Book Reviews

Reactor Handbook, 2nd ed. (HARRY SOODAK, ed.). Interscience, division of Wiley, New York, 1962, 313 pp. $10.75.

There is a line from *You Can't Take It With You* (spoken by the ballet instructor) which concisely summarizes my opinion of the second edition of the physics section of the *Reactor Handbook*. However, such a flip dismissal of all the personal effort and expense associated with the volume is unjust, especially since it may only reflect the parochial attitude of the reviewer. Let me then try to be specific and, further, to separate my comments into, first, one class with which I feel most people working in the field of reactor physics would agree and, second, into a class which may merely constitute an expression of my own prejudices.

It seems to me that the primary purpose of this handbook should be to present under one cover for the use of someone involved in a practical reactor design a collection of pertinent data, and a summary of standard, practical, theoretical methods and prescriptions along with appropriate references. Superficially the present handbook realizes these objectives. Particularly in the area of experimental data, a very broad coverage of pertinent information is provided. Unusual pieces of information which would be hard to find under ordinary circumstances are conveniently collected and displayed. Unfortunately, most of the information of a practical nature—nuclear data and methods useful in design—was somewhat out of date in 1957. Moreover in the intervening years these data and methods have been improved substantially. Thus in the areas of greatest concern to a reactor designer the second edition of the *Reactor Handbook* is no substantial improvement over the first edition.

It may be argued that a volume covering such a wide range of material in such a rapidly advancing field should not be expected to be completely up-to-date. This is a point which I readily grant. However, the deficiencies in the present instance are so extreme that I feel it would be more accurate to describe the present volume as completely out-of-date. For example:

1. Most of the 237 references in the first chapter (on nuclear data) are dated 1955 or earlier. To quote for the age of fission neutrons in light water the (inaccurate) value measured in 1950 seems out of place in a 1962 handbook.

2. The experimental methods described in Chapter 2 come mostly from papers now ten years old. The measurements of such quantities as thermal utilization, capture-to-fission ratios and surface to volume resonance capture are not discussed. No mention of pulse neutron techniques is made.

3. Chapters 3 and 4 (Theory of Neutron Transport, and Reactor Statics) are based, except for a section on resonance capture, almost entirely on papers published prior to 1956, and in some cases, not published at all. They ignore, for example, the neutron thermalization problem. Even more serious is the failure to discuss the development of computing machine methods which has taken place during the past ten years. One table is given summarizing features of ten digital computer codes. It is so inadequate and so out-of-date as to be ludicrous. (For example, the Bettis code, LIL ABNER, is listed. It hasn't been used at Bettis in some seven years and is the great-great-great-great grandfather of a version of the program, WANDA, which has been used for some two years.) Anyone trying to find out what computations in transport theory or reactor statics are feasible today will get no help from this handbook.

4. The chapter on reactor dynamics ignores space-time transients. (Although there are *references* to the xenon tilt phenomenon, I could find nothing in the text referring to these references.) It also neglects to discuss digital and analog techniques for describing transient phenomena particularly those involving feedback effects. Fast transient studies of the SPERT and KEWB programs are not mentioned. No discussion of stochastic and correlation phenomena appears. In short the chapter could just as well have appeared in the 1955 edition.

The final chapter on Critical Data is to some extent an exception. It appears to have been written in 1958. More information has since appeared (for example, the Savannah River, G.E.-Vallecitos, B and W, and WCAP work). However, perhaps this is an instance of being not completely up-to-date rather than of being out-of-date.

My conclusion from the foregoing comments is that the present edition of the physics section of the *Reactor Handbook* adds little to the earlier edition. I have, however, a second class of comments which suggests that issuing this edition may actually do harm.

It seems to me that the present edition of the handbook perpetuates a number of theoretical methods and approximations which would better be retired from active service and admired as historical relics. All those double-named methods (Serber-Wilson, Feynmann-Welton, Selengut-Goertzel, Nordheim-Scalettar) along with a good many others played a role in their day. But they are no longer used—or, if they are, they shouldn't be, since cheap methods of considerably greater accuracy are available to solve the same problems. I have the feeling that the continued appearance of these procedures in books and handbooks reflects more the background of the authors than the importance and utility of the methods themselves. In particular, I think they have no place in a handbook. Thus, it is my opinion that the present edition of the physics section of the *Reactor Handbook* suffers not only from containing too little of the right material, but—and perhaps this is more serious—of containing too much of the wrong material.

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Reactor physics over the past five or six years has continued its steady growth, and is now a quite different subject from what it was in the early and mid fifties. Thus, there are current needs for texts and handbooks—the latter both of the German expository type and the data handbook.

The new edition of the *Reactor Handbook* does not fill these needs.

The preface to the volume states that the bulk of the work was completed in 1957. The material contained in it supports this statement; most of it is now obsolete. There are occasional references to publications as late as 1961, and a number of references to material published in the Proceedings of the 1958 Geneva Conference. This material appears almost exclusively in a small part of Chapter 4 (Reactor Statics, Theoretical) and in Chapter 6 (Critical Data).

One would think that in the five years between preparation and publication, time would permit excellent editing. However, the references in Chapter 5 are completely garbled.

The reviewer appreciates the difficulties of speedy publication, being now in the throes of trying to unjam a similar work (*Reactor Physics Constants*, second edition, put to bed in January 1962, and soon, I trust, to be published). Nevertheless, five years is much too long.

Chapter 1, "Nuclear Data," is well organized, presenting material on the fission process, radiation sources, range-energy relations, neutron cross-section theory and data, and integral resonance and neutron age data. The data are, for the most part, obsolete. The theoretical parts are well written, but they do not contain discussions of the more sophisticated optical models, and the discussion of inelastic scattering by condensed matter for neutrons of low energies is brief and qualitative. The data are for the most part archaic.

Chapter 2, "Experimental Methods," contains universally useful material. Again, it suffers by omission of modern material on: fast response circuitry; experimental methods for determining neutron spectrum; pulsed and oscillating source experiments; and lattice sample and substitution methods for determining k_∞, B^2, and lattice constants. The section on critical experiments is an excellent summary of general principles. The data are obsolete.

Chapter 3, "Theory of Neutron Transport," leans heavily on the simple approximations. It is generally compact and correct. The spherical harmonics method is given too much space in terms of its general utility, and numerical methods too little. The Milne problem is treated in unnecessary detail, since its practical value is now nonexistent. The best part of the chapter is the descriptive text explaining the Boltzmann equations. The much used S_n method is qualitatively described, very well. The codes cited for solving slowing down equations are uniformly obsolete.

Chapter 4, "Reactor Statics," is the one containing the most recent material, and by far the most interesting. It contains a modern approach to the "classical" description of a reactor in terms of the four factor formula, leakage, cell homogenization, void and control theory, and temperature effects. In many ways, I find the presentation of the material covered more satisfactory than "Wigner and Weinberg" which is animated by the same philosophy. There is however a purely sentimental attachment to diffusion theory, with many plots of E factors, F factors, and other mathematical formulas which are no longer used because they are in error on their basic physical assumptions. The Amouyal-Benoist method for computing thermal disadvantage factors, which is a very good approximation, could have been substituted with profit—that is, its tables, figures, etc., printed out instead. The thermal spectrum problem with its interaction with the transport problem is not presented, nor is the physics of burnup reactivity change. These related problems are the bone in the throat of classical theory, so that their omission makes the presentation appear undeservedly authoritative. Nevertheless, this is an interesting chapter.

Chapter 5 is on Reactor Dynamics. The first several references are from some other book. It almost looks as though a subsection on reactivity changes under long term irradiations was originally included, and then stricken. The chapter contains several standard charts. Its coverage does not reflect the same careful attention to historical priority as do the other chapters (for example, good early work on Nyquist stability criteria was performed by H. A. Strauss at Oak Ridge and J. Chernick at BNL). The chapter is not very good.

Chapter 6 contains critical calculations and data. It contains many curves from the Second Geneva Conference—72 figures and 12 tables, of which I estimate half to be from that source. If this book is all the reader has to work with, it must be admitted that the data are useful. On the other hand, most of the data presented were already included in the first edition of *Reactor Physics Constants*, and this reviewer feels that such data belong preferably in this latter work. It is clear that a better correlation between these two volumes will be necessary in the future.

In summary, as may be gathered from the foregoing, I do not recommend purchase of this book.

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(About the Reviewer: Bernard Spinrad's interests have been in the fields of reactor physics and reactor engineering at Argonne National Laboratory since 1949. Until recently he was Director of its Reactor Engineering Division, a position he had occupied for the past six years. Preceding his tenure at ANL and following completion of his graduate studies at Yale he was associated with the Clinton Laboratories (Oak Ridge) for two years. Dr. Spinrad has served on several committees advisory to the U. S. Atomic Energy Commission on matters germane to basic reactor development, and is currently Chairman of the European-American Committee on Reactor Physics, an advisory body to the European Nuclear Energy Agency on matters of reactor physics.)