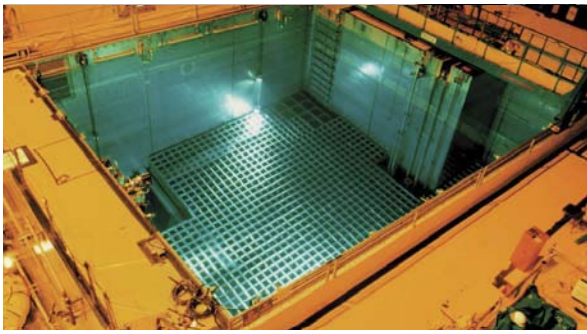

The Reporter's Handbook on Nuclear Materials, Energy, and Waste Management

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Preface

Journalists, who face the challenge of writing stories that are accurate, balanced, objective, and responsible, have reported about the benefits and risks associated with radionuclides from the days of the Manhattan Project when information was a guarded secret and few knew what was happening to today when a plethora of information and opinions exists. They have written about the beneficial use of radioactivity to kill rapidly growing cancer cells and identify malfunctioning organs and of x-rays to detect caries and other dental problems, the development of devices to accurately measure the thickness and quality of products, the use of radionuclides to kill pathogens, the installation of radionuclide-containing smoke detectors, and many other uses of radioactive materials to improve quality of life and create economic opportunities.

Yet, journalists instantly recognize the words Chernobyl and Three Mile Island, along with acid rain, Bhopal, dioxin, Love Canal, Exxon Valdez, global warming, and ozone depletion as among the environmental stories that rose to front-page and nightly network news headlines. There is nothing simple about preparing an accurate, balanced, objective, and responsible story about radiation and radioactivity.

World events require stories that tie together nuclear power, nuclear waste, nuclear weapons, global warming, economic development, and public health. This need for high-quality reporting about nuclear issues comes at a time when newspapers, radio and television stations, and magazines are under substantial financial pressure. During the 1980s, many media outlets added environmental beat reporters. Most of these specialist jobs have disappeared. Nonspecialist reporters assigned to a breaking or background story probably have relatively little knowledge about radionuclides. We believe they would benefit from a handbook that provides basic information and leads for further research.

Our goal is to provide that handbook; it most certainly is not to try to persuade journalists that radioactivity and its uses are good or bad. In 1988 we published the *Environmental Reporter's Handbook,* using a formula suggested to us by journalists. The book was praised by reviewers and received a special

award for journalism from the Sigma Delta Chi Society of professional journalists in 1989. In 1995, we published a second edition, adding more information and changing the title to *The Reporter's Environmental Handbook,* because we learned that most of the users were not environmental reporters but nonspecialist reporters who were covering an environmental story. In 2003, we published a third edition of the handbook. That edition was informed by a survey of the members of the Society of Environmental Journalists, who identified topics they wanted us to cover and helped us tweak the handbook format. The current book is more specialized, focusing on nuclear materials, nuclear energy, and nuclear waste; otherwise it resembles its predecessors.

Part I begins with suggestions about how to use this book most effectively and continues with an introductory essay on why nuclear-related developments have become a major policy issue. The next essay presents synopses of various crosscutting themes, such as environmental impact, risk assessment, and economic analyses, and describes the frameworks used by analysts to assess and weigh the advantages and disadvantages of policy options involving these themes. Part I ends with an essay by Tom Henry, an award-winning journalist with more than 26 years of experience, who writes about how he would cover some of the issues presented in this handbook. Readers will find his brief useful when covering nuclear power; however, he does not focus directly on issues related to waste management and transportation, decommissioning, the economics of nuclear power, weapons, or issues of nonproliferation. These topics are covered elsewhere in this volume.

Part II consists of essays that focus on nuclear-related issues. Journalists indicated that they do not want a science textbook in which they have to thumb through 10,000-word essays with 100 citations of sources that are mostly available only in paper copies in a library. Our briefs of 2,500–4,000 words capture the essence of an issue, such as dirty bombs or nuclear reactor safety. They are the heart of the book. Each brief

- describes the broad background of the issue;
- identifies key questions and issues for journalists to ask in their investigation;
- discusses hazards, risks, and benefits to the public;
- reviews what experts believe are myths and misunderstandings among the public;
- suggests pitfalls that are commonly found in media coverage on the topic; and
- offers resources for follow-up research

We recognize that a 2,500–4,000 word essay on medical uses of radionuclides, dirty bombs, or engineering of nuclear reactors will not satisfy the reporter who specializes in the subject. That reporter will find the information in the briefs to be too basic. Rather, our target, as noted earlier, is the reporter who does not have much of a background with nuclear topics and will probably be covering one or two other stories, perhaps about crime, politics, and health, at the same time. He or she may need a reliable concise source of information as a starting point that can be read in 20 minutes and offers readily accessible sources for follow-up. The briefs in this handbook should serve that purpose. Several of the briefs are longer than 4,000 words because our experts told us that the initial draft did not convey sufficient basic information.

Journalists read background materials but also rely on expert sources for information. For this book, as for its predecessors, we interviewed leading experts from universities, business, government, and citizens groups. Some of the briefs will appear to be slanted in one direction or the other because experts, like everyone else, have viewpoints. Yet, it was critical for us that the book be as balanced as possible. Consequently, every brief in the book has been reviewed by an external panel of individuals who, while they may have different viewpoints, have expertise on this subject.

Part III includes a glossary, a summary of key laws and policies, a summary of the history of nuclear power, and a list of organizations, with a description of each one, that may be consulted for detailed reviews of the subjects covered in this book. For example, the American Nuclear Society, founded in 1954, is a not-for-profit international organization consisting of over 10,000 engineers, scientists, professors, students, and others interested in nuclear issues. The vast majority of members live outside the United States. Notably, the society has issued "position statements" on almost 40 subjects, including nonproliferation, health effects of low-level radiation, disposition of surplus weapons plutonium, transporting nuclear waste, and many others.

Several notes are in order about the topics covered in this volume. Early on, we recognized that though it was not feasible to cover non-nuclear topics in depth, reporters need quick access to information about related topics. Thus, for example, there is a single brief about climate change and non-nuclear energy options that summarizes the issue and its relationships to fossil fuels, renewable sources, and conservation.

It was also not feasible to provide equal coverage about every nuclear-related topic. Within the nuclear topics, we emphasize nuclear waste management and nuclear power and devote less attention to military uses of nuclear materials, such as nuclear weapons and nuclear-powered submarines and other U.S. Navy ships. Other choices about what to include followed from conver-

sations with journalists. They asked us to look back at what has happened as a result of the Three Mile Island and Chernobyl events, and they asked us to prepare a brief about the protection of current nuclear power plants against terrorists. Less attention was devoted to licensing of existing nuclear power plants. Also in response to these conversations, we emphasized the science and engineering issues rather than economics, politics, and communication issues, which are included in single briefs. Finally, our geographical focus is the United States, although international issues are found throughout the volume.

Avoiding actual or even perceived bias in the handbook has been our major concern. To ensure minimum bias, we isolated the authors from the review panel. The experts who reviewed the briefs were not chosen by the authors. All correspondence and review of materials was done through the Consortium for Risk Evaluation with Stakeholder Participation (CRESP), a multi-university group funded by the U.S. Department of Energy (DOE) to conduct research. Also, in response to a concern that readers would not encounter a range of responsible views and criticisms of the topics presented in this volume because of the potential for bias in the authors' choices of sources, we added a section to the resources in Part III called "Key Sources." Here we list classic and recent books and articles, and Web sites for organizations and individuals that support and oppose nuclear power, reprocessing, and some other applications of nuclear technology.

In addition to consulting the specialized sources throughout this volume, reporters should look to their state and local health departments for information. Almost every one has an individual or group that deals with radiation health and is involved with preparedness. We are not saying that these institutions replace national experts, we are saying that for local stories they must be consulted.

The authors are greatly indebted to many individuals who participated in the preparation of this volume. First, we thank the scientists who were interviewed for the briefs. These are listed on the briefs, and a short biography is provided for each of them.

We are a deeply grateful to CRESP for supporting the project and for organizing and conducting the peer review. We thank Charles Powers and David Kosson for their encouragement and patience. We thank Arthur Upton and Bernard Goldstein for chairing the peer review panel and for organizing the peer review of the entire document. We also thank Milton Russell and Don Hopey who reviewed the entire handbook. Short biographies of the reviewers are found at the end of the volume.

The Reporter's Handbook on Nuclear Materials, Energy, and Waste Management is based on work supported by the DOE, under Cooperative Agreement Number DE-FC01-06EW07053 entitled "The Consortium for Risk Evaluation with Stakeholder Participation III" awarded to Vanderbilt University. The opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily represent the views of the DOE or Vanderbilt University. Obviously, the DOE has a stake in nuclear-related issues. While the DOE funded the handbook, it did not instruct the authors about the topics to be included, and it did not exercise editorial control over the handbook. Four of the 21 briefs are partly based on interviews with DOE subject-matter experts. Also, as noted, all briefs were peer reviewed by our expert panel for accuracy and objectivity.

A closing note: the media too frequently are blamed for bad public policy decisions, and the media probably do not receive enough credit for good policy decisions. But no one denies the importance of their efforts to communicate accurate, balanced, objective, and responsible stories.

About CRESP

Consortium for Risk Evaluation with Stakeholder Participation III

The Consortium for Risk Evaluation and Stakeholder Participation (CRESP), since 1995, has been researching ways to advance cost-effective cleanup of the nation's nuclear weapons production waste sites and test facilities. The consortium responded to a request by the U.S. Department of Energy (DOE) and the National Research Council for the creation of an independent institutional mechanism to develop data and methodology to make risk and stakeholder involvement a key part of decision making at the Environmental Management Office of DOE. As a result of a national competition, a 5-year cooperative agreement was awarded to CRESP in March 1995. The CRESP co-founders and initial management board included Bernard D. Goldstein, John A. Moore, Gilbert S. Omenn, Charles W. Powers, and Arthur C. Upton. CRESP I was institutionally managed by the Environmental Occupational Health Sciences Institute in New Jersey with Bernard D. Goldstein as principal investigator and Charles W. Powers as executive director.

The first 5-year cooperative agreement was renewed in 2000 with the Institute for Responsible Management as the lead institution and Charles W. Powers as principal investigator. CRESP worked to improve the scientific and technical basis of environmental management decisions leading to advance protective and cost-effective cleanup of the nation's nuclear weapons, and to enhance stakeholder understanding of the nation's nuclear weapons production facility waste sites. CRESP II pursued this work through a unique institutional model: (1) its primary mode of operation was an unprecedented program of interdisciplinary, multi-university research; (2) it was independent and its beneficiaries are those who have a stake in effective cleanup of federal facilities; and (3) it was organized to provide guidance to and peer review of the evolving effort to use risk methods and evaluations to shape cleanup decisions at DOE sites. All three elements were effectively demonstrated in CRESP's work on key problems at both major and "small" DOE Environmental Management sites, especially Amchitka, a volcanic island that is part of the Aleutian islands of Alaska.

CRESP III was renewed as a DOE cooperative agreement in the fall of 2006 with Vanderbilt University as the lead organization, and Charles W. Powers and David S. Kosson as co-principal investigators. The objective of the CRESP III project is to advance cost-effective, risk-informed cleanup of the nation's nuclear weapons production facility waste sites and cost-effective, risk-informed management of potential future nuclear sites and wastes. This objective is being accomplished by seeking to improve the scientific and technical basis for environmental management decisions by the DOE, and by fostering public participation in that search. The CRESP III member colleges and universities now include Howard University, New York University School of Law, Oregon State University, Robert Wood Johnson Medical School, Rutgers, the State University of New Jersey, University of Arizona, the University of Pittsburgh, and the University of Washington.

Part I: Getting Started

How to Use the Handbook

If you need just a definition or quick explanation, go directly to the glossary in Part III. For example, if you want to know what a "curie" is, go to the glossary and look up the definition. You will find that it is "the basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion (3.7×10^{10}) disintegrations per second, which is approximately the activity of 1 gram of radium." If you want a more detailed discussion of a particular topic, go to the table of contents and look over the topics in Part II. For example, for information on how a curie relates to a becquerel and how both are related to health impacts, turn to Section 1 of Part II. It provides background information about radionuclides, key issues related to public health, possible stories, and pitfalls noted in previous coverage of health impacts.

Each brief is self-contained. Reporters should be able to get what they need from a given brief; in other words, we hoped to reduce the need to search through the book. This means that there is some unavoidable redundancy among the briefs. To assist those who need more information, within the briefs, we cross-reference other briefs. The index provides further guidance.

We clustered the briefs into five sections within Part II. Section 1 examines nuclear materials and radioactivity—that is, what they are, how they are formed, where they are found, and most important, effects of radiation on humans. Section 2 examines nuclear power and other nonmilitary uses of radionuclides, including nuclear medicine and food irradiation. It explores issues that have arisen during the past half-century, such as nuclear-energy safety systems, the Chernobyl and Three Mile Island events, and the economics of nuclear power. Section 3 focuses on nuclear waste management. Briefs describe nuclear waste, how and where it is managed, monitoring of waste management sites, the ecological impacts of cleanup, and long-term surveillance and maintenance of waste management sites. Section 4 focuses on military-related nuclear issues, such as managing nuclear weapons, radiological dispersal devices (dirty

bombs), nonproliferation initiatives, nuclear terrorism, and international and national policy related to these. Section 5 reviews climate change, public perception, and risk communication focused on nuclear energy and waste issues.

Reporters who are not familiar with environmental risk, economic, and technology assessment, risk perception, and theories about how technology fits into the larger context of resource management will find helpful background in the short overviews in Part I, "Crosscutting Themes."

Why Now? Why This Discussion?

Written by Michael R. Greenberg, with comments by
John F. Ahearne and Richard L. Garwin

The simple answer to "Why now?" is that the governments and people of the world are being driven to consider nuclear power and other energy sources, along with conservation, as options for meeting increasing energy demand. This is not the first time this pressure has gripped the United States, but the increasing fear about climate change has added another dimension. Also, the United States, Russia, France, and Great Britain face major nuclear weapons waste issues as a cold war legacy.

Beginning with the nuclear energy issue, on October 17, 1973, the members of the OAPEC (Organization of Arab Petroleum Exporting Countries) embargoed petroleum shipments to the United States, some of Israel's allies in Western Europe (initially the Netherlands) and Japan because of their support for Israel against Egypt and Syria in the Yom Kippur War. Just before the oil embargo in 1973, the average gas price at the pump was $1.80 per gallon (adjusted for inflation to 2007 dollars). In 1981, the average price was $3.00 (a 70% increase). These price increases sent a recessionary ripple through the economies of the dependent nations that spread across the world. High oil prices persisted until 1986. The embargo and price increases sparked an interest in exploration for conservation and new sources of fossil fuels. Governments' monetary policies became more restrictive, and interest in nuclear power increased.

France, Belgium, Sweden, and Japan now heavily depend on nuclear power. In the United States, even before the Three Mile Island nuclear reactor meltdown in 1979, U.S. commercial business interest in nuclear power was waning. A worldwide recession during the oil embargo caused economists to reduce their estimates of the growth of electricity demand, and the price of new reactors seemed high to U.S. utilities. Furthermore, the U.S. economy grew despite the lack of growth of energy use. Serious efforts were made by all sectors of the U.S. economy to economize energy use. After 1986, the year of the Chernobyl nuclear incident, the economy continued to grow; while