radioisotopic power generators. The book is without a list of illustrations or a list of the 41 tables. It is probably of interest to many engineers to list here the titles of tables in each of the chapters of Part A:

Chapter 1 "Introduction to Radioisotopic Power Generation"
- 1-1 Historical summary of the Development of Radioisotopic Power Generators
- 1-2 Characteristics of Some Radioisotopic Power Generators
- 1-3 Radioisotopic Generator Performance Factors
- 1-4 Power Plant Environmental Constraints
- 1-5 Power Plants that Compete with Radioisotopic Generators
- 1-6 Classes of Space Missions

Chapter 2 "Radioisotopic Fuels"
- 2-1 Types of Radioactive Decay
- 2-2 Radioisotopic Fuels
- 2-3 Availability and Costs of Selected Radioisotopes

Chapter 3 "Nuclear Safety"
- 3-1 Maximum Permissible Concentrations of Radioisotopic Fuels
- 3-2 Maximum Permissible Exposures to External Radiation
- 3-3 Physical Forces Important to Safe Design
- 3-4 Accident Frequency Rate for Generator Shipment
- 3-5 Forces Impressed During Accidents on Space Missions
- 3-6 Hypothetical Generator Safety Engineering Data
- 3-7 Scout Booster Data
- 3-8 Hypothetical Mission Staging Data
- 3-9 Impact Range for Most-Probable Aborts
- 3-10 Definition of Terms in Fallout Equation

Chapter 4 "Energy Conversion"
- 4-1 Comparison of Dynamic Converters
- 4-2 Energy Conversion Matrix

Chapter 5 "Generator Design Principles"
- 5-1 Typical Shock and Vibration Loads for a Space Generator During Launch
- 5-2 Some Major Design Decisions and Their Implications
- 5-3 Fuel Capsule Structural Materials
- 5-4 Properties of Thermal Insulating Materials
- 5-5 Radiation Tolerance of Electronic Circuit Components
- 5-6 Radiation Tolerances of Electronic Equipment

In Part B, there are chapters describing surface, undersea, and space generators. One chapter discusses nuclear batteries, which the authors define by exception as those radioisotopic power generators that do not use heat engines in the energy conversion process. A final brief chapter mentions some advanced concepts. Some generator details have been intentionally omitted for security reasons particularly in the case of space generators. The first radioisotopic-powered electric generator in space was carried by Transit IV-A, a satellite launched by the United States on June 29, 1961. This event represented an important milestone in the U.S. space program. Apparent lack of Soviet activity in this field leaves the U.S. with a technological lead.

This book fills a gap in the technical literature. It is recommended particularly to application engineers concerned with power sources—radioisotopic or not—in the electrical power range from a few watts to a few kilowatts.

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About the Reviewer: Richard Madey is Professor of Physics and Chairman of the Physics Department at Clarkson College of Technology in Potsdam, New York. He received his PhD from the University of California at Berkeley in 1952 and a BEE degree from Rensselaer Polytechnic Institute in 1942.

Prior to his present position, he was Chief of Applied Physics at Republic Aviation Corporation. Before joining Republic in 1956, he conducted research in high-energy physics at the University of California Radiation Laboratory in Berkeley from 1947 to 1953 and at the Brookhaven National Laboratory from 1953 to 1956. He served in the US Navy from 1944 to 1946 after spending fifteen months with the Allen B. DuMont Laboratories.

Numerical Methods of Reactor Analysis. By Melville Clark, Jr. and Kent F. Hansen. Academic Press, New York, N. Y., 340 pp., $10.50.

Clark and Hansen have written a graduate-level text designed to be used in a one-semester course on the numerical methods used in the solution of various forms of the neutron transport equation. The subject matter is the mathematics underlying difference approximations to the equation; programming and details of codes in existence are not discussed to any extent. Hence, the book has rather general interest.

The student who studies from this book should be well prepared in differential equations, matrix algebra and reactor physics. He will also need to come to the course well motivated, that is to say, he must already appreciate that many problems in reactor technology can be solved only by recourse to numerical techniques. The student will find that he must stay awake during the lectures that accompany the book and work out the assigned problem because the writing is quite concise, making parts of the book rather heavy going.

By expending the amount of work that a mature graduate student should, the student will come away from a course based upon this book with somewhat more than the title suggests. This is because the authors have used the reasonable approach that the equations used in solving the reactor equations are simply examples of more general classes of differential equations. In fact, the first half of the book could be well the first half of a book entitled "Numerical Methods of ________" (fill in the blank). This is all to the good, particularly as one might legitimately raise the question as to whether it might not be better to have a student study numerical methods as a general mathematical tool instead of emphasizing a particular application. In the first three chapters that cover the general subject of difference equations and their numerical solution, there are good discussions on the convergence and stability of numerical solutions, truncation error, and on the analytic solution of difference equations. This latter is quite welcome because many of us who use computers often neglect to seek analytic solutions and it is through the behavior of analytic solutions that one can best understand what is happening in a numerical solution.

The second half of the book starts with a discussion of multigroup approximation to the age-diffusion equation. The treatment here follows the standard approach. The reviewer's feeling is that the relationship between flux and slowing-down density is given rather cursory treatment and that the authors might well have indicated that many modern codes treat slowing down via a scattering matrix. There then follows a chapter on the transport equation which discusses various transport approximations i.e., P_N, double P_N, discrete ordinates, S_N and the Spencer-Fano moments method. The reviewer's feeling is that there is a bit too much emphasis on the P_N method; it is not very widely used in numerical work and it is not a particularly transparent method. I was also disappointed by the fact that integral transport theory received no mention at all. Aside from these points, the chapter is rather good.

The final chapter is on Monte Carlo techniques; this, of course, is isolated in approach from the rest of the book because here one follows an analog of the neutron motion instead of solving a differential equation. This chapter, sad to say, does not measure up to the rest of the book, primarily because the treatment is so compact that it is almost incomprehensible in parts.

The text concludes with four appendices ("A. Boltzmann Transport Equation," "B. Velocity Relations for Nuclear Events," "C. Moments Methods for Neutrons," "D. Special Functions") that should serve as a useful compilation for easy reference.

Each chapter has references for collateral reading and a set of problems that are valuable for elucidation of points in the text.

On balance this is an adequate text so long as the student is fairly well prepared and it is accompanied by reasonable lectures and/or outside reading. It should also be useful to the worker in the field of reactor calculations who desires to learn about some of the mathematics behind the codes that are in everyday use.

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About the Reviewer: Paul Michael has been a member of Brookhaven's Theoretical Reactor Physics group since 1958. He has worked on neutron thermalization, neutron and reactor physics, and was involved in the design of the HFBR. He is currently working on numerical methods for solving the Navier-Stokes equation. Prior to coming to BNL, he received his Ph.D. from New York University.