BOOK REVIEWS

Selection of books for review is based on the editor's opinions regarding possible reader interest and on the availability of the book to the editor. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

Reaktorsicherheit

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Reviewer Adolf Birkhofer

Nuclear reactor safety is not an isolated discipline but a broad field to which many different engineering branches must contribute due to feedback to processes and interference of systems. Therefore, covering nuclear reactor safety in a textbook requires not only a broad knowledge of the entire field but also the skill of explaining complicated interrelations in a clear and systematic way. The author of this book combines both qualities in a unique manner.

The clear and systematic structure is reflected in the table of contents. The reader is introduced to the topic by a presentation of the reactor plant as a system. Fault tree and event tree methods, important tools for safety evaluations, are explained.

Individual systems descriptions of pressurized water reactors (PWRs), boiling water reactors (BWRs), and fast breeder reactors (FBRs) are presented in three subsequent chapters. Detailed treatment is given only to safety-related systems or to those of importance to plant behavior under accident conditions. This selection is not easily made, since it requires a great deal of insight, yet the author succeeds in reducing the enormous amount of plant information to a clearly structured package of safety-related data. The description is given for one PWR and one BWR of Kraftwerk Union (KWU) design. To point out differences between German and U.S. designs, two U.S. plants (Westinghouse Electric Corporation and General Electric Company) are described as well. Reactor core, pressure vessel, feedwater and steam dump systems, control and protection systems, emergency core cooling system, electric power supply, and containment are not only described but also evaluated with respect to safety relevance.

It is well worth mentioning that the author integrates in this system-oriented book the treatment of the pressure vessel, which usually is considered isolated. Pressure vessel design, fabrication, and testing procedures are described as well as the principles of fracture mechanics.

For FBRs, the description is less detailed than for light water reactors (LWRs), emphasizing mainly their major design differences. The advantages and disadvantages of pool- and loop-type FBRs are pointed out clearly.

The main sections dedicated to accident analysis are "Transients," "Anticipated Transients without Scram (ATWS)," and "Loss-of-Coolant Accidents (LOCA)." The author emphasizes the importance of transients compared to LOCA by both the sequence and volume of these chapters. The transient behavior, which is sometimes rather complicated due to several inherent feedback effects and the influence of control and safety systems, is described in an easily understandable way. Needless to say, for the sake of clarity in the description of complicated processes, some simplifications cannot be avoided.

The chapter on LOCA contains not only a phenomenological explanation of the accident but also a description of a typical blowdown code and experimental facilities for the investigation of LOCA phenomena. With respect to experimental results, special attention is given to fuel rod behavior.

External impacts (e.g., earthquake, airplane crash) are treated briefly in a separate chapter. More volume is dedicated to core melt accidents. For LWRs, the course of events is described according to the event trees in the Reactor Safety Study (WASH 1400). For FBRs, a presentation and an evaluation of the phenomena of a core disruptive accident is given.

The author deliberately focuses his attention on plant design and behavior, and does not treat the radiological aspects (radioactive release, dispersion models, etc.).

The entire book is easy to read. The systematic structure and the clear description of systems and processes are of advantage especially for the student and young engineer. But the "insider" will also find this book of considerable value, because of the data collection and the wide range of topics covered in it. It is the complexity of the area and the great number of technical disciplines, rather than a perception of shortcomings of the book, that enables a reviewer to express some critical ideas.

In a textbook on nuclear reactor safety in the German language, one regrets not seeing a description of a PWR concept with once-through steam generators (Babcock and Wilcox Company), not because of the Three Mile Island accident, which occurred while the book was being printed, but because of the fact that a reactor of this type is under construction in Germany.

For the reader who is trying to penetrate somewhat deeper into the problems, some difficulties may arise due to the fact that in the book the system descriptions, transient analyses, and LOCA analyses are not always based on the data of the same reactor plant. It is recognized that it is nearly impossible to obtain a consistent set of data from the available literature, however, some indication of design differences in plants of the same type (e.g., PWR of KWU), which may affect plant behavior under accident conditions, might be helpful.

A valuable complement to the mostly technical treatment of safety problems would have been a chapter on licensing, describing the main safety principles, the procedures, and the development of safety philosophy (e.g., from deterministic toward probabilistic approaches).

Of course, these critical comments are suggestions for possible improvements, and the concluding remarks can only be positive. There is no comparable book available, especially in the German language. This book can be recommended to specialists (to expand their technical horizon) as well as to students and beginners (as an introduction to the principles of nuclear reactor safety). The author deserves special recognition for making his tremendous treasure of knowledge available to colleagues and students. This is of particular value in a technical field where a broad knowledge and understanding of complex systems is necessary to meet the high quality standards.

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