# Book Reviews

**Nuclear Power Plant Design Analysis.** By Alexander Sesonske. TID-26241, U.S. Atomic Energy Commission (1974). $10.60.

This book is on the systems engineering approach to nuclear power plant design. As such, the book covers so much that it is a bit overwhelming, but of course a nuclear power plant is a rather overwhelming system. An attempt is made to cover all the subsystems and parameters needed to optimize the system. The author is only partially successful, but to be completely successful, he would have had to write volumes.

Particularly useful chapters are Chaps. 2, 3, 7, and 8. Chapters 2 and 3 are on the economics of electrical utilities and nuclear power plants. It is becoming increasingly important that nuclear engineers understand the economic as well as the technical problems of power plants. I am glad to see a clear presentation of the economics of nuclear power for the generation of electricity in a textbook. Some of the projections are already out of date. For example, the total construction cost for a 1000-MW(e) plant is given as $313/kW, and today's cost has already passed $500/kW. This simply shows the effects of inflation during the past two years since the book was written.

Chapter 7, "Fuel-System Analysis," includes a cost analysis of the nuclear fuel cycle. Again, the costs are out of date. The cost of a separative work unit may soon be twice the $32/kg quoted, but we can't blame the author for inflation. The methods for calculating the costs are in the book, and that is what is important. Chapter 7 also contains a good summary of in-core fuel management techniques, a subject seldom covered in other textbooks.

Chapter 8, "Design Considerations," gives a good example of the systems design approach for a fast reactor. This example illustrates the object of the book. The design of a nuclear plant is very complicated, and very many factors must be included. To go through a comparable exercise, a group of graduate students in nuclear engineering should take at least one semester and preferably two semesters.

Chapter 9 is on "Optimization Approaches." Some mathematical terms such as objective function, constraints, linear programming, and dynamic programming are defined. A more detailed example of how these terms and procedures are used in designing a nuclear plant would have been helpful.

Chapters 4 and 5 are far from complete in themselves. A student needs a good background in heat transfer, fluid flow, and the thermal hydraulics of a reactor to be able to read and understand Chap. 4, "Thermal Transport Systems and Core Design." An elementary derivation of the equations for the radial temperature profile in a fuel element is given, and a good example of calculating this profile is applied at the midplane of the core. Still, the hottest spot in the core is beyond the midplane, and there is no comparable description of the axial temperature distribution in the core, which is needed to determine the location of the hot spot. This is somewhat inconsistent.

Chapter 5 is on "Nuclear Analysis Methods," and a student should have had at least two semesters of reactor theory to be able to understand this chapter. Much is left out, and some terms are poorly defined. For example, the term "Alpha Search" is mentioned under "Criticality Search Codes," but the uninitiated reader has no way to find out what is meant by an Alpha Search. The list of references to the various codes at the end of the chapter is the most valuable part of the chapter.

Chapter 6, "Safety and Related Design Requirements," is more complete than the previous two chapters in parts, but in other sections it does not stand alone. The reader must have a good background in reactor kinetics and control to read those sections with intelligence. The part of the chapter on fission-product buildup and transport is good, and there is a good example of the calculation of a dose downwind using Sutton's formula for atmospheric dispersion. The loss-of-coolant-accident sequence is described using a block diagram and is understandable. A numerical example would have been useful, but of necessity would have been quite lengthy.

In summary, the book can be quite useful as a reference for the experienced nuclear engineer or as a text in an advanced graduate course in reactor design using the systems engineering approach. Students taking such a course should have good preparation in reactor theory, kinetics, controls, and thermal hydraulics.

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*About the Reviewer: J. L. Meem has been chairman of the Department of Nuclear Engineering and director of the Reactor Facility at the University of Virginia since 1957. He received his BS in chemistry from Virginia Military Institute in 1939 and his PhD in nuclear physics from Indiana University in 1949, was a reactor physicist at Oak Ridge National Laboratory from 1950 to 1955, and was chief reactor scientist at Alco Products from 1955 to 1957. Dr. Meem was a visiting staff member at Los Alamos National Laboratory from 1967 to 1968. He is a past chairman of the Reactor Operations Division of the American Nuclear Society, and was general chairman of the American Nuclear Society Conference on Research Test and Training Reactors held at the University of Virginia in 1974.*