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.

Nuclear Energy Technology: Theory and Practice of Commercial Nuclear Power

Author Ronald Allen Knief

Publisher Hemisphere Publishing Corporation, New York (1981)

Pages 605

Price $27.95

Reviewer John C. Courtney

Dr. Knief's first textbook is an excellent presentation of the current technology of nuclear energy. His writing is clear and crisp, and tables and figures have been carefully selected to illustrate the general and specific points of knowledge. The level of detail is appropriate for an introductory text, and the topical coverage and sequence of development are logical. The practical orientation makes *Nuclear Energy Technology* useful for people outside the nuclear community who need an overview of fission power. Dr. Knief's extensive reference lists and bibliography are valuable leads for those who wish to pursue a subject in more depth.

The level of presentation is appropriate for undergraduates in engineering and the sciences. Because of the broad coverage, it would be easy for an instructor to select specific topics on which to concentrate. The text is flexible enough to be used in several types of courses. If additional quantitative material were used to supplement the text, it could be used for graduate level courses for nonnuclear majors. My only complaint about the book, and a minor one at that, is the lack of numerical examples and challenging problems.

The first chapter gives an overview of the basic concepts of reactors and the nuclear fuel cycle. Appendix III treats the need for fission power in the United States; Chap. 1 and Appendix III could be used together as an introductory short course on nuclear energy directed at nontechnical people.

Chapters 2 through 7 cover the basics of nuclear physics, reactor theory, and heat removal. Design descriptions of domestic and foreign reactor systems, covered in Chaps. 11 through 15, illustrate how these basic concepts are implemented. Appendix IV is a concise tabulation of the characteristics of seven types of power reactors. Economics and current concerns at the front and back ends of the fuel cycle are outlined in Chaps. 8, 9, and 10.

A strong point in this text is the treatment of reactor safety and safeguards in Chaps. 16 through 20. An entire chapter is devoted to a description of the March 1979 accident at Three Mile Island, Unit 2. Events that led to the incident and the consequences, political and technical, are clearly explained. A highlight of the text is the chapter on nuclear safeguards. Dr. Knief's interest in this topic is apparent from the detailed treatment of the various aspects of this complex subject.

The last chapter is a brief overview of the basic concepts of nuclear fusion. Both magnetic and inertial confinement techniques are clearly outlined. Some of the problems of engineering a practical fusion system are covered realistically.

In summary, *Nuclear Energy Technology* is an exceptionally well-written, up-to-date text that is suitable for undergraduate instruction or for self-study. The coverage may lack depth in some areas, but the breadth and variety of topics overcome this disadvantage so that an interested reader could pursue specific areas of interest.

John C. Courtney is a professor of nuclear engineering at Louisiana State University (LSU) in Baton Rouge. He received his doctorate in nuclear engineering from the Catholic University of America in 1965. He is active in public communication on energy issues, and his major research interests are radiation protection and neutron shielding. He works with the Hot Fuel Examination Facility at Argonne-West and the Radiation Shielding Information Center at Oak Ridge National Laboratory on a variety of nuclear analyses and educational projects. Prior to joining LSU, he was associated with the NERVA nuclear rocket project and was on active duty in the U.S. Air Force.

Borehole and Shaft Plugging

(Proceedings of a Workshop by the Organization for Economic Cooperation and Development's Nuclear Energy Agency and the U.S. Department of Energy held in Columbus, Ohio, May 7-9 1981)

Publisher Organization for Economic Cooperation and Development, 2, rue André-Pascal, 75775 Paris-Cedex 16, France

Pages 434

Price $30.00

Reviewer Jaak J. K. Daemen

Deep underground disposal remains the most likely solution for long-term management of high-level radioactive wastes. The concept has been accepted worldwide, and, as a consequence, extensive research and development is ongoing in many countries. Exchange of information, therefore, is essential to minimize duplication of effort and pursuits of traveled paths, as well as to optimize planning of further investigations. A workshop with a narrowly focused topic yet with divergent inputs, as organized here, presents an ideal approach to such an exchange.

The volume under discussion, *Proceedings of a Workshop on Borehole and Shaft Plugging* held in Columbus, Ohio, May 7-9, 1981, and organized jointly by the Organization for Economic Cooperation and Development Nuclear Energy Agency and the U.S. Department of Energy (DOE) constitutes a most timely and valuable contribution to an important subtopic in geological waste isolation. Man-made penetrations, such as shafts and boreholes, of the rock mass surrounding a repository are necessary to provide access for waste emplacement and probably desirable for site investigations. Yet they could become preferential pathways for radionuclide migration, e.g., by facilitating the flow of water (or gas) into and out of a repository. To maintain and guarantee the degree of isolation provided by the repository surroundings, host rock, and sealed perforations, it will be necessary, therefore, to design and emplace shaft and borehole plugs that will provide isolation compatible with long-term safety requirements, to demonstrate the feasibility of plug construction, to assess the plug performance, and to evaluate the consequences of plug performance on the overall level of isolation that can be provided by the rock mass surrounding a repository.

The significance attached to this sealing problem, as well as the intensity and multiple approaches with which it is being investigated, is well demonstrated by the fact that the Proceedings contains publications originating in 7 different countries, and by the attendance at the workshop of some 60 representatives from 13 countries. The Proceedings then presents a quite comprehensive summary of most active and planned research programs on borehole and shaft sealing.

The contributions can be classified very broadly as: program overviews and outlines of planned studies, discussions of seal performance requirements, presentations of preliminary or draft plug designs, results of plug performance tests, and results of research on sealing materials—especially as influenced by the geochemical environment within which they will be emplaced. Of particular value is the transcription of the concluding panel discussion, which summarizes concisely the current state-of-the-art, identifies gaps in present knowledge, thereby identifying research needs, and draws attention to the necessity for specifying plugging performance requirements.

Program overviews include the U.S. DOE efforts directed by the Office of Nuclear Waste Isolation, concentrating on bedded salt, domed salt, and granite disposal, and by the Basalt Waste Isolation Project, concentrating on basalt; the German and Dutch projects on salt penetration sealing; the sealing aspects of the Belgian repository in clay; the Swedish studies on plugging with compacted bentonite; and the Canadian rock-grouting research.

A wide variety of fairly detailed plug designs is included, generally qualified by their designers as preconceptual, draft, or preliminary, even though it is obvious that considerable thought and careful engineering form their basis. The concept of multiple component seals appears to be followed widely, with salt plugs to be used in salt, various combinations of concrete, cement, and bentonite dominating the approach to plugging in other rocks. Uncertainties seem greatest with respect to the requirements that need to be satisfied and with respect to long-term material behavior.

A series of papers describes in detail the full range of aspects considered in the Sandia National Laboratories borehole plugging program. This includes what remains today (November 1981) as the only emplacement and performance testing of *in situ* borehole plugs at great depth, hence the particular importance of the data, techniques, and analyses presented here.

The other subject on which extensive experimental and theoretical results are given is the chemical stability analysis of sealing materials. The importance of this topic follows from the extreme longevity requirements for the seals, and hence the need to predict their aging behavior with satisfactory reliability. This volume includes papers that address the necessary thermodynamical-geochemical characteristics, modeling possibilities and requirements, as well as ongoing experimental investigations on materials such as cements, a wide variety of cement-based mixtures, and compacted bentonite.

All in all, this volume provides an excellent overview of the present knowledge of borehole and shaft plugging. It indicates the directions in which current research and development is progressing, and identifies remaining problems and uncertainties. The book is an essential reference and compendium for anyone involved in repository sealing. It should be of interest to people with a more general interest in geological waste isolation as well.

Jaak J. K. Daemen is an assistant professor in the Department of Mining and Geological Engineering, University of Arizona, Tucson, Arizona. He graduated as a mining engineer from the University of Leuven, Belgium, and obtained his PhD degree in geo-engineering from the University of Minnesota. He has been involved for over a decade in rock mechanics research and engineering for tunnels, shafts, and underground mines. His publications on design of underground structures in rock have been quoted extensively in major state-of-the-art survey publications. Dr. Daemen is presently directing a major research project on borehole plugging for the U.S. Nuclear Regulatory Commission. This project includes laboratory and field testing of the performance of a variety of plugs installed in different rock types.

Fouling of Heat Transfer Equipment

Editors	E. F. C. Somerscales and J. G. Knudsen
Publisher	Hemisphere Publishing Corporation, New York (1979)
Pages	743
Price	$75.00
Reviewer	Peter Griffith