Book Reviews

Dynamics of Nuclear Reactors. By David L. Hetrick. The University of Chicago Press (May 1971). 542 pp. $18.50.

Over the past 20 years a great deal of work has been done in analyzing the dynamic behavior of nuclear reactors. The primary justification for this activity has been the great importance of predicting and understanding the transient behavior of reactors. However, many of those who have worked in this area have also been motivated by the fact that the problems encountered are often amenable to attack by a variety of sophisticated experimental and mathematical techniques. As a consequence, the literature abounds in papers which present a staggering amount to be assimilated by someone just entering the field. For such a person, Professor Hetrick's book should be extremely valuable. It provides a very thorough and orderly review of a significant portion of the field of reactor dynamics.

The material of the book is organized around the point kinetics equations. These equations are first derived and discussed in an approximate manner. Then the solutions for constant and time-dependent sources and reactivities are described—first analytically and then numerically. A chapter on reactivity feedback and reactor excursions is then presented, followed by chapters on linear and nonlinear system stability. Finally, there is a chapter on space-dependent neutron dynamics.

The literature on all the subjects covered is reviewed in detail. (There are 38 pages of references.) Yet the book is far more than a mere summary of pertinent papers. It is a unified whole, and the various parts fit together well. In many instances the same problem is attacked by several different methods to illustrate their interrelationships. The level of mathematical difficulty has been kept uniform (in some instances by quoting theorems without proof) so that the material should be readily comprehensible to someone having had the standard courses in mathematics required of most undergraduate engineers and physicists. Although there is one chapter on numerical solution of the point kinetics equations, most of the emphasis is on analytical methods. As a result, the feedback models are often highly simplified. Professor Hetrick, however, is careful to point out the limitations of approximate methods along with their virtues.

There are certain areas which, by the author's choice, *Dynamics of Nuclear Reactors* does not cover. Most notably, there is no material on neutron fluctuations. Also, the discussion of numerical methods and of space-dependent effects is limited. Finally, there is no presentation of the detailed mathematical models which are frequently applied during the design stage of a power reactor. The emphasis is more on how to analyze the dynamic behavior of a reactor in terms of certain general feedback parameters after it has been built rather than on how to predict its dynamic behavior beforehand.

I don't mean to imply criticism in pointing out these omissions, but merely to note them. (Professor Hetrick points out that he made them quite consciously.) The topics on which the book is concentrated are treated thoroughly and well, and I recommend it to anyone working in those areas. I also believe it would serve as a very good textbook for a course dealing with those topics. However, for this latter application, I believe the teacher should supplement somewhat the motivation and evaluation for certain approaches and possibly omit some of the material. For example, I think it is worthwhile in a reference book to include the analytical treatment of the ramp reactivity insertion problem. I would, however, be inclined to omit it from a one-term course in reactor dynamics.

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About the Reviewer: Al Henry has been professor of nuclear engineering at the Massachusetts Institute of Technology during the past few years following an extended association with the Bettis Atomic Power Laboratory. While at Bettis he was responsible for the nuclear design of submarine propulsion reactors. Dr. Henry, who completed his graduate studies at Yale in 1950, has helped guide Nuclear Science and Engineering *as a member of its Editorial Advisory Committee.*

Monte Carlo Principles and Neutron Transport Problems. By Jerome Spanier and Ely M. Gelbard. Addison-Wesley Publishing Company, New York (1969). 234 pp. $14.95.

Each of the authors should understand that each criticism below relates solely to the contributions of his colleague.

It should be mentioned that I have already reviewed the book (*Computing Reviews*, March 1970) for a different audience and that I have, on the closer examination appropriate for the present audience, changed my mind on some points.

The dual purpose of the book is already well indicated in the title. The first half (three chapters) is to serve as a general introduction to the Monte Carlo method. The second half (also three chapters) is to serve as an exposition of its application to neutron transport.

The authors have, however, charted a course which severely limits the value of the book as an introduction to Monte Carlo. They have selected a quite restricted class of neutron transport problems for discussion, explicitly omitting all problems of shielding and of reactor criticality. The two problems discussed in detail are the calcula-