PREFACE

PLUTONIUM UTILIZATION IN COMMERCIAL POWER REACTORS

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Received May 3, 1972

By the mid-1970s, a rapidly rising surplus of plutonium from light water reactors will be available for commercial recycle back into the reactors. Storage of the plutonium for use in the LMFBR does not seem desirable because a sufficient number are not expected to be available soon enough to use the surplus plutonium. Even after LMFBRs become established and viable power sources, there still appear to be benefits from a combined energy economy using both plutonium recycle reactors and the LMFBR. Thus, interest in using plutonium in light water reactors is increasing.

Significant programs concerned with plutonium use have been conducted or are planned by laboratories, industrial organizations, foreign governments, and such groups as Edison Electric Institute. All have recognized that plutonium recycle is important for power generation planning. One of the earlier research and development programs, the Plutonium Utilization Program, was initiated by the U.S. Atomic Energy Commission.

The basic mission of the Plutonium Utilization Program, carried out for the AEC by Battelle's Pacific Northwest Laboratories, has been to develop the base technology needed to implement plutonium recycle in commercial power reactors. In the last few years, the program emphasized translation of this technology to a viable industrial capability. The scope of the program has been quite broad and included fuels development work, chemical reprocessing studies, reactor system decontamination studies, reactor neutronics studies, and technical and economic optimization studies. Major efforts have been directed toward the immediate consideration of using plutonium as refueling enrichment in present generation water moderated power reactors. The results of some of the more significant studies are reported in this special issue of *Nuclear Technology*.

An objective of the fuel development work has been to demonstrate that mixed-oxide fuels could be developed whose performance is comparable to UO_2-only fuels. Studies of general irradiation behavior, plutonium and fission product migration, defected fuel performance, and performance under transient conditions are included in this issue. Although the performance statistics for mixed-oxide fuels are not as extensive as for UO_2-only fuels, their irradiation behavior has been entirely satisfactory and no inherent performance limitations are evident. In addition, it is reported that the commercial fuels can be fabricated, stored, and transported without excessive personnel exposure and with a minimum addition of special radiation protection procedures.

The primary objective of the reactor neutronics research and development studies has been to improve and evaluate analysis methods so that reliable engineering calculations can be made for reactor loadings containing plutonium. As a result, the accuracy of various computational techniques for calculating the reactivity, kinetics, and burnup characteristics has been determined from extensive analytical and experimental studies conducted under the Plutonium Utilization Program. In total, the number of lattice studies using plutonium fuels is much less than the number con-

ducted for uranium. However, the studies have been made for a wide range of moderator-to-fuel ratios and plutonium and ^{240}Pu concentration so that a reference set of neutronics data is available for evaluation of calculational methods. Results are reported for evaluations of the calculational methods using some of the results from experimental lattice measurements of the neutron multiplication, reaction rates, and the ratio of effective delayed-neutron fraction to prompt-neutron lifetime. In addition, spectrum-averaged cross sections obtained from burnup measurements on plutonium-only and mixed-oxide fuel have been used in the evaluation of the calculational methods.

The papers included in this issue provide information on some of the final studies conducted under the Plutonium Utilization Program. However, they are only a small part of the total reports that are available. References and bibliographies of other reports can be found in several summary articles such as "Reactor Physics Data for the Utilization of Plutonium in Thermal Power Reactors" (BNWL-801), and "Results from the USAEC Plutonium Utilization Program" presented at the 1968 and 1971 IAEA panels on Plutonium Utilization (BNWL-SA-2065 and BNWL-SA-3865). The results of these studies have contributed significantly to the current status of the technology, and articles are being prepared in which these contributions are reviewed. The total technology should allow rapid implementation of plutonium utilization in commercial reactors on a reload scale.