CONTENTS

CONTRIBUTORS v
PREFACE vii
CONTENTS OF PREVIOUS VOLUMES xiii

GAS-COOLED REACTOR TECHNOLOGY
H. B. Stewart, C. L. Rickard, and G. B. Melese

I. Introduction 1
II. Gas as a Reactor Coolant 6
III. Choice of Moderator for Gas-Cooled Reactors 15
IV. Fuel Element Designs for Gas-Cooled Reactors 23
V. Plant Equipment and Arrangement 38
VI. Fuel Cycles 46
VII. Fuel Cycle Economics 53
VIII. Future Trends in Gas-Cooled Reactor Designs 58
References 64

SAFETY AND ECONOMIC CHARACTERISTICS OF A 1000-MWe FAST SODIUM-COOLED REACTOR DESIGN
K. P. Cohen and G. L. O'Neill

I. Introduction 68
II. Summary of Safety Characteristics 69
III. Summary of Design 73
IV. Safety Analysis 91
V. Economics 100
References 106

THE DOPPLER EFFECT IN FAST REACTORS
R. B. Nicholson and E. A. Fischer

I. Introduction 110
II. Definitions and Notation 119
III. Definition of the Doppler Temperature Coefficient of Reactivity for One Isotope 127
IV. Multigroup Perturbation Theory 129
V. Effective Cross Sections 134
VI. Influence of Overlap between Resonances of Two Different Sequences 138

VII. Doppler Effect in the One-Isotope Approximation 143
VIII. The Low-Energy and High-Energy Approximations 146
IX. Statistical Distributions 151
X. Resonance Parameters of the Fuel Isotopes 162
XI. Calculational Results 171
Appendix A. The Two-Sequence Expansion for the Effective Cross Section 177
Appendix B. Derivation of the Overlap Correction in the One-Isotope Approximation 179
Appendix C. The High-Energy Approximation 186
Appendix D. Derivation of the Resonance Position Distribution . 190
References 192

FAST REACTOR MELTDOWN ACCIDENTS USING BETHE-TAIT ANALYSIS

R. A. Meyer and B. Wolfe

I. Introduction 198
II. Modified Bethe-Tait Method 199
III. Description of Typical Reactor Core 200
IV. Parameter Study of Equivalent Spherical Reactor Cores . . . 200
V. Cylindrical Reactors 213
VI. Excursions Starting Below the Threshold for Core Disassembly . 215
VII. Summary 221
Appendix A. Modified Bethe-Tait Model 223
Appendix B. Equation of State for Fast Reactor MHA Analysis . 243
References 249
Appendix A References 249
Appendix B References 249

OPTIMUM NUCLEAR REACTOR CONTROL THEORY

Jeffery Lewins and Albert L. Babb

I. Introduction 252
II. Systems with Constrained Controls 256
III. Hamilton Density and Hamiltonian 263
IV. Example with Control Constraints 266
V. Systems with State Restraints 277
VI. Example with State Restraints 282
VII. Importance Interpretations of the Adjoint Function 286
VIII. Dynamic Programming 291
IX. Distributed Systems 300
References 306

DEVELOPMENTS IN PERTURBATION THEORY

Jeffery Lewins

I. Introduction 309
II. Systems Having a Source 312
III. Collision Probability Theory 318
IV. Arbitrary Ratios in Critical Systems 324
V. Conclusion 328
References 332

INDUSTRIAL APPLICATIONS OF IONIZING RADIATIONS

S. Jefferson, R. Roberts, F. J. Ley, and F. Rogers

I. Summary 335
II. Ionizing Radiation in the Chemical Industry 339
III. Ionizing Radiation in the Medical Product and Food Industries 356
IV. Sources of Ionizing Radiation 372
References 382

AUTHOR INDEX 385

SUBJECT INDEX 391