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.

Radiation for a Clean Environment
(Proceedings of the International Symposium on the Use of High-Level Radiation in Waste Treatment—Status and Prospects)

Publisher	International Atomic Energy Agency (1975) (distributed by Unipub, Inc.)
Pages	672
Price	$41.00
Reviewer	Charles R. Rhyner

This book is a collection of 48 papers presented at eight sessions of the symposium. The majority of the papers deal with the use of high-level radiation to treat liquid wastes and sludges, although the papers in one of the final sessions considered treatment of solid wastes and exhaust gases.

The book is remarkably well organized. The first session (chapter) consists of several review papers that survey current wastewater treatment technology. The following three sessions present topics in biology, chemistry, and physics that are pertinent to understanding the effects of radiation on micro-organisms and aqueous pollutants. Each of these sessions begins with a review paper. The second half of the book addresses the technological and economic aspects of this approach to waste treatment and the experiences obtained from pilot plant operations. The papers included in each session generally address the theme of the session, with the exception of one on the "Use of Sewage Sludge as Fodder," which has little to do with the use of radiation in waste treatment.

For some time, work on using radiation for disinfection of water and waste water has yielded promising results; however, economic considerations have not been favorable. The foreword of the book states that this conference was motivated by the world energy shortage. This implies that the central issue to be addressed is the influence of the energy shortage on the economics associated with alternative methods of water treatment. Perhaps the greatest disappointment is that the economic analysis contained in these papers is not complete enough for a realistic economic assessment of the relative costs or projected costs of various treatment alternatives. Also, a comparison of the energy intensiveness of the various treatment strategies would have aided the reader in assessing future role of this technology relative to conventional treatments.

The quality of the papers is high and uniform. The reader will also find the discussion at the end of each paper useful. This book is an excellent resource book for researchers or graduate students. Because of the inclusion of the numerous review papers and the extensive references, the book provides a good introduction for readers who are contemplating research on the use of radiation for waste treatment.

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Reliability of Nuclear Power Plants
(Proceedings of a Symposium, Innsbruck, April 14-18, 1975)

Publishers	Unipub, Inc. (1975)
Pages	751
Price	$42.00
Reviewer	George Apostolakis

This volume contains 48 papers (of which 11 are in French and 3 in Russian with abstracts in English) that were presented at the Symposium on Reliability of Nuclear Power Plants in Innsbruck, Austria, in April 1975. The draft report of WASH-1400 was issued in August 1974, and quite naturally, the papers of the Symposium do not reflect the great impact that the report has had in the area of probabilistic risk assessments. Only occasional references to the report are made in the discussions that follow the papers, which, incidentally, are among the

better parts of the proceedings. My impression from reading this volume is that reliability engineers and researchers will not find much that will be useful to them.

The first group of seven papers (one in Russian) deals with Reliability Data Collection, Storage, and Use. The efforts to create a computerized data base in the U.S. are described by M. J. Wise in "The U.S. Nuclear Plant Reliability Data Program," and similar efforts in the United Kingdom are described in C. D. H. Fothergill's "The Collection, Storage and Use of Equipment Performance Data for the Safety and Reliability Assessment of Nuclear Power Plants." The last paper also discusses the problem of fitting a theoretical distribution to the data and the derivation of confidence bounds (although the use of the Kolmogorov-Smirnov goodness-of-fit test when the parameters of the distribution are estimated from the data is questionable). The collection of data is also the theme of B. Anderson et al. in "Failure Data Collection from a Swedish Nuclear Power Plant" and H. Zeibig et al. in "Collection of Reliability Data for Sodium Components in KNK." A. Fattah and R. Skjoeldebrand in "Performance Analysis on Nuclear Power Plants from Operating Experience Data" analyze the performance data (load, operation, and unavailability factors) of 107 reactors from 75 member states of the International Atomic Energy Agency. The paper by J. R. Taylor, "A Study of Failure Causes Based on U.S. Power Reactor Abnormal Occurrence Reports," contains several very interesting observations concerning the causes of failures and interdependencies among components. The dominant cause of failure is design error (36% of 490 failures), while the usual "hardware" failures account for only 19% of the total. This certainly shows how important further work on design errors is, even today. Analysis of multiple and single failures shows that coupled failures are much more frequent than one might expect, a point that supports the current intensive efforts to improve our ability to handle common cause failures.

The second session includes six papers (two in French) on Methods and Techniques of Reliability Analysis. A description of the special features of the REDIS program is given by H. E. Kongso in "REDIS, A Computer Program for System Reliability Analysis by Direct Simulation." A method of fitting a distribution to observed data was developed several years ago by W. Nelson of General Electric Company. This method uses plots of the hazard function instead of the cumulative distribution function, and it is quite flexible in that it can handle incomplete data and more than one failure cause. W. A. Wolfe in "Interpreting Failure Data in a Nuclear Plant by the Hazard Function" applies this method to fit the Weibull distribution to failure data on pump seals collected from the Pickering Nuclear Generating Station over a period of three years. Two more papers in English appear in this session, "Modeling Maximum Likelihood Estimation of Availability" by R. A. Waller et al. and the very mathematical "Diakoptical Reliability Analysis of Transistorized Systems" by J. M. Kontoleon et al. Finally, the paper by J.-P. Signoret on "Fiabilité et Disponibilité de Systèmes Redondants: Programme de Calcul et Utilisation d'Abaques" presents nomographs for the determination of the reliability and availability of redundant systems when the failure and repair rates are given.

The third session on Reliability Assessment of Nuclear Power Plant Systems contains ten papers (five in French). Reliability methods are used to compare different designs, identify weak links, and generally improve the performance of systems.

The fourth session on Application of Reliability Analysis in Nuclear Power Plant Design consists of seven papers (one in French and one in Russian). Again, several of the papers show how important the use of reliability techniques is in the design. L. A. Hopkins et al. in "Availability: The Other Aspect of Nuclear Power Plant Reliability" emphasize that plant availability in addition to safety should be a factor in the design, licensing, and operation of nuclear plants. Similarly, L. Cave in "The Relationship Between Reliability and Safety in Nuclear Power Plants" argues that the design criteria for releases up to 10^3 Ci ^{131}I per reactor year should be based on economic factors (plant availability), while for higher potential releases, reactor safety should be the dominant consideration. "Reliability Studies in a Developing Technology" by L. A. Mitchell et al. gives a clear exposition of the special problems that arise when mechanical components are used in new environments for which previous experience cannot be used for reliability evaluations.

The session on Testing and Inspection of Nuclear Power Plant Systems and Components contains eight papers (one in French). P. Nichols in "Limited Test Data: The Choice Between Confidence Limits and Inverse Probability" compares the Bayesian approach to estimation with the classical confidence limits. Although one may object to some of his assumptions, e.g., the use of a uniform distribution as the prior distribution, the idea is good and deserves more attention. Several papers in this session examine various aspects of ultrasonic testing.

The next group of three papers (two in French) comes under the title "Quality Assurance of Nuclear Power Plants." Having read these papers and the following two on Nuclear Technology Standards and Reliability (one in Russian), this reviewer agrees with L. Cave, who commented in the ensuing discussion that " . . . something should be done to put these requirements into quantitative terms."

The last session of five papers is entitled Operation and Maintenance of Nuclear Power Plants. R. K. Robinson et al. in "An Engineered Maintenance Approach to Improved Nuclear Plant Availability" describe the development and implementation of a maintenance program at Hanford's N Reactor, which was very effective in reducing the number of forced outage hours to 6 per 100 operating hours, while the nuclear industry's average was 20 per 100 operating hours (1974 figures). Mathematical models based on Markov processes are presented by N. Kontoleon et al. in "The Throw-Away Maintenance Philosophy Versus Repair," while the other papers of the group are qualitative and have to do with operating experiences.

In conclusion, I would hope that a future symposium of this kind would include more papers on the problems that are still with us, e.g., the handling of common cause failures, and that these papers would achieve a better balance between mathematical analysis and applications.

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The Unfinished Agenda

Author	Amory Lovins
Publisher	Thomas Y. Crowell Co.
Pages	184
Price	$3.95
Reviewer	Gerry Dampier

Small, Beautiful World, Can We Help You?

Once there were many small groups of people, each group concerning itself with solving some urgent problem. "This part of the system is out of balance; let's fix it this way," one group said. Another group heard the plan. "If you fix the system *that* way," the second group said, "it will come unglued over here." The first group responded, "If we don't solve this problem soon, the system will be permanently beyond repair. Can we fix our part of the system so that your part won't break?" The two groups conferred. "Maybe," they agreed, "if we rearranged things yonder, both this problem and that problem will be resolved." So they tried it. It's too soon to judge the results, but something very unexpected happened: The groups decided to get together with other small problem-solving groups to see if they could agree on some ways to solve *all* the problems each group had tried to solve separately. They found ways to think about the whole system.

Some people in the small groups call themselves "environmentalists." There are many other small groups; if others wish, they can join the game. Any number can play. It will be easier now; the environmentalists have "got their act together." In *The Unfinished Agenda*, the problems the small groups are trying to solve are defined and solutions are suggested. This is a very significant book. It will help if members of other groups read it and respond to it.

Those who consider themselves to be environmentalists have devoted decades of thoughtful concern to finding ways to implement survival on spaceship earth. Among those ardent earth-enthusiasts, some are wilderness hikers. It's a real challenge to plan a rough hike: One determines the destination first, then thinks backwards. Which path? How many days' supply of food and water to take? Can fellow hikers tolerate the rigors of this route or should an alternate trail be scouted? Many lawyers, engineers, and even nuclear scientists enjoy wilderness hikes. Given this way of thinking, one can appreciate "spaceship" logic. *The Unfinished Agenda* might be approached from this perspective.

Prior to the 1976 election, The Rockefeller Brothers Fund initiated "The Environmental Agenda Project" to find out what the so-called environmentalists in fact want. What are they *for*? (It is no secret what many are against.) Pooling their expertise, many visible, responsible spokespeople for the environmental movement helped to identify what the environmentalists perceive to be the crucial issues to be faced in the decade ahead and to recommend explicit actions that might be taken as steps along the path to survival. Short papers were submitted to be evaluated by many. A tentative draft was drawn up by Gerald Barney (PhD, physics), and a conference was held in New York. A task force, one representative from each of the 12 environmental organizations having the largest membership, aided Barney in rewriting his first draft into the published version of *The Unfinished Agenda*. It is a consensus document. The order in which the issues are addressed is significant. Remember, these are responsible survival strategists, from varied backgrounds and disciplines. They found they could agree on which issue is fundamental. It is first.

The third, and contingent, issue, is "Energy." The entire section on that topic was written by Amory Lovins. Well known to nuclear scientists as an "anti-nuke," Lovins deserves special attention: Barney confirms that Lovins indeed expresses the consensus opinion of the Task Force. Lovins is articulate; he proposes "orderly phasing-out over about ten years of existing (nuclear) facilities" (p. 66) and "repeal of the Price Anderson Act" (p. 66), leading to "termination of the fast breeder program and all other steps leading toward a plutonium economy" (p. 67). He has shown elsewhere how he believes that this could be done without major disruption to the fabric of society.[1]

It is the expressed hope of the Rockefeller Brothers Fund staff that *The Unfinished Agenda* will initiate dialog on the issues addressed. This volume has won wide readership in Washington and among those in favor of a non-nuclear future. A spokesman for President Carter has commented that the book will serve as a benchmark against which this Administration will be judged.

This book will not be enjoyable reading, but it is certainly important reading. Meaningful dialog is possible only when each party to the dialog has given thoughtful consideration to what the other party is saying. Viewing the book from the perspective of the wilderness hiker, consider Lovins' model of two divergent paths. Each path is an energy strategy: One strategy implements the "hard" technologies—including coal and nuclear; the other implements "soft" technologies, which rely on such renewable energy resources as solar energy. Lovins believes we have recently passed the fork in the path. He believes "soft" technologies are along the trail to survival. Backpackers know that divergent paths may lead to the same destination. Perhaps one is the high road, the other the low road—different hikes for different tykes. Can reconciliation be effected through meaningful dialog? What kind of future can we *all* accept?

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