physicists and engineers who wish to understand the methods used to calculate neutron energies, fluxes, and distributions in real and imaginary arrays of fuel elements. It will, therefore, be valuable to all those who are involved in teaching courses on reactor physics, as well as to their students, particularly those from developing countries where French is a second language. The large number of mathematical exercises (without answers) that it provides will help the serious student.

Much of the matter in the first five sections (480 pages) has already been treated in English in the classic monographs by Glasstone and Edlund or Weinberg and Wigner. The mathematical treatment of neutron absorption, diffusion, and thermalization given here is clear and straightforward. The sections concerning applications to homogeneous and heterogeneous reactors incorporate a substantial contribution by such French scientists as A. Amouyal, P. Benoist, and M. Cadilhac that cannot be found in standard texts in English. The last two chapters (130 pages) give an up-to-date summary of French experience with uranium/light water and plutonium/liquid-sodium reactors that I found both original and stimulating.

There are nine mathematical appendixes and a short index; bibliographies are given after each chapter. The book specifically does not cover problems of heat transfer, shielding, and health physics or experimental detection of neutrons. Minor criticisms concern the figures (which are only numbered consecutively by chapter, and whose axes are not always clearly labeled) and the failure to relate all the units quoted to SI (e.g., "pcm" used as units of reactivity). However, jargon terms, such as "pile" for reactor, are not overemphasized, and the style is lucid. All in all, this is a scholarly work that can be recommended.

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Elements of Nuclear Reactor Design

Editor	Joel Weisman
Publisher	Elsevier Scientific Publishing Company (1977)
Pages	466
Price	$51.65
Reviewer	Roger A. Rydin

To paraphrase the Preface to *Elements of Nuclear Reactor Design*, "The primary objective of this work is to provide a basic description of the quantitative aspects of nuclear reactor design. An effort has been made to consolidate material scattered throughout the literature and to treat in considerable detail the topics of reactor computations, piping and vessel design practice, fuel element design and reactor safety, which in the past have generally received superficial treatment. The book should be suitable both as a reference and as the sole text for reactor engineering courses."

The announced goals are certainly ambitious. In my opinion they serve as an adequate basis for judging the book. The questions to be answered are:

1. Is it a good textbook?
2. Is it a good reference book?

Before going into detail, a few statistics are in order. The book consists of 14 fairly distinct chapters averaging 27 pages of text material plus 3 pages of references and problems each. The appendixes contain some mathematical data plus useful physical and thermodynamic data on coolants, fuels, moderators, and cladding materials. Nine different authors contributed to the book.

First, I would like to make a general observation. A reference book and a textbook have somewhat different requirements put upon them. A textbook is supposed to provide a fundamental understanding of a subject starting from basic principles, while a reference work is supposed to summarize the latest high-level design practice. While these two requirements are not inherently incompatible, at a minimum they require extra explanation and coordination of subject matter, i.e., a longer book. I find that the authors of *Elements of Nuclear Reactor Design*, in a conscious effort to keep chapter lengths in bounds, have opted in the direction of a reference work rather than a textbook. A detailed critique of each chapter follows.

Chapter 1. "Elements of Reactor System Design" by J. Weisman. This is a well-written and informative description of current reactor system designs. The author has wisely refrained from trying to cover every design that has ever been used or conceived of.

Chapter 2. "Reactor Materials" by J. Weisman. The author presents a generally good description of reactor materials and their problems.

Chapter 3. "Thermodynamics of Nuclear Power Systems" by J. Anno. This is a moderately good, logical presentation of thermodynamics as applied to nuclear systems. The author assumes that the reader has had an undergraduate-level course in thermodynamics and is familiar with its basic definitions and vocabulary. He takes an interesting approach to the topic of irreversibility. Unfortunately, some of the problems at the end of the chapter are unrelated to the text.

Chapter 4. "Reactor Physics Computations" by A. Shapiro. This chapter is a quantum jump above the previous chapter in level of difficulty. Here, the author assumes that the reader has had a year of graduate work in reactor theory. While the presentation is reasonable given space limitations, there are a few flaws. Specifically, he does not emphasize that the industry uses two- or three-parameter fits for ultimate generation of most few-group cross sections, and he fails to mention the importance of self-shielding in depletion calculations. His discussion of control rod calculations is archaic. Finally, the problem set is the most difficult set in the book.

Chapter 5. "Nuclear Reactor Shielding" by J. Moteff. This is the longest, and one of the best-written, chapters in the book. It is easy to read, informative, and contains good shielding design suggestions.

Chapter 6. "Heat Generation and Transport" by J. Weisman. This chapter serves as an introduction to the calculation and use of hot-channel factors. Unfortunately, the author spends a great deal of time on one-group diffusion theory and leaves a real impression that thermal design is accomplished using Bessel functions and chopped-cosine power shapes.

Chapter 7. "Fluid System Design" by J. H. Rust. The first third of this chapter is well written and deals with single-phase flow pressure-drop correlations; most of the problem set deals with this area. The more interesting area of incompressible flow is slighted, since much more could have been said concerning the simultaneous solution of the continuity, momentum, energy, and state equations. Two-phase flow is treated primarily through correlations, tables, and graphs.

Chapter 8. "Heat Transfer" by J. H. Rust. In this chapter, fluid-flow heat transfer is treated almost completely in terms of empirical correlations, while conduction heat transfer is reduced to fairly simple one-dimensional solutions. Precious little is said about computer methods and how they work.

Chapter 9. "Elements of Stress Analysis" by J. Weisman. This is a very short chapter to explain stress and strain to the uninitiated. The ideas of stress decomposition are not fully explained. This material should have been combined with that in Chap. 10, or the derivations in Chap. 10 should have been included here.

Chapter 10. "Vessel and Piping Design" by J. Weisman. The stress-strain equations are derived here, but unfortunately in the middle of the chapter. Most of the rest of the chapter seems to have come out of an ASME handbook. The author's description of nil ductility temperature and its behavior as a function of neutron damage is a bright spot.

Chapter 11. "Fuel Element Design" by P. E. MacDonald and I-Chih Wang. This chapter is easily the most scholarly, thorough, and up-to-date chapter in the book. It excels not only in the discussion of basic phenomena, but also in presentation of data and correlations and in detailed description of how all the information is used in design computer codes. The chapter contains the only use of SI units in the book and is essentially free of typographical errors.

Chapter 12. "Radioactivity Releases" by J. H. Leonard. This chapter presents data on the various isotopes present in a reactor system, and discusses in a simple manner the leakage of these isotopes out of the fuel, out of the containment, and their subsequent dispersion into the atmosphere. Unfortunately, large accidents are not mentioned.

Chapter 13. "Loss-of-Cooling Accidents" by J. Weisman. The primary difficulty with this chapter is its choppiness. Descriptions of subjects such as flow coastdown and loss-of-coolant accident philosophy are excellent, while the treatment of other portions such as shock wave propagation are perfunctory.

Chapter 14. "Reactivity Insertion Accidents" by K. S. Ram. This is the most disappointing chapter in the book, since it begins with a discussion of temperature coefficients based on the old four-factor formula. The idea of having different temperatures in a reactor and defining a power coefficient is not even mentioned. Most of the chapter is spent deriving the analytic point kinetics models known as Nordheim-Fuchs and Bethe-Tait. The space would have been better utilized by giving more details of the workings of some of the accident analysis computer codes used in industry, plus the results obtained therefrom.

In summary, the book contains a fairly complete description of various aspects of nuclear reactor design, as advertised. Unfortunately, the treatment is often cookbook in nature, with relatively little derivation and an assumption that the reader already knows the vocabulary of the subject matter. The problems are often tailored to using tables, graphs, or given formulas to obtain a solution. Many problems cannot be done using only the knowledge given in the chapter. Some problems are poorly written.

One of my colleagues at the University of Virginia has already tried using this book as the text for a graduate course. Both he and his students were disappointed with it. While others may experience a somewhat different result, in my judgment it would be relatively difficult to teach from this book.

On the other hand, I found the book to be an interesting review and update of a number of subjects that are outside of my current areas of interest. To that extent, *Elements of Nuclear Reactor Design* has value as a reference book; I intend to keep my copy handy and refer to it from time to time.

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Material Accountability: Theory, Verification, and Applications

Author	Rudolph Avenhaus
Publisher	John Wiley and Sons, Inc. (1977)
Pages	187
Price	$24.95
Reviewer	W. C. Bartels

This monograph presents a mathematical treatment of the accountability of materials in bulk form. It is presented under the auspices of the International Institute for Applied Systems Analysis. Principles for material balance accountability and verification and related systems aspects are developed. The development of principles is elegant and theoretical. Applications are described for materials used in an industrialized society, including basic materials, materials produced, and waste materials. The monograph and this review are focused primarily on the detailed treatment