● PRINCIPLES OF NUCLEAR REACTOR ENGINEERING

Samuel Glasstone, Consultant, United States Atomic Energy Commission. D. Van Nostrand Co., Inc., New York, 1955. ix + 861 pp. Figs. and tables. 16 × 23.5 cm. $7.95.

In this book the author demonstrates again his extraordinary organizing and editing ability as he brings into one coherent volume an introduction to each of the principal component scientific and engineering fields comprising nuclear reactor engineering. The boundaries of reactor engineering are defined as encompassing "the design, construction, and operation of reactors for the release of energy in a continuous and controlled manner by the fission of certain atomic nuclei." Dr. Weinberg notes with satisfaction in a foreword of this book that nuclear technology has developed to the point of dwindling dependence on nuclear physicists while the role of reactor engineers is becoming predominant. This is as it should be. Nevertheless, the nuclear physicist leaves to his heirs as a legacy that cannot be declined a residium of fundamental principles of nuclear physics and radiation interaction with matter which are essential to all engineering practice in this field.

It is not an accident, therefore, that the first one-fourth of this book, after an introductory chapter which defines the scope and concepts of reactor engineering, is devoted to the basic phenomena and principles of nuclear physics and radiation interactions which must be integrally interwoven into all applied reactor technology. The four chapters in this section are: Nuclear Reactions and Radiations; Reactor Theory: Steady State; Reactor Theory: Disturbance to the Steady State; and Nuclear Reactor Instrumentation. The latter really could be called Radiation Detection and Measuring Instruments, for it deals with the principles and characteristics of basic instruments such as ionization chambers, geiger counters, etc.

These four chapters are well arranged and clearly written. They contain the physical concepts essential to reactor engineering applications and give perspective indication of the engineering areas in which they are relevant.

The engineering heart of this book is contained in the six chapters entitled Control of Nuclear Reactors (the principles and systems of reactor control), Processing of Nuclear Reactor Fuel, Nuclear Reactor Materials, Radiation Protection, Shielding of Nuclear Reactor Systems, and Thermal Aspects of Nuclear Reactor Systems. In each of these component areas the author begins with a qualitative description and identification of the principal problems from an engineering viewpoint, then defines the relevancy and orientation of the problems to the over-all reactor system, and finally describes the engineering approach to solutions of the problems.

Some will insist that the amount of engineering practice in these sections is too small; that the relative emphasis, for example, on chemical engineering—fluid flow, corrosion, remote manipulation systems and equipment, etc.—is not enough. It is true, of course, that volumes could be written on reactor applications in any one of these component fields, and that an expert in any one will immediately think of much more which might have been included.

On the other hand, the chief purpose of the book, "to describe the fundamental scientific principles on which reactor engineering is based," has clearly been achieved. The important concepts are all included, though some of the details and essentially all of the "techniques" of necessity are omitted.

The last two chapters give further orientation and over-all perspectives to the scope and components of reactor engineering. Nuclear Reactor Design Variables describes the innumerable permutations and combinations of fuel elements, moderators, coolants, reflectors, and shielding arrangements which might be chosen for a reactor system and identifies some of the promising possibilities. The last chapter, Descriptions of Nuclear Reactors, is just that. The essential characteristics and components of some 15 typical reactors of various types, now in operation, are tabulated and briefly discussed.

As a means of giving a new student his first perspective view of reactor engineering, or providing for an engineer practicing in some orthodox field an introduction to the important concepts of reactor engineering applications in other fields, this book could hardly be excelled.

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● PRODUCTION OF HEAVY WATER

A volume of the National Nuclear Energy Series (Division III, Volume 4F). Edited by *George M. Murphy,* Department of Chemistry, New York University. McGraw-Hill Book Co., Inc., New York, 1955. xvii + 394 pp. Many figs. and tables. 16 × 23.5 cm. $5.25.

Deuterium quickly became an important research tool in many fields after its discovery by Urey, Brickwedde, and Murphy in 1931. Immediate attention was given to the development of economical methods for its production. But the early efforts in this direction were completely overshadowed by the production program associated with the Manhattan Project during the second World War. Here the principal impetus was the possible large-scale use of heavy water as a slowing-down agent, or moderator, for neutrons in reactors planned for plutonium production. As it turned out, the problems of producing graphite of suitable purity and density for use as reactor moderator material were solved early enough so that the first production reactors, those at Hanford, were graphite-moderated. However, heavy water soon found use in research reactors at Argonne, Chalk River, and elsewhere and more recently, on a larger scale, in the production reactors at Savannah River.

This book is an excellent and detailed account of the heavy water production program conducted as part of the Manhattan Project. Security policy has only recently made possible its publication. Part I was written by J. O. Maloney, G. F. Quinn, and H. S. Ray and surveys the actual status of the heavy water plants in operation at the close of the war. This includes descriptive details of the design and operation of the catalytic exchange-electrolytic process used at Trail, British Columbia, and the water distillation process used at Morgantown, West Virginia. Also included is an analysis of the possible use of a liquid hydrogen distillation process and, in less detail, other processes that were considered.

Part II of the book is devoted to a description of the development research that was conducted for the heavy water processes. It is divided into a series of chapters each written by an authority on the subject who was intimately connected with the work. Included is an introduction by H. C. Urey and chapters on general considerations of catalytic exchange by H. S. Taylor; development of nickel-chromium oxide catalyst by E. H. Taylor; platinum and palladium catalysts by G. G. Joris; and a hydrogen-water vapor pilot plant, the distillation of water, and dual temperature processes by M. L. Eidinoff.

The book is naturally somewhat out of date, the various parts having been compiled about ten years ago. This is most noticeable in the Introduction to Part I of the book (Chapter I) where anachronisms are found in cases such as the estimated costs of research and construction and the recommendation that seized German information on heavy water manufacture be released to qualified heavy water experts. Nevertheless, the book will prove interesting to anyone who is curious about the road which this country took in order to realize a large-scale production of heavy water. It will be an invaluable starting point for anyone interested in the possible development of improved processes, especially if it is read in conjunction with a briefer, more recent review of the subject, "Survey of heavy water production processes," prepared by Manson Benedict for the Geneva "Atoms-for-Peace" Conference.

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