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Nuclear Waste Management
(The Ocean Alternative)

Editor	Thomas C. Jackson
Publisher	Pergamon Press, Inc., Elmsford, New York (1981)
Pages	124
Price	$17.50
Reviewer	John S. Niederkorn

According to the publication *Nuclear News* of February 1983, at the end of 1982 the total number of operating nuclear power plants was 230 worldwide and their overall capacity was 153 266 MW(electric). More than 233 units are under construction, with a 201 010-MW(electric) projected capacity. The U.S. nuclear energy production is 35.7% of the world production of this type of energy source.

As we can see, the rate of development of nuclear energy used for energy production is very high worldwide. Many experts are considering that, without its increasing application, it will not be possible to satisfy the exponentially growing energy need of mankind. In spite of the expected significant role of nuclear plants in energy production, its consolidation is endangered by environmental issues. Indeed, spent nuclear fuel contains very strongly radioactive fission products and transuranic elements that are both very harmful to biological environment. For instance, a 1000-MW(electric) nuclear plant produces 280 to 300 tons of spent fuel annually that contains ~3.5 tons of fission products and 2.4 tons of transuranic elements, mostly plutonium. Either, the spent fuel or, if it was processed, the high-level radioactive products must be safely isolated from the biological environment for thousands of years.

The handling of radioactive waste, temporary disposal, and especially the ultimate isolation are overly complex and difficult problems. Unfortunately so far, there is no safe and generally accepted long-term disposal technology available. The research activity to solve this problem is intensively developing in several directions. The underground radioactive waste burial in geologically stable regions of basalt, granite, or salt host rocks might be an acceptable solution. However, during the last 30 yr, sea disposal was the most common practice worldwide, alongside of the controlled temporary surface disposal.

The volume, *Nuclear Waste Management (The Ocean Alternative)*, edited by Thomas E. Jackson and sponsored by the Oceanic Society is devoted to the history, the results of disposal site controls, and the prospects of the ocean burial alternative of low- and high-level radioactive waste materials. The content of the book is divided into eight chapters, containing eight principal papers, eight comments, questions, and answers.

The explanation of basic material begins with the paper of Robert S. Dyer entitled "Sea Disposal of Nuclear Waste; A Brief History," which is devoted to the past practices and policies of sea disposal of radioactive waste. After reviewing the scope of American sea disposal programs between 1946 and 1970, the survey results of radioactive wastes at 35 U.S. dump sites are examined. The decision to halt sea disposal in 1970 and current federal laws are also discussed.

W. L. Templeton devoted his paper to "The Basis of the Revised IAEA Definition as Related to the Dumping of Low Level Radioactive Wastes in the Deep Ocean." Also in connection with low-level nuclear waste disposal, Dr. Kieho Park discusses the topic of "Potential Priorities for Scientific Studies of Deep-Sea Life." The last paper concerning the low-level waste issue is given by Robert Dyer on "A Review of Field Studies at United States Dump Sites."

An extensive article by Dr. Charles Hollister entitled "A Review of Current Science and Technology for Disposal of High Level Radioactive Wastes Within Geological Formations of the Deep Seabed" examines the geologically passive seabed zones covered by clay deposits as a prospective radioactive waste burial site. He considers that the high ion-exchange capacity of the clay or other sedimentary deposits may capture radioactive elements that manage to escape from their original packages.

The last part of the book is devoted to the policy issues of the sea disposal of nuclear wastes. The paper of Dr. David Deese, "A Discussion of National and International Political Legal Considerations" is followed by Clifton Curtis's article entitled "An Examination of United States Policy Trends."

This publication of the Oceanic Society is an excellent source of information about the conceptual and technological issues as well as on the national policy and legal considerations in the field of ocean alternatives of radioactive waste burial.

Although this book is an excellent synthesis of knowledge in a vitally important field of general and special interests, maybe it is proper to recall from the book, the remarks by W. L. Templeton: "Our understanding of the processes occurring in the deep oceans is insufficient to permit the construction of a single comprehensive model of the movements of radionuclides. The original oceanographic model used for the provisional definition was inapplicable for long-lived isotopes in finite sized basins."

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Reliability and Risk Analysis—Methods and Nuclear Power Applications

Author	Norman J. McCormick
Publisher	Academic Press, Inc., New York (1981)
Pages	446
Price	$39.50
Reviewer	Jose G. Martin

In the Preface of this book, the author states that a "practical itinerary is provided for senior-level or first-year graduate students who want a summary of . . . reliability and risk studies primarily for nuclear power applications." Those students -and their instructors- should consider themselves fortunate that the author has taken such care to make the itinerary a smooth one.

The quality of smoothness does not guarantee uniform standards throughout, and it does not offer protection from an occasional wrong signal along the way. However, the many strengths of this book may well turn it into a classic.

It is comprehensive and well organized. Furthermore, it is extremely readable. The author develops the material progressively, pulling together subjects that are not particularly manageable and turning them into a consistent whole. New terms are defined in context with perfect timing. There is no table of symbols for quick reference; it can be argued that this book does not really need one, partly because of its careful organization, but mostly because it is written so well. The author gives credit to LaDonna Kennedy for transferring illegible script into readable form; it is not clear from the acknowledgment whether the "transfer" refers just to script or to composition as well. There is no question that "sombody in charge" has a beautiful command of English written for the purpose of teaching and informing.

The discussions about the reliability of simple systems and availability with repairs are particularly lucid. Professor McCormick manages to make the reader feel at ease among Markov processes.

In the same way that spots are more obvious in good linen, the care taken in the organization of the text makes some weaknesses more apparent. For example, the division of the material into chapters emphasizes that the manipulation of failure data is more carefully treated than the origin of the failure data itself. The book introduces failures via probabilities, instead of the other way around. The very first example of the book refers to an uncompensated ionization chamber, which, "according to manufacturers' data," has a probability of failure "under the period of interest and at the reactor operating conditions of 0.02. . . . " This may be self-explanatory, but a student may best be served by some insight into this "0.02" before he is asked to manipulate the figure.

The effort made in Chaps. 3, 4, and 5 to provide this insight seems half-hearted. Manipulation should follow understanding, like carts follow horses. The helpful questions at the ends of the chapters give a clue to the author's placement of the carts. Chapter 3 on probability distributions has 17 questions, Chap. 4 on data manipulation has 10, and Chap. 5 on failure data has none. The reviewer had to suppress a mischievous impulse to manipulate *these* data.

In a more serious vein, it is self-evident that a tool is made more useful when one knows something about its limitations. There is little hint in this text about the possible limitations of the suggested analytical tools. There is a reference to this subject in the reactor safety study, but this is slightly off the main "itinerary." It may be justifiable to waive disclaimers when lecturing about the manipulation of probability distributions. It may also be justifiable (barely) to waive disclaimers when lecturing about the probability that the toss of a coin will yield a tail. However, the "richest, longest-lived, best-protected, most resourceful civilization" has a right to demand that its engineers have an understanding of the limitations of its analytical tools. If the engineers can see no such limitations, then that civilization has reasonable grounds to be frightened.

Chapter 17 on risk-benefit assessment deserves comment. There is a precarious quality to this topic. Maybe our descendants will be able to put discussions about dollars per life on the same logical level as we now put medieval discussions about the angelic capacity of pinheads, but those descendants will have to give the present discourses credit for gruesomeness. In the meantime, anybody attempting to deal with the subject will cautiously refer to "several approaches" taken by others. This is what the author has done. It is of course easy to criticize maladroitness whenever such a topic appears, while thinking, "There, but for the grace of God, go I."

The epilogue is almost banal. Its breast-pounding advocacy reeks of irritating sophomoric inspiration from a normally bright student.

The operative word is bright. One does not waste harsh criticism such as the one given above on the dull. Sophomoric advocacy or not, this book is one of the best technical books to reach my desk in a long time. I do not know how nuclear engineering departments managed for so long without a text such as this one. It is likely to become a classic. In this reviewer's humble estimation, two extra words in its Preface would have made it something of a masterpiece: *caveat emptor*.