Book Reviews

Introductory Nuclear Reactor Statics. By Karl O. Ott and Winfred A. Bezella. American Nuclear Society, LaGrange Park, Illinois (1983). 366 pp. $43.00.

Nuclear engineering curricula are getting crowded. The number of topics subsumed under nuclear engineering keeps increasing, and students are being forced to commit themselves early to one or another subspecialty. In this situation, insisting that each major topic—such as professional level reactor neutronics—be covered in a 1-yr course sequence is regressive: Students may either be forced to forego taking other desirable courses, or, at best, find that their own ability to sequence their courses optimally is impaired.

For these reasons, there is a need for a sound, one semester course in "reactor theory" at a level of rigor appropriate for seniors or beginning graduate students. *Introductory Nuclear Reactor Statics* attempts to meet this need. Its seven chapters cover:

1. basic neutron physics concepts
2. neutron balance, diffusion, and criticality
3. spatial dependence in multiregion problems
4. neutron slowing down
5. resonance absorption
6. neutron transport theory
7. multigroup diffusion theory.

The above listing is by subject, rather than by chapter title.

For the most part, this selection of topics is appropriate. I would have included reactor perturbation theory and omitted neutron transport theory, but that is a matter of individual preference. The point is that most of the topics omitted from the standard 1-yr course are suitable for inclusion in parallel or subsequent independent courses: elementary neutron physics, reactor control, kinetics and dynamics, burnup, and reactivity change. Thus, I would concur that this book can achieve its stated objective of presenting the fundamentals of reactor statics.

The authors state that their treatment is long on mathematics and short on physics, relative to other texts at the same level. I do not agree with their assessment. I find that the interplay between presentation of concepts ("physics") and their formulation ("mathematics") is well balanced, as it must be in any successful textbook.

In one respect, the book is not quite modern. It is very important to acquaint the serious beginning student with the iterative logic that enters into computer solution of real problems. Being familiar with the concepts of inner and outer iteration, and of numerical solution of spatial and spectral problems, is necessary to anyone who is asked to digest the meaning of printouts from standard computer programs. This is a common assignment both in research laboratories and in industry. I think it is a defect that these concepts were not introduced early and illustrated throughout the book, rather than, as is the case, briefly mentioned at the very end.

The writing and presentation are generally clear, but there are some difficult spots. Some of the complexities introduced in the earlier chapters, such as the attempt to justify diffusion theory in Chap. 2 with rigorous transport theory arguments, are not helpful. The introduction of the Selengut-Goertzel and Greuling-Goertzel slowing down treatments is, contrariwise, displaced from its logical order as a general improvement on slowing down theory, and pops up later in the resonance escape chapter, where it is not especially relevant.

With these criticisms, it might be inferred that I don't like the book. That's not so. If it were a bad book, I wouldn't be taking the trouble to review it carefully. I am, in fact, presently considering this text, competitively with other recent texts of good quality, for adoption in a beginning graduate course. My selection will be based primarily on how well the book's coverage and presentation match what I want to include in *my* course. The price of the book on a per page basis is a little high, as is the case with many American Nuclear Society volumes, but that is not an overriding factor.

The authors are very well-respected reactor physicists, and the book is well recommended simply by virtue of its presentation of the material that is taught within a quality program at Purdue. These facts are sufficient to commend the book for serious consideration by engineering educators.

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About the Reviewer: Bernard I. Spinrad began his career as a reactor physicist at Clinton Laboratories (now Oak Ridge National Laboratory) in 1946. He moved to Argonne National Laboratory in 1949, where he stayed until 1972, as senior physicist and, for 7 yr, director of the Reactor Engineering Division. He took time out for 3 yr (1967 to 1970) to serve as Director of the Nuclear Power and Reactors Division of the International Atomic Energy Agency. From 1972 to 1982, he was Northwest Energy Chair Professor at Oregon State University, and assumed his present position (Professor and Chair of the nuclear engineering department at Iowa State University) early in 1983. He has a long record of activity as a reactor design physicist, including conceptual design of the Materials Testing Reactor and the Savannah River reactors. He was also an early codifier of reactor physics theory, specifically two-group calculations and long-term reactivity change theory. In recent years he has been active in more general nuclear energy problems

(service on the steering committee for the Committee on Nuclear and Alternative Energy Systems), in safeguards research, in decay heat research, and in nuclear economics. He regularly teaches courses in reactor physics and in nuclear fuel cycle, and occasionally in a broad spectrum of topics within his interest.

Before It's Too Late, A Scientist's Case for Nuclear Energy. By Bernard L. Cohen, Plenum Publishing Corporation, New York (1983). 292 pp. $16.95.

This is the best book this reviewer has read that sets forth the advantages of nuclear energy and counters the misconceptions about it spread by the media and antinuclear critics. Written in language understandable by the general public, it deserves to be widely read. The book can do much to overcome the unreasoning fear of nuclear energy now felt by many Americans. Nuclear specialists wishing to advance public acceptance of nuclear energy will find the book indispensable because of its numerous, striking examples of the advantages and safety of nuclear energy compared with coal and other energy sources.

Chapter 1, "Problems in Public Understanding," explains why the public has such gross misunderstanding about nuclear power and alternative energy sources and tells how the author intends to set the record straight.

Chapter 2, "How Dangerous Is Radiation?," is a balanced comparison of the risks from exposure to radiation with the risks of ordinary living. Some striking examples: One millirem of radiation gives the same risk of being killed as driving three miles or crossing the street three times on foot. The genetic effect of one millirem of radiation is equivalent to five hours of wearing pants.

Chapter 3, "The Fearsome Reactor Meltdown Accident," compares the probability and consequences of various classes of reactor accidents and shows them to be much less serious than accidents with other technologies that are accepted without concern—motor vehicles, hazardous chemicals in commerce, coal-burning power plants, and hydroelectric dams.

Chapter 4, "Understanding Risk," is an impressive comparison of the small risk from nuclear power generation with the much greater risk from other aspects of life. For example, the average loss of life expectancy from being 30 pounds overweight is 900 days; from motor vehicle accidents, 200 days; from hydroelectric dam failures, 0.5 days; if all U.S. electricity were nuclear generated, 0.03 days. Having all U.S. electricity nuclear generated would shorten the average American's life the same amount as smoking one cigarette every 15 years. Tightening buildings to reduce fuel consumption would reduce life expectancy of occupants from increased radon exposure by 24 days and thus make this conservation measure the most dangerous energy strategy from the standpoint of radiation exposure.

Chapter 5, "Hazards of High-Level Radioactive Waste," shows that the harmful effects of properly stored high-level waste are much less than from burning coal or from commonly used industrial chemicals. Seven layers of protection prevent wastes stored underground from getting into water supplies during the first few hundred years, and after 15 000 yr the wastes are less toxic than the natural uranium from which they were generated.

Chapter 6, "More on Radioactive Waste," deals with radioactive hazards other than from stored high-level waste. From a coal-burning plant, radon, air pollution, and chemical carcinogens are shown to cause far more fatalities than radioactive wastes from a nuclear plant of the same capacity.

Chapter 7, "Plutonium and Bombs," deals with the value of plutonium as an energy resource and its dangers as bomb material or poison. The author first makes a strong case for plutonium having the potential to provide all the electric energy the world will ever need through use of breeder reactors. He then tackles the concerns about plutonium. He shows that diversion of plutonium from a nuclear power plant would not be the preferrred way to make a bomb or the most effective way for a terrorist to blackmail a community by threatening to poison its water supply. Plutonium toxicity has been greatly overstated. It is much less toxic than natural toxins that can be responsible for botulism or mushroom poisoning.

Chapter 8, "Costs of Nuclear Power: The Achilles Heel," is a good account of the great increase in U.S. nuclear power costs caused by antinuclear opposition, regulatory ratcheting, and regulatory delays. It concludes with a plea for sensible, expedited regulation so that nuclear power costs in the United States can again be as low as in France, Japan, and other countries where nuclear plants are being built in half the time.

Chapter 9, "The Solar Dream," shows how the low surface density and variability of sunlight puts solar energy at an insuperable disadvantage compared with coal or nuclear energy for steady, dependable electric generation.

Chapter 10, "What The Polls Tell Us," reports the results of a questionnaire Cohen sent to members of the Health Physics Society and Radiation Research Society. The members responding believed that the public's fear of radiation was greatly exaggerated and that media coverage greatly overstated the dangers.

Chapter 11, "Questions from the Audience," lists frequently asked questions critical of nuclear power and gives concise answers that refute the criticisms. This chapter alone would provide valuable education for a person uninformed about nuclear power.

Chapter 12, "A Cry for Help," lists the reasons for public misunderstanding about nuclear power: wildly exaggerated fear of radiation, failure to understand and quantify risk, grossly unjustified fears about disposal of radioactive waste, fear of plutonium, and the romantic notion that solar electricity could or should replace nuclear energy or coal. The book concludes with the sentence "If, with your help, we can clear up the public misunderstandings..., we may still enjoy the wonderful blessings that nuclear power is so capable of bringing us—cheap and abundant energy forever, along with improved health, safety and preservation of our environment."

Cohen's book goes a long way toward clearing up these misunderstandings.

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About the Reviewer: No word from this Editor can add to the identity and stature of our reviewer. His impact on the nuclear community is eloquently stated through his service as a principal architect of the art of the separation of uranium isotopes in the grim days of World War II, as an administrator and educator (Massachusetts Institute of Technology, U.S. Atomic Energy Commission/General Advisory Committee, and the American Nuclear Society), and as a scholarly gentleman. He has helped shape this journal as a member of its Editorial Advisory Committee for 25 years. For this guidance and for a personal/professional association dating from 1941, I shall always be grateful. (DC)