Book Review

Nuclear Power Plant Engineering. By J. H. Rust. Horalson Publishing Company, Buchanan, Georgia (1979). 504 pp. $30.00.

Nuclear Power Plant Engineering by J. H. Rust is a good balance between development of basic physical principles and their application to analysis and design of nuclear reactors. The text is aimed at senior or first-year graduate students in nuclear engineering. The book has the same orientation as *Elements of Nuclear Reactor Design* edited by J. Weisman or *Nuclear Heat Transport* by M. M. El-Wakil.

The organization of the material is logical. After an introductory chapter briefly describes the main reactor types in the U.S. [pressurized water reactor (PWR), boiling water reactor (BWR), high-temperature gas-cooled reactor (HTGR), and liquid-metal fast breeder reactor (LMFBR)], a chapter follows on their thermodynamics, stressing the Rankine and Brayton cycles. Chapters 3, 4, and 9 are devoted to fluid systems. Chapters on heat generation, thermal-hydraulics analysis, and stress analysis, along with four appendixes, complete the book. Typically, each chapter is organized by first presenting a basic introduction to the material in that chapter, defining various terms that will be used, developing or listing fundamental relations, and then applying these relations to analysis of the nuclear reactor. References (sometimes not very complete) follow the material presented and an average of eight or nine problems conclude the chapter (except for Chapter 1). The problems seem well formulated and there are one or more worked examples in most chapters to illustrate some of the concepts.

About one-third of the text is devoted to the development and use of fluid flow concepts. Chapter 3 is a review of boundary layer theory and turbulent flow. Some typographical errors occur (arrows omitted over vectors) but otherwise the material is lucidly presented. It may be that Chapter 3 could have been condensed or summarized and combined with Chapter 4 to make this treatment consistent with the rest of the book. Realism is included in the calculations by accounting for pressure losses due to friction, drag coefficients for spacers, flow instabilities, pump performances, etc.

The book has much to recommend it for adoption as a text, including:

1. A presentation of material with enough breadth and depth developed to accommodate students with widely varying backgrounds.

2. A good compilation of tabular and graphical information with a clear explanation of its use and limitations.

3. A text with the emphasis on the design as well as the analysis of nuclear power plants.

4. An excellent development of hot channel factors. About 13 pages are devoted to this important topic, and an example is presented.

There are also some areas where improvement could be made, which include:

1. The chapter on heat generation in nuclear reactors is so brief that it is almost misleading in some areas. The volumetric heat generation rate, q''', is not discussed in any detail, and its treatment for heterogeneous reactors is just mentioned. Transient conditions are mentioned also, but in a manner not very useful for power reactors. There is also an error in Eq. 5.3.3, in that the beta- and gamma-ray energies released are reversed from that mentioned. This is carried through to Eq. 5.3.7.

2. R. L. Whitelaw of the Mechanical Engineering Department of Virginia Polytechnic Institute and State University has pointed out that the liquid-metal heat transfer correlation of Lubarsky and Kaufman (Report 1270 of the National Committee for Aeronautics, 1956) supersedes the correlation of Lyon and Martinelli used in the book.

3. A figure of the pressurizer appears, but no pressurizer analysis or design is presented.

4. Essentially nothing is presented on thermal, fluid flow, or stress analysis of abnormal transients in the PWR or BWR. Loss of coolant accidents also should be incorporated. These accidents are mentioned in the introduction to Chapter 7, "Reactor Thermal-Hydraulic Analyses," but no calculations are provided. Also, no safety or accident analysis is provided for the LMFBR or HTGR either.

5. A few more examples sprinkled throughout the text would be especially useful to students.

6. Little attention is paid to the computer codes available for solving problems. Even in the exercise at the end of the chapter, computer methods are not required.

This text is carefully written with student needs in mind and will undoubtedly be adopted by many universities. This book can be useful to students as well as practicing nuclear or mechanical engineers.

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About the Reviewer: Ronald J. Onega, associate professor of nuclear engineering in the College of Engineering of the Virginia Polytechnic Institute and State University, has been active in the fusion and fission engineering areas. Dr. Onega, whose graduate training was at Penn State University, has been teaching nuclear and mechanical engineering courses for the past ten years. He has spent some time at the Oak Ridge National Laboratory working in the Fusion Energy Division. His research interests are in the modeling and analysis of transients in fission reactors as well as tokamaks.