book's coverage is illustrated by the titles of its 10 chapters:

- Chapter 1. Summary;
- Chapter 2. The case for technology;
- Chapter 3. The case for electrical power;
- Chapter 4. A little basic nuclear science;
- Chapter 5. Nuclear reactor physics and nuclear reactors;
- Chapter 6. All the bad stuff about things nuclear;
- Chapter 7. Energy, the big picture and our choices;
- Chapter 8. The status of nuclear power today;
- Chapter 9. The future of nuclear power;
- Chapter 10. What all this means to you and what you can do?

Heaberlin, in his opening line of the book, says:

> "There is a lot of negative feeling about nuclear energy. I think that feeling is based on a lack of understanding of nuclear energy and the failure to see nuclear energy, energy in general and all of human technology in a wider, more appropriate context. My goal in this book is to explain nuclear energy to you and to give you some of that wider context. I believe that if you have some relevant facts and see those in valid context you will conclude that the negative feelings about nuclear energy are largely unfounded and in fact harmful to the future success of humanity."

Not the least of the features of nuclear energy production is the minimal waste resulting from the process. Production of electricity using nuclear power requires fuel amounts that are a fraction of the fuel used in electricity generation by coal. For example, to generate 10^9 W of power, one needs 2.6×10^6 metric tonnes of coal or 120 metric tonnes of nuclear fuel. Unlike production of electricity by coal and other fossil fuels, no carbon dioxide is produced. Moreover, fossil fuel combustion to product electricity yields 2/3 of the sulfur dioxide released to the environment and 1/5 of the nitrogen oxides. Both of these pollutants have significant impact on human health. Wastes produced by US nuclear power plants amount to 2530 tonnes per year; Coal power plants produce 66×10^6 tonnes per year while municipal waste amounts to 230×10^6 tonnes per year and human waste to 277×10^6 tonnes per year. Another limitation of coal and gas, the author notes, is their limited supply.

Some argue that renewable resources are the most favorable sources of new energy supply. Heaberlin discusses the role and outlook of electrical power generation by hydro, biomass, geothermal, sun and wind. For power production in 1999 in the United States using renewables, the following data were presented to illustrate the per cent of total US electrical generation by the various renewable sources: (1) hydro 8.4%, (2) biomass 1.6%, (3) geothermal 0.35%, (4) wind 0.12% and (5) solar 0.03%.

While advances are being made in the production of electrical power by both solar and wind devices, neither can produce the amount of electrical power needed on a consistent time basis (i.e. around the clock without ceasing production) at a cost approaching other production sources. Neither process is currently economical with subsidies required by US law that force power companies to purchase power from renewable sources at costs that may exceed their own generation costs.

The other important aspect of nuclear electrical power generation is public concern for its safety and ultimate radioactive waste production. In this context, the author notes that:

- nuclear power plants are not nuclear bombs;
- nuclear accidents, though they have occurred, have resulted in NO deaths in the United States;
- nuclear waste can be safely handled and stored and its amount is small compared to ash from coal combustion.

In his next to last chapter, Heaberlin notes the increasing demand for energy and diminishing fossil fuel supply. He notes nuclear energy can fill the void in power demanded by industrialized and industrializing companies provided we move fast but he fears we are not doing so. Heaberlin produces some sobering projections. He estimates the world will need a 60% increase in energy production in 20 years. Consequently, for nuclear power to maintain its current share of electrical production, the number of reactors should increase from 437 to 695 worldwide. Even if those reactors were built, the amount of coal burned would have to increase by 60% to produce needed electricity.

The last chapter, entitled "What all this means to you and what you can do?" is an exhortation to the readers to spur them to be public advocates for construction of nuclear power plants by contacting elected and non-elected officials, speak at public meetings, get engaged in education, try to educate the media on correct reporting, and not let public figures get away with uninformed public advocacy.

G.F. Bennett

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Integrated Life-Cycle and Risk Assessment for Industrial Processes

Guido Sonnemann, Francesc Castells, Marta Schuhmacher, Lewis Publishers, Boca Raton, FL, 2004, US$ 149.95, 386 pp., ISBN 1-56670-644-0

This book represents the new paradigm in the engineers' approach to the environmental impact of technology. Pollution control has been superceded by pollution prevention and that analysis is being augmented by life-cycle assessment. This book integrates life-cycle assessment (described as a methodology used to evaluate the environmental impacts of a product during the span of its life-cycle) and risk assessment (described as a tool to evaluate potential hazards posed to human health and the environment by pollution). It

is a combination of this life-cycle analysis and risk assessment that makes this book unique.

In the preface, the authors briefly outline the book's contents:

> "The first four chapters of the book give a general overview of environmental management strategies, describe life-cycle assessment and risk assessment and place them in the so-called environmental management toolbox. The fifth chapter supplies additional information on techniques for data analysis that are commonly used in the analysis of environmental impacts. The sixth and seventh chapters show the interfaces between life-cycle assessment and risk assessment and provide ways of integrating the two. In the final chapter, resolved exercises of integrated life-cycle and risk assessments are presented."

An interesting technique employed in the writing of this book was the use, in several places, of a common case study, i.e., a Municipal Solid Waste Incinerator in Spain. This incinerator was first studied to identify, evaluate and compare the environmental loads from its production of electricity by incineration of municipal waste.

In a second example using this incinerator, the authors examine the risk from the emissions of PCDD/FS using a Monte Carlo approach. A third analysis involving the incinerator (but not the specific process noted above) was of the environmental damage estimation of the waste incineration process chain. A final case study examined the site-dependent impact indicators used for the waste incineration process chain.

Designed to be used as a text, each chapter has a list of questions and exercises for student assignment.

Sustainability is, I believe, the next logical step in environmental analysis but it requires a life-cycle approach in which all stages of product production, use, and disposal are examined. This book advances that analysis but adds to it risk assessment. Both types of analysis are essential according to the foreword to the book written by Mary Ann Curran of the US EPA. I fully agree with this comment.

Gary F. Bennett

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Contaminated Ground Water and Sediment: Modeling for Management and Remediation

Calvin C. Chien, Miguel A. Medina Jr., George F. Pinder, Danny D. Reible, Brent E. Sleep, Chunmiao Zheng (Eds.), Lewis Publishers, Boca Raton, FL, 2003, 283 pp., US$ 139.95, ISBN 0-56670-667-X

This book is a product of a workshop held in 2000 on the topic "Modeling and Management of Emerging Environmental Issues". Approximately four dozen modeling experts participated. These attendees were divided into four panels with each panel addressing a different environmental contamination or remediation problem. This book resulted from those panel discussions. Each panel produced a chapter on the topic it addressed. These chapters are written by one of the panel members with input by other panel participants.

Reproduced below are the topics of the panel reports and brief summaries of the contents thereof.

1. Surface water–ground water interactions and modeling applications.

   "This panel examined the technical complexities of surface water and ground water interaction on a spatial and temporal scale. The regulatory framework of mixing zones was reviewed, and the policy implications of mixing zones on ground water and surface water interaction were discussed. The panel focused on mathematical modeling of these processes and reviewed the state-of-the-art technology in aqueous mixing simulation models. Advantages and disadvantages of different modeling approaches, time, and spatial resolution disparities, and aggregation–disaggregation were also discussed."
2. The role of modeling in managing of contaminated sediments.

   "This chapter summarizes applications of quantitative prognostic models of contaminant processes in sediments, assesses the state-of-the-art of these models with respect to accuracy and adequacy, and identifies research that can contribute to improvement in model development and their use in resolving sediment management challenges."
3. Optimization and modeling for remediation and monitoring.

   "The focus of this chapter is optimization and modeling for remediation and monitoring. The goal is to provide the reader with insights into optimization and modeling tools available for cost-effective resolution of environmental problems, especially as they pertain to ground water contamination and its long-term impacts. To achieve this goal, the technical and practical challenges inherent in this approach are presented as well as documented accomplishments. Utilizing this organizational approach, the reader should comprehend both the financial benefits and the anticipated costs associated with using optimal design and modeling when resolving and managing problems addressable via this technology.

   The chapter is subdivided into the following three main topics: the user's perspective, current state of knowledge, and gaining acceptance. Each topic is further subdivided to address many of the specific issues of current importance to the professional ground water community."
4. Modeling fate and transport of chlorinated organic compounds in the subsurface.

   "The panel discussed issues associated with simulating chlorinated organic compound behavior in the subsurface. Presentations by panel members focused on