radiochemistry, and the applications of nuclear methods in many fields.

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January 11, 1982

About the Reviewer: Vincent Guinn is professor of radiochemistry at the University of California-Irvine, where for more than a decade he has taught courses in radiochemistry, nuclear chemistry, nuclear activation analysis, and forensic chemistry and where, with his students at all levels, he conducts research in these fields. Previously he pursued similar interests at Shell Development and at General Atomic. Dr. Guinn did his graduate work at Harvard under Professor Kistiakowsky. He is a Fellow of the American Nuclear Society and has been chairman of its Isotopes and Radiation Division.

Nuclear Reactor Engineering, 3rd ed. By Samuel Glasstone and Alexander Sesonske. Van Nostrand Reinhold Company, New York (1981). $39.50.

The long and distinguished contribution to nuclear engineering education of Samuel Glasstone and Alexander Sesonske has additional lustre with the publication of the third edition of *Nuclear Reactor Engineering*. A large number of the nuclear engineers and scientists who received their education during the sixties and seventies learned the basics from the first and second editions. Many of us in academia attempted to use the second edition (circa 1967) by updating and extending the material far beyond the half-life usually assigned to a basic textbook in a changing technical field. The third edition, while retaining format, style, and many of the figures and illustrations of its predecessors, has been extensively rewritten with a clear and consistent emphasis on those topics directly related to the light water reactor power plant and the fast reactor power system. Gone are the interesting reactor concepts such as sodium-graphite and organic-cooled reactors, the thermal test reactors, and pulsing systems. Even the Fast Flux Test Facility receives only a paragraph in a section devoted to the liquid-metal fast breeder reactor as a nuclear steam supply system. The current real-world problems are addressed appropriately throughout the text, and a new chapter, "Nuclear Reactor Safety," includes much of the post-Three Mile Island impact on operating systems. Lessons learned are not tacked on as an afterthought, but are carefully tied into appropriate sections of the text. Although two chapters have been eliminated, and a smaller type case is used, the number of pages remains essentially the same. There are few topics included that are of minor significance; I would have difficulty deciding what to omit. Curricula using the new edition may wish to devote three semesters to adequately utilize the material.

As the authors note in the Preface, the International System of Units (SI) has been used throughout. Some of us oldtimers will encounter a few rough spots adjusting to neutron flux in $n/m^2 \cdot s$ and plants operating at pressures of 15.5 MPa. Most engineering students use both systems and should be able to make the transition from the SI classroom to today's non-SI control rooms. Problems have been revised and updated. The material seems to be relatively free of errors and the authors have been careful to use current references throughout.

The development of basics in the early chapters is unchanged. Doppler broadening is first introduced very early, immediately after the introduction of neutron resonances, rather than several chapters later, in reactor control. To keep size within bounds the authors have trimmed the earlier edition wherever possible; a solution to the reflected reactor and the neutron cycle for a thermal fission system are gone, along with such historical exercises as the variation of resonance escape probability (p) with thermal utilization (f) as the moderator-fuel ratio is changed in uniform mixtures of graphite and natural uranium. The exponential pile survives, for those who may still wish to do such measurements in laboratory courses.

Multigroup diffusion theory leads off the chapter on reactor analysis, and the need for and methods employed in large machine computations are carefully developed. Representative codes are mentioned by name. Fuel depletion calculations and an introduction to transport theory are also presented. With this material, students in our senior nuclear engineering course were able to utilize the "Nuclear Engineering Computer Module, RS-8, Multigroup Calculations" with a minimum of supervision.

Portions of reactor kinetics and control have been revised without changing the basic content and approach. The temperature coefficient of reactivity is developed to emphasize the net effect on a thermal or fast reactor, rather than effects on individual reactor parameters. Important operational terms, such as isothermal temperature coefficient and power coefficient, are explained; Doppler broadening is discussed for various fuel compositions.

Material on reactor control includes excellent sections on the function of control systems in the pressurized water reactor (PWR) and the boiling water reactor, and the shutdown margin, an important parameter frequently ignored in textbooks. Treatment of rod worth, a difficult experimental measurement, is rather sparse. The concepts of rod bank swapping, rod shadowing, and deboration measurements are generally omitted. In earlier editions, Glasstone and Sesonske often discussed experiments and experimental techniques. Unfortunately, for some of us, omission of these topics is most easily justified when trimming is necessary.

The chapter on energy removal reflects current concerns. Additions to the general development include gap conductance, transient heat transfer, core design constraints, and statistical core design. A new section on liquid-metal heat transfer supports the fast reactor concepts developed.

As before, the authors consider nonfuel materials in one chapter, followed by a second on reactor fuel. Nonfuel materials is now less general, and specific problems such as nondestructive testing surveillance and stress corrosion cracking address current operating plant concerns. The importance of good water chemistry and the steam generator tube failure problem in PWRs has been omitted. Treatment of the reactor fuel system includes modeling principles and available codes, waste storage options, and nonproliferation concepts, such as denatured fuels and the Civex process.

A comprehensive treatment of radiation problems inherent in nuclear plant operations is included in the chapter "Radiation Protection and Environmental Effects." Exposures as low as reasonably achievable and other environmental concerns such as radiation exposure pathways and radwaste treatment are included. Dispersion of effluents and siting implications are considered later in the chapter on reactor safety.

The authors present reactor safety in 55 pages. Even though much of the material, by nature, must be descriptive, ground work in previous chapters has been so thorough that a complex sequence of events and system responses can be presented in a concise fashion. New regulatory requirements, standards, and codes are presented. The student will recognize the relationship between the materials, components, and systems evolved in previous chapters, and the entire plant as a safety-engineered system. The only omissions I have detected in this excellent chapter are natural circulation as a safety feature, and the brief, rather idealistic, discussion of quality assurance.

Only rarely does a reviewer have the opportunity to review a book by authors with the knowledge and literary skill of Samuel Glasstone and Alexander Sesonske. Welcome back to our classrooms, *Nuclear Reactor Engineering*, 3rd ed.!

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January 11, 1982

About the Reviewer: Andrew Robeson, now professor emeritus of nuclear engineering, recently concluded a lengthy academic career, which began at Virginia Polytechnic Institute in 1955. Interspersed were periods at the Oak Ridge National Laboratory and the Babcock and Wilcox Company. He is now associated with Management Analysis Company on matters related to the nuclear power programs. Dr. Robeson's graduate training was at Virginia.

Nuclear Reactor Safety Heat Transfer. Edited by Owen C. Jones, Jr., Hemisphere Publishing Corporation, Washington, D.C. (1981). 959 pp. $99.00.

This book contains something for everyone. It combines a historical overview, textbook material, handbook information, and a bit of the editor's personal philosophy on the safety of nuclear power plants. The main part of the book is a collection of lectures prepared by leading experts in thermal hydraulics and reactor safety. These lectures were given at the International Centre for Heat and Mass Transfer in Dubrovnik, Yugoslavia, August 25-29, 1980. As stated in the author's Preface, the purpose was to ". . . bring together in one course the major areas of concern in the field of nuclear safety heat transfer and to describe the state-of-the-art at the turn of the decade."

The text is divided into five parts: Overview, Fundamental Concepts, Design Basis Accident–Light Water Reactors (LWRs), Design Basis Accident–Liquid-Metal Fast Breeder Reactors (LMFBRs), and Special Topics.

The first section contains three chapters that cover a historical overview of nuclear safety, a systems overview that includes all general classes of power reactors, and a review of a safety issue from the standpoint of thermal-hydraulic considerations. As the opening part of this section, the editor has prepared an abbreviated history of the development of nuclear power starting with the major scientific events leading up to the first criticality.

The second section discusses the transient response of LWRs and LMFBRs that follows initiating events, such as normal operating transients, and various accident scenarios. Also included are chapters on single- and two-phase flow, single- and two-phase heat transfer, and nuclear systems safety modeling. The section contains material on startup and shutdown procedures, as well as information on transient response during normal and upset conditions.

The third section discusses the design basis accident for LWRs. Descriptions are provided for the large break loss-of-coolant accident (LOCA) as well as the small break accident. Acceptance criteria for emergency core cooling systems are presented. The blowdown phase of a large pipe break is the subject of a separate chapter. Emergency cooling water injections and heat transfer during reflood are covered broadly. The section closes with information on the application of computer codes, such as RELAP and TRAC, to safety analysis.

The fourth section discusses the design basis accident for LMFBRs. The section begins with a description of core disruptive accidents followed by separate chapters on accident initiation and fuel motion that results from melting of fuel during a LOCA. The problem of debris cooling within a reactor vessel is followed by a treatment of ex-vessel heat removal for the more severe accidents. The last chapter in this section deals with an LMFBR system safety analysis utilizing current state-of-the-art computational methods employed in the United States for analysis of hypothetical core disruptive accidents. Emphasis is placed on the phenomenological basis and numerical methods of the SAS, VENUS-II, SIMMER, and REXCO codes.

The remaining section is devoted to special topics that are receiving particular attention and study in today's safety climate. These subjects include vapor explosions, natural convection cooling, blockages in LMFBR subassemblies, sodium boiling, and experimental methods in two-phase flow.

The last chapter in the book is devoted to the accident at Three Mile Island Unit 2 reactor in Pennsylvania. The sequence of events during the first 16 hours of the incident is described along with the fundamental heat transfer processes that took place during that time.

In the opinion of this reviewer, the text meets the objective stated in the Preface of providing a state-of-the-art summary. Some of the chapters contain considerably more depth of treatment and detail than others, but that can be attributed to individual authorship and viewpoint in the selection of information and to the presentation style of each author. Generally speaking, the text provides a good starting point for those interested in studying the safety aspects of nuclear power generation.

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January 18, 1982

About the Reviewer: For more than three decades at Argonne National Laboratory, Paul Lottes has contributed to the knowledge of heat transfer in general and of boiling phenomena in particular. He completed his graduate training at Purdue in mechanical engineering in 1950. Additionally, Dr. Lottes has been active in Society affairs, and is currently chairman of the committee that oversees the publication of its archival journals.