Book Review

Fast Breeder Reactors. By Alan E. Waltar and Albert B. Reynolds, Pergamon Press, Inc., Elmsford, New York (1981). 853 pp. $47.50.

This is a very useful and well-written book, which surveys the entire landscape of fast breeder reactor technology. The principal stated objective of the authors was to provide a text for a one-semester graduate level course on fast breeder reactors. A second objective was to serve as a background reference for practicing engineers. Assimilation of the wealth of technical information in the literature surely made accomplishment of these objectives a monumental task. The book achieves the authors' objectives, although a student attempting such a course is advised to be very well prepared in fundamentals before embarking on this road to applications. The authors' emphasis on methodology enhances the book's utility as a teaching text.

The book is organized in a five-part structure:

Part 1, Overview (three chapters): introductory material on breeding, resources, programs, design, and economic analysis.

Part 2, Neutronics (four chapters): detailed material on nuclear design methods, cross sections, kinetics and reactivity control, and fuel management.

Part 3, Systems (five chapters): stress on topics in thermal hydraulics and mechanical design of the core. One chapter covers the primary and auxiliary systems.

Part 4, Safety (four chapters): description of general safety considerations, followed by presentation of protected and unprotected transients. A concluding chapter lumps considerations affecting containment.

Part 5, Gas-Cooled Fast Reactors (two chapters): overall discussion of design and safety aspects.

Comprehensive appendixes covering design characteristics of the world's fast reactors and multigroup cross sections are included, as well as a short comparison of the Clinch River Breeder Reactor's homogeneous and heterogeneous core designs.

To cover this broad spectrum, the authors invited other experts to prepare the chapters on economic analysis and gas-cooled fast reactors. The results are well-written additions but with the inevitable lack of cross referencing (i.e., Secs. 1-4 and 3-8 deal with uranium resources and introduction of the breeder) and change in style (i.e., Chap. 3 does not list references) between insertions and a main text. We agree with the inclusion of the economic analysis chapter given its importance to decisions on the future pace of construction of sodium breeder fast reactors. Inclusion of material on fast gas-cooled reactors is debatable, but given that the coverage is <10% of the total content and deletion would not have provided the principal authors themselves with time for refocus on the main text, debate is really irrelevant.

In their preface, the authors acknowledge the difficulty in choosing topics and the depth of presentation of each topic. A notable choice made was the severely limited discussion of primary and auxiliary systems. Noting the evolving state of light water reactor design, it is obvious that academic, if not industry design activity should be focused in the systems and components areas in the future. This text, however, reflects heavy emphasis in core design and related safety considerations. By virtue of the authors' experience and competence, this focus for their work is appropriate. However, the "System" title for Part 3 and the overall book title imply a broader balance than the text delivers.

The review of any text inevitably identifies detailed issues or errors. For example, the use of figures without numerical values on their axes in Chaps. 1 and 3 stresses principles but loses the opportunity to convey a sense of reality to the reader, which is particularly important for student readers. Overall, however, we find the text reasonably clean in this regard and offer those noted below not as examples of a general problem but as points to be checked in any derivative publication or revision.

1. Pages 39 and 293: It is not universally true that all fast breeder reactors use triangular pitch. Also, not all light water reactors use square pitch. The Fermi core was square, and Russian pressurized water reactors are triangular.

2. Page 47: The adoption of standard symbols q'' and q' for heat flux and linear power versus the authors' q and χ, respectively, is strongly encouraged.

3. Page 50: As page 478 indicates, ^{22}Na has a 2.6-yr, not a 2.6-day, half-life—which makes a large difference!

4. Page 224, line 3: Analytic solutions using flux time as the variable in fact allow the flux to vary in magnitude: e.g., it can rise with burnup to maintain constant power. Perhaps the authors are restricting their observation to a particular method.

Neil Todreas
Michael Driscoll

Massachusetts Institute of Technology
Cambridge, Massachusetts 01853

February 22, 1983

About the Reviewers: Neil Todreas is professor of nuclear engineering and head of the department at the Massachusetts Institute of Technology (MIT) where he has been a member of the faculty for more than a decade. His graduate studies in engineering were at Cornell and at MIT. Professor Todreas's current professional interests are thermal and hydraulic aspects of reactor design and safety analysis.

Michael Driscoll is also professor of nuclear engineering at MIT where his current interests are nuclear fuel management and applied reactor physics. His academic training was at Carnegie Tech, the University of Florida, and MIT where he earned his PhD in nuclear engineering.