PREFACE

NONCONVENTIONAL CORE DESIGNS OF LIQUID-METAL FAST BREEDER REACTORS

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Heterogeneous fast reactor designs have received increasing attention since the concept was first proposed by the French in 1975. The possible advantages offered by such designs were quickly recognized, and analytical and experimental programs to investigate heterogeneous concepts were undertaken in the breeder programs around the world. The most basic reason for the interest is this: Such concepts open up to the designer a much wider range of possible design solutions to problems involving two of the most fundamental properties of liquid-metal fast breeder reactors (LMFBRs)—their breeding and their sodium voiding reactivity characteristics. The heterogeneous configuration does this by decoupling, to a considerable degree, the amount and distribution of ^{238}U in the core from the stringent constraints imposed by the nuclear, thermal-hydraulic, mechanical, and materials consistency requirements that are implied by the single pin size of normal two-enrichment-zone homogeneous breeder reactor designs.

For breeding, the single most effective parameter available to the designer is the fuel volume fraction in the core or, more precisely, the average ^{238}U density. In a homogeneous design, once the fuel pin diameter is selected (and the selection is influenced by many considerations other than breeding), this parameter is fixed. But in heterogeneous designs, the introduction of subassemblies of blanket pins with their larger pin diameters and higher ^{238}U volume fractions opens up this parameter to the designer again.

For the sodium voiding reactivity effect, the degree of segregation of plutonium and ^{238}U possible in these designs operates similarly to the modular core designs proposed specifically to lower the sodium voiding effect in the earlier days of LMFBR development. Segregating to some degree ^{238}U and plutonium in effect increases the enrichment of the fueled subassemblies. Then, with the voiding of sodium, the direct spectral component is reduced, and leakage to the blanket subassemblies is increased. A reduction in the positive reactivity effect results.

Thus, in a single stroke, both parameters have been made more accessible to engineering design. There are, of course, associated design penalties and trade-offs, and this group of papers deals with many of them. Furthermore, and most importantly, the papers give an excellent summary of the status of design, and of analysis and experimental backup, for heterogeneous fast reactor designs at the time of the June 1977 Meeting of the American Nuclear Society, held in New York. Heterogeneous reactor designs have now become a part of the range of options available to the fast reactor designer. The authors of these papers are to be commended for the excellent job they have done, and I in turn commend their efforts to your attention.