Book Reviews

Nuclear Energy Conversion. By M. M. El-Wakil. Intext Educational Publishers (1971). 666 pp. $16.50.

Nuclear Energy Conversion covers the broad range of engineering problems involved in the conversion of nuclear energy into electricity. The sources considered include not only nuclear fission, but nuclear fusion, thermionic and thermoelectric, and direct conversion. Much of the book, however, is concerned with standard thermodynamic energy cycles as applied to the specific problems raised by the standard reactor configurations. After an initial introduction into nuclear power concepts and thermodynamics, Professor El-Wakil discusses the boiling water, pressurized water, gas cooled, liquid metal (fast breeder), and organic moderated reactors. For each of these basic reactor concepts there is one chapter describing the specific design criteria for that reactor class which distinguishes it from the other class of nuclear reactors. Following the description of the reactor class, a second chapter expands on the power plant and the specific problems in coupling the turbine to the heat source.

The book emphasizes the engineering problems of the reactor and the power plant. The physics of the system is discussed only to the extent necessary for proper understanding of the design requirements which the physics imposes on the system. The major area of discussion is the engineering thermodynamics of the power plant, and this is treated quite completely.

The book is designed as a textbook for a senior or graduate course, with an excellent collection of nontrivial problems at the end of each chapter. The text is marred, however, by a few obvious, but disturbing, misprints which usually involve errors in typesetting the equations.

In general, however, the book should prove a useful text and reference for the concepts and design of nuclear reactor power plants.

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About the Reviewer: Since 1969 E. Richard Cohen has been a member of the technical staff of the North American Rockwell Science Center after twenty years in various research positions at North American. Dr. Cohen's graduate studies were at Cal Tech where his continuing interest in evaluating fundamental physical constants began. He is a recipient of an E. O. Lawrence Award, is a Fellow of both the American Nuclear Society and the American Physical Society, and a member of the Editorial Advisory Committee of Nuclear Science and Engineering.

Direct Conversion of Nuclear Radiation Energy. By G. H. Miley. American Nuclear Society (1971). 532 pp. $34.90.

A first impression of this book by Miley is that it is uncharacteristically large for an ANS-AEC monograph. Upon closer inspection, however, I do not feel that it is too long, especially in view of the many subjects covered, very helpful chapter summaries, exhaustive reference lists, and substantial appendix. The author apparently knows the subjects well, and they are presented coherently with a minimum of "fat." The absence of a previous exhaustive review in this field justifies the numerous detailed fundamental derivations, which, I believe, should relieve subsequent authors of this task. Miley's book could become a "classic" in the field; whether or not it will probably depends on the growth of the field and, more importantly, on whether the approaches which become practically important are among those included and/or emphasized in this book.

Miley has omitted or only mentioned at least two approaches which clearly fall within the stated scope of the book and which at present have practical importance equal to or greater than those included in the work. These are the radio-voltaic and the radio-photovoltaic semiconductor devices. The first is the semiconductor equivalent of the Ohmart ionization-electric cell described in the book. In the second, nuclear radiation excites a phosphor whose photons thereupon energize a semiconductor photocell. Publications on these approaches date back to the mid 50's. Demonstrated efficiencies and powers equal or exceed those demonstrated for many approaches treated extensively in the book. Furthermore, a ^{147}Pm-powered beta-voltaic device is presently being marketed under the trade name "Betacel" by the McDonnell-Douglas Corporation. In view of this current activity and the practical and basic descriptive literature available on these approaches, I am puzzled as to why they were omitted. If there are other significant omissions of which I am unaware, the book could fall short of being a "classic" work.

On a number of occasions, my colleagues and I have used this book as a reference and for the data and derivations it contains. For one group working in this area, therefore, this demonstrates that the book is useful to have around.

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studies at Case Institute with principal interest in solid-state physics. Subsequently he was director of the Energy Conversion Department at Atomics International, vice president of Thermo Electron Corporation, and a consultant for a number of organizations here and abroad. Dr. Rasor's research interests have been in surface and plasma physics, energy conversion, and cardiovascular engineering, including investigations of artificial hearts and pacemakers.

Measurement of Low-Level Radioactivity, ICRU-22. International Commission on Radiation Units and Measurements, ICRU Publications, Washington, D. C. (1972). $3.50.

The task group which prepared *Measurement of Low-Level Radioactivity* is to be commended, because an introductory monograph on techniques for and problems of measuring concentrations of radioactivity below one nCi/g is needed to accommodate the expanded interest in low-level measurements. Relatively few workers to date have been actively involved in such measurements.

Report 22 is particularly useful, we think, in indicating that low-level measurements require very special care. It presents an important and useful discussion on the statistical treatment of radioactivity counting data, particularly detectable activity and its dependence on detector background and efficiency, and sample size, as well as the comparison of results from different analytical methods. The chapter on sample treatment is also useful since this subject has not been covered adequately in other monographs. The discussion on contamination, particularly as it affects beta-particle measurements, is enlightening and should guard the low-level analyst from falling into the pitfall of sample contamination.

The discussion of gamma- and x-ray measurements, particularly that of Ge(Li) spectrometry, is incomplete, and the reader should direct his attention to the references and to the fairly extensive literature which postdates this report. The statement in Sec. 3.7.1, for example, indicates the problem with the low Ge(Li) efficiency; it would have been helpful to devise a discussion comparing the practical considerations governing the choice for various applications between Ge(Li) with its high energy resolution and low efficiency and NaI(Tl) with its high efficiency and low resolution.

The discussion of shielding offers insight into the reduction of background from naturally occurring gamma radiation and cosmic radiation. Table 3.2 gives thicknesses of water, steel, and lead for the simple exponential attenuation of photons of four energies to specified fractions, which are in agreement with measurements by May and Marinelli (1962) as referenced. The exact relevance of such attenuation data depends strongly on what one wishes to count. To reduce the total counts from gamma rays will almost certainly require some additional consideration of buildup of secondaries which add to the continuum in the pulse height spectrum. It might have been appropriate to present data nearer the prominent energies of natural gamma rays from the thorium and uranium series and from ^{40}K.

The chapter on alpha- and beta-particle measurements is complete enough, although the subsection containing radiochemical procedures for specific beta emitters might have been omitted since various texts which are more comprehensive and complete have been referenced.

The negative aspects of the present review should not detract from the monograph, because it does provide a good introduction for individuals now becoming involved in low-level radiation measurements. Although the various sections could have been more thorough, they are supported by a good bibliography.

The reviewer acknowledges the assistance of his Health and Safety Laboratory associates, particularly Donald Bogen and Harold Beck.

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