5 g/cc U in fuel meat) used in the demonstration performed in a completely safe and acceptable manner without any fuel failures. Seven standard elements and four fuel followers achieved averap bumups of 50% or greater. In fact, two of the followers had average ^{235}U bumups of nearly 75% with peak values greater than 90%.

2. The gradual and safe transition from an all-HEU core, through a series of mixed HEU/LEU cores, to an all-LEU core was clearly demonstrated for the 30-MW Oak Ridge Research Reactor.

3. Numerous experimental measurements validated REBUS-3 fuel cycle predictions. Calculations supported experimentally-determined criticality conditions throughout the bum cycle for each of the 22 full-power cores used in the demonstration. REBUS-3 cycle-averaged fuel element powers agreed (usually within 5%) with the measured values. Calculated fuel-element-ave raged ^{235}U bumups are in good agreement with results obtained from two independent experimental methods. Measurements of uranium and plutonium mass spectra in discharged fuel elements support the calculations. Measured and calculated plutonium production per gram of uranium in the fuel agree.

4. Standard methods, models and codes successfully accounted for a wide variety of experimental measurements. These included citicality conditions for unirradiated HEU and LEU cores radially-reflected with water and beryllium, differential and integral shim rod worth determinations, prompt neutron decay constant evaluations, ^{60}Co and ^{198}Au reaction rate distributions, and isothermal temperature coefficient measurements.

5. The interpretation of differential shim rod worth measurements in the ORR had to take into account the combined effects of temperature changes during the reactivity transient and delayed photoneutron contributions to the total delayed neutron fraction. Changing temperature effects were essentially eliminated by analyzing the initial shape of the measured time-dependent flux. However, only a rough treatment of delayed photoneutron contributions was possible. Plans to extract an effective set of kinetic parameters from an analysis of the shape of the flux die-away curve following a rod drop had to be abandoned because no such measurements were made before the unexpected shutdown of the reactor. Nevertheless, the rough photoneutron treatment resulted in C/E ratios close to unity for differential shim rod worths and for the prompt neutron decay constant in core 179A.

In view of the above remarks, it is concluded that the goals of the ORR Whole-Core LEU Fuel Demonstration have been successfully achieved.

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