

# **Environmental Radioactivity From Natural Industrial Military Sources Fourth Edition From Natural Industrial And Military Sources**

Library of Congress Subject Headings Fukushima Accident Biological Monitoring of  
Environmental Contaminants Radioactivity in the Environment Soil  
Contamination Man-Made and Natural Radioactivity in Environmental Pollution and  
Radiochronology Radioecology: Lectures In Environmental Radioactivity McGraw-Hill  
Encyclopedia of Science & Technology Toxicological Profile for Plutonium Advances  
in Petrochemicals Rare Earths Industry Nuclear Safety Nuclear and  
Radiochemistry Environmental Radioactivity from Natural, Industrial and Military  
Sources Isotopes in Environmental Studies biochemical sciences: health and  
environmental aspects Naturally Occurring Radioactive Materials in  
Construction Radioactive Releases in the Environment Evaluation of Guidelines for  
Exposures to Technologically Enhanced Naturally Occurring Radioactive  
Materials Environmental Toxicants The Natural Radiation Environment VII Radiation  
and Radioactivity on Earth and Beyond Radiation Protection  
Management Environmental Radioactivity and Emergency Preparedness Nuclear  
Radioactive Materials (Tenorm) in the Oil and Gas Industry Radionuclide Behaviour  
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Bulletin Environmental Radioactivity Low-Level Environmental  
Radioactivity Radionuclide Concentrations in Food and the Environment The science  
of the total environment Radiation SPE Production & Facilities Remediation of  
Contaminated Environments Radioactivity in the Environment The Natural Radiation  
Environment Environmental Remediation and Restoration of Contaminated Nuclear  
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Radiation Principles and Applications in Nuclear Engineering

## **Library of Congress Subject Headings**

The goal of this book is to examine the complex state of radioactivity in the environment, and to understand the interplay of its two principal sources: man-made and natural. The text examines human contributions to release of radionuclides, with an eye to future reductions, and assesses natural occurrences in an evaluation of baseline radioactivity.

## **Fukushima Accident**

Nuclear Radioactive Materials in the Oil and Gas Industry comprehensively discusses the TENORMs generated from various types of oil and gas processes and their associated adverse human health effects, effective TENORM waste management strategies, and the quantitative risk analysis. The book thoroughly investigates current knowledge, addressing the three main gaps identified in available studies: 1) Exposure to radioactivity, 2) High volume waste as a source of radiation exposure, and 3) A lack of uniform, international safety regulations. This book offers researchers, scientists and graduate and undergraduate students a comprehensive and well-researched reference that covers fundamental concepts, problem identification and solutions development. It is an ideal, comprehensive

guideline for professionals involved in the oil and gas and nuclear industries who are concerned about radiological issues. Demystifies NORM and TENORM concepts and redefines TENORM from technical and nuclear scientific perspectives  
Addresses statistically representative data of quantitative risk assessment and dynamic accident modeling Stresses the need for legislation and consistency of safety standards relating to radiological risks posed by TENORM on health and the environment

## **Biological Monitoring of Environmental Contaminants**

Rare Earths elements are composed of 15 chemical elements in the periodic table. Scandium and yttrium have similar properties, with mineral assemblages, and are therefore referred alike in the literature. Although abundant in the planet surface, the Rare Earths are not found in concentrated forms, thus making them economically valued as they are so challenging to obtain. Rare Earths Industry: Technological, Economic and Environmental Implications provides an interdisciplinary orientation to the topic of Rare Earths with a focus on technical, scientific, academic, economic, and environmental issues. Part I of book deals with the Rare Earths Reserves and Mining, Part II focuses on Rare Earths Processes and High-Tech Product Development, and Part III deals with Rare Earths Recycling Opportunities and Challenges. The chapters provide updated information and priceless analysis of the theme, and they seek to present the latest techniques, approaches, processes and technologies that can reduce the costs of compliance with environmental concerns in a way it is possible to anticipate and mitigate emerging problems. Discusses the influence of policy on Rare Earth Elements to help raise interest in developing strategies for management resource development and exploitation Global contributions will address solutions in countries that are high RE producers, including China, Brazil, Australia, and South China End of chapter critical summaries outline the technological, economic and environmental implications of rare earths reserves, exploration and market Provides a concise, but meaningful, geopolitical analysis of the current worldwide scenario and importance of rare earths exploration for governments, corporate groups, and local stakeholders

## **Radioactivity in the Environment**

Radioactive sources such as nuclear power installations can pose a great threat to both humans and our environment. How do we measure, model and regulate such threats? Environmental Radioactivity and Emergency Preparedness addresses these topical questions and aims to plug the gap in the lack of comprehensive literature in this field. The book explores how to deal with the threats posed by different radiological sources, including those that are lost or hidden, and the issues posed by the use of such sources. It presents measurement methods and approaches to model and quantify the extent of threat, and also presents strategies for emergency preparedness, such as strategies for first-responders and radiological triage in case an accident should happen. Containing the latest recommendations and procedures from bodies such as the IAEA, this book is an essential reference for both students and academicians studying radiation safety, as well as for radiation protection experts in public bodies or in the industry.

## **Soil Contamination**

Human health as well as aquatic and terrestrial ecosystems are threatened from increasing levels of environmental radiation of various sources, many of them of anthropogenic causality: large areas of the former Soviet Union suffer from radioactive pollution, in particular after the Chernobyl accident; the increase in the incidence of UVB radiation at the Earth's surface as a result of a progressive depletion of stratospheric ozone is a global problem that requires international concerted actions; in areas of former uranium mining the natural radiation level is substantially increased due to elevated radon levels; a growing portion of the population involved in air traffic is exposed to increased levels of natural radiation; and with the International Space Station an increasing number of astronauts will be exposed to the complex field of cosmic radiation. To estimate the corresponding risks, a better knowledge of the underlying radiobiological mechanisms at the molecular, cellular and system level is required. This book is the result of a multidisciplinary effort to discuss the current state of knowledge of the fundamental processes that result from interactions of environmental radiation -ionizing as well as UV radiation -with living matter and the existing radiation protection concepts, and then to define future research work needed as fundamental information for the assessment of risks from increased levels of environmental radiation to human health and ecosystem balance. It comprises the key lectures and statements presented at the NATO Advanced Research Workshop.

## **Man-Made and Natural Radioactivity in Environmental Pollution and Radiochronology**

### **Radioecology: Lectures In Environmental Radioactivity**

### **McGraw-Hill Encyclopedia of Science & Technology**

A comprehensive, 20-volume reference encyclopedia on science and technology.

### **Toxicological Profile for Plutonium**

Numerous sources of ionizing radiation can lead to human exposure: natural sources, nuclear explosions, nuclear power generation, use of radiation in medical, industrial and research purposes, and radiation emitting consumer products. Before assessing the radiation dose to a population one requires a precise knowledge of the activity of a number of radionuclides. The basis for the assessment of the dose to a population from a release of radioactivity to the environment, the estimation of the potential clinical health effects due to the dose received and, ultimately, the implementation of countermeasures to protect the population, is the measurement of radioactive contamination in the environment after the release. It is the purpose of this book to present the facts about the presence of radionuclides in the environment, natural and man made. There is no aspect of radioactivity, which has marked the passing century, not mentioned or discussed in this book.

## **Advances in Petrochemicals**

This publication presents the proceedings of the IAEA's International conference on isotopes in environmental studies - Aquatic Forum 2004 at which present state of the art isotopic methods for investigation of the aquatic environment were reviewed. The main subjects being considered were: i) behaviour, transport and distribution of isotopes in the aquatic environment; ii) climate change studies using isotopic records in the marine environment; iii) groundwater dynamics, modelling and management of freshwater sources; iv) important global projects; v) joint IAEA-UNESCO submarine groundwater investigations in the Mediterranean, the Southwest Atlantic, and Pacific Oceans; vi) new trends in radioecological investigations; vii) transfers in analytical technologies from bulk analyses to particle and compound specific analyses; viii) development of new isotopic techniques

## **Rare Earths Industry**

Numerous sources of ionizing radiation can lead to human exposure: natural sources, nuclear explosions, nuclear power generation, use of radiation in medical, industrial and research purposes, and radiation emitting consumer products. Before assessing the radiation dose to a population one requires a precise knowledge of the activity of a number of radionuclides. The basis for the assessment of the dose to a population from a release of radioactivity to the environment, the estimation of the potential clinical health effects due to the dose received and, ultimately, the implementation of countermeasures to protect the population, is the measurement of radioactive contamination in the environment after the release. It is the purpose of this book to present the facts about the presence of radionuclides in the environment, natural and man made. There is no aspect of radioactivity, which has marked the passing century, not mentioned or discussed in this book.

## **Nuclear Safety**

## **Nuclear and Radiochemistry**

Understanding radionuclide behaviour in the natural environment is essential to the sustainable development of the nuclear industry and key to assessing potential environmental risks reliably. Minimising those risks is essential to enhancing public confidence in nuclear technology. Scientific knowledge in this field has developed greatly over the last decade. Radionuclide behaviour in the natural environment provides a comprehensive overview of the key processes and parameters affecting radionuclide mobility and migration. After an introductory chapter, part one explores radionuclide chemistry in the natural environment, including aquatic chemistry and the impact of natural organic matter and microorganisms. Part two discusses the migration and radioecological behavior of radionuclides. Topics include hydrogeology, sorption and colloidal reactions as well as in-situ investigations. Principles of modelling coupled geochemical, transport and radioecological properties are also discussed. Part three covers application issues:

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assessment of radionuclide behaviour in contaminated sites, taking Chernobyl as an example, estimation of radiological exposure to the population, performance assessment considerations related to deep geological repositories, and remediation concepts for contaminated sites. With its distinguished editors and international team of expert contributors, Radionuclide behaviour in the natural environment is an essential tool for all those interested or involved in nuclear energy, from researchers, designers and industrial operators to environmental scientists. It also provides a comprehensive guide for academics of all levels in this field. Provides a comprehensive overview of the key processes and parameters affecting radionuclide mobility and migration Explores radionuclide chemistry in the natural environment Discusses the migration and radioecological behaviour of radionuclides

### **Environmental Radioactivity from Natural, Industrial and Military Sources**

Nuclear Safety provides the methods and data needed to evaluate and manage the safety of nuclear facilities and related processes using risk-based safety analysis, and provides readers with the techniques to assess the consequences of radioactive releases. The book covers relevant international and regional safety criteria (US, IAEA, EUR, PUN, URD, INI). The contents deal with each of the critical components of a nuclear plant, and provide an analysis of the risks arising from a variety of sources, including earthquakes, tornadoes, external impact and human factors. It also deals with the safety of underground nuclear testing and the handling of radioactive waste. Covers all plant components and potential sources of risk including human, technical and natural factors. Brings together information on nuclear safety for which the reader would previously have to consult many different and expensive sources. Provides international design and safety criteria and an overview of regulatory regimes.

### **Isotopes in Environmental Studies**

The petrochemical industry is an important area in our pursuits for economic growth, employment generation, and basic needs. It is a huge field that encompasses many commercial petrochemical and polymer-enabled products. The book is designed to help the reader, particularly students and researchers of petroleum science and engineering, to understand synthesis, processing, mechanics, and simulation of the petroleum processes. The selection of topics addressed and the examples, tables, and graphs used to illustrate them are governed, to a large extent, by the fact that this book is aimed primarily at petroleum science and engineering technologists. Undoubtedly, this book contains must read materials for students, engineers, and researchers working in the area of petrochemicals and petroleum and provides valuable insights into the related synthesis, processing, mechanisms, and simulation. This book is concise, self-explanatory, informative, and cost-effective.

### **biochemical sciences: health and environmental aspects**

The author is ready to assert that practically none of the readers of this book will

ever happen to deal with large doses of radiation. But the author, without a shadow of a doubt, claims that any readers of this book, regardless of gender, age, financial situation, type of professional activity, and habits, are actually exposed to low doses of radiation throughout their life. This book is devoted to the effect of small doses on the body. To understand the basic effects of radiation on humans, the book contains the necessary information from an atomic, molecular and nuclear physics, as well as from biochemistry and biology. Special attention is paid to the issues that are either not considered or discussed very briefly in existing literature. Examples include the ionization of inner atomic shells that play an essential role in radiological processes, and the questions of transformation of the energy of ionizing radiation in matter. The benefits of ionizing radiation to mankind is reflected in a wide range of radiation technologies used in science, industry, agriculture, culture, art, forensics, and, what is the most important application, medicine. Radiation: Fundamentals, Applications, Risks and Safety provides information on the use of radiation in modern life, its usefulness and indispensability. Experiments on the effects of small doses on bacteria, fungi, algae, insects, plants and animals are described. Human medical experiments are inhuman and ethically flawed. However, during the familiarity of mankind with ionizing radiation, a large number of population groups were subject to accumulation, exposed to radiation at doses of small but exceeding the natural background radiation. This book analyzes existing, real-life radiation results from survivors of Hiroshima and Nagasaki, Chernobyl and Fukushima, and examines studies of radiation effect on patients, radiologists, crews of long-distant flights and astronauts, on miners of uranium mines, on workers of nuclear industry and on militaries, exposed to ionizing radiation on a professional basis, and on the population of the various countries receiving environmental exposure. The author hopes that this book can mitigate the impact of radiation phobia, which prevails in the public consciousness over the last half century. Explores the science of radiation and the effects of radiation technologies and biological processes Analyzes the elementary processes of ionization and excitation Summarizes information about inner shells ionization and its impact on matter and biological structures Discusses quantum concepts in biology and clarifies the importance of epigenetics in radiological processes Includes case studies focusing on humans irradiated by low doses of radiation and its effects

## **Naturally Occurring Radioactive Materials in Construction**

Fukushima Accident presents up-to-date information on radioactivity released to the atmosphere and the ocean after the accident on the Fukushima Dai-ichi nuclear power plant, on the distribution of radionuclides in the world atmosphere and oceans, and their impact on the total environment (man, fauna, and flora). The book will evaluate and discuss the post-Fukushima situation, emphasizing radionuclide impacts on the terrestrial and marine environments, and compare it with the pre-Fukushima sources of radionuclides in the environment. The authors' results, as well as knowledge gathered from the literature, will provide up-to-date information on the present status of the topics. Fukushima Accident is based on the environmental and nuclear research; however, the presentation will be suitable for university-level readers. 2013 PROSE Award winner in Environmental Science from the Association of American Publishers Covers atmospheric and marine radioactivity, providing information on the global atmospheric dispersion of

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radionuclides in the atmosphere and world oceans Examines radiation doses to the public and biota to understand the health risks to the public and ecosystems Provides information on monitoring radionuclides in the environment – information on sources of radionuclides, their temporal and spatial variations, and radionuclide levels Covers transport of radionuclides from different sources (e.g. nuclear power plants) as well as atmospheric simulations and modeling approaches

### **Radioactive Releases in the Environment**

#### **Evaluation of Guidelines for Exposures to Technologically Enhanced Naturally Occurring Radioactive Materials**

These lectures presented by experts from the Nordic countries are collected with the purpose of education in the field of environmental radioactivity. The book may be used in university courses on, eg., health physics and environmental science. Administrators and managers of environmental programmes may also find useful background information. The book covers all important aspects of environmental radioactivity such as source terms, atmospheric transport, processes in aquatic and terrestrial systems, radiochemistry and measurement techniques, radioactivity in man, modeling and assessment of absorbed doses. The Nordic Committee for Nuclear Safety Research, NKS, organises joint research programmes such as the above lectures to strive for a better understanding in the Nordic countries of factors influencing nuclear safety, radiation protection and emergency provisions.

### **Environmental Toxicants**

Naturally occurring radionuclides are found throughout the earth's crust, and they form part of the natural background of radiation to which all humans are exposed. Many human activities—such as mining and milling of ores, extraction of petroleum products, use of groundwater for domestic purposes, and living in houses—alter the natural background of radiation either by moving naturally occurring radionuclides from inaccessible locations to locations where humans are present or by concentrating the radionuclides in the exposure environment. Such alterations of the natural environment can increase, sometimes substantially, radiation exposures of the public. Exposures of the public to naturally occurring radioactive materials (NORM) that result from human activities that alter the natural environment can be subjected to regulatory control, at least to some degree. The regulation of public exposures to such technologically enhanced naturally occurring radioactive materials (TENORM) by the US Environmental Protection Agency (EPA) and other regulatory and advisory organizations is the subject of this study by the National Research Council's Committee on the Evaluation of EPA Guidelines for Exposures to Naturally Occurring Radioactive Materials.

### **The Natural Radiation Environment VII**

This handbook gives a complete and concise description of the up-to-date knowledge of nuclear and radiochemistry and applications in the various fields of science. It is based on teaching courses and on research for over 40 years. The

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book is addressed to any researcher wishing sound knowledge about the properties of matter, be it a chemist, a physicist, a medical doctor, a mineralogist or a biologist. They will all find it a valuable source of information about the principles and applications of nuclear and radiochemistry. Research in radiochemistry includes: Study of radioactive matter in nature, investigation of radioactive transmutations by chemical methods, chemistry of radioelements etc. Applications include: Radionuclides in geo- and cosmochemistry, dating by nuclear methods, radioanalysis, Mössbauer spectroscopy and related methods, behaviour of natural and man-made radionuclides in the environment, dosimetry and radiation protection. All subjects are presented clearly and comprehensibly, and in logical sequence. Detailed derivations of equations are avoided and relevant information is compiled in tables. The recent edition of the multi-coloured Karlsruhe 'Chart of the Nuclides' is included. Clearly a standard work by an author with extensive experience in research and teaching.

### **Radiation and Radioactivity on Earth and Beyond**

All papers have been peer-reviewed. The NRE-VIII Symposium covered a variety of topics from cosmic rays in the solar system to exposure of biota to natural radioactivity, passing through terrorism with natural radionuclides. The Symposium was an example of multidisciplinary.

### **Radiation Protection Management**

Nuclear sites become contaminated with radionuclides due to accidents and activities carried out without due consideration for the environment. Naturally-occurring radioactive materials (NORM) released by industrial processes such as coal power production and fertilizer manufacture may also require clean-up. Environmental remediation and restoration aim to reduce exposure to radiation from contaminated soil or groundwater. This book provides a comprehensive overview of this area. Part 1 provides an introduction to the different types of contaminated site and their characteristics. Part 2 addresses environmental restoration frameworks and processes. Part 3 then reviews different remediation techniques and methods of waste disposal. Explores types and characteristics of contaminated nuclear and NORM sites Provides an in depth guide to environmental restoration frameworks and processes including stakeholder involvement, risk assessment and cost-benefit analysis in the remediation and restoration of contaminated nuclear and NORM sites Offers coverage of remediation techniques and waste disposal from electrokinetic remediation to in situ and ex situ bioremediation of radionuclides contaminated soils

### **Environmental Radioactivity and Emergency Preparedness**

This edited book, Soil Contamination - Current Consequences and Further Solutions, is intended to provide an overview on the different environmental consequences of our anthropogenic activities, which has introduced a large number of xenobiotics that the soil cannot, or can only slower, decompose or degrade. We hope that this book will continue to meet the expectations and needs of all interested in diverse fields with expertise in soil science, health, toxicology,



and other disciplines who contribute and share their findings to take this area forward for future investigations.

## **Nuclear Radioactive Materials (Tenorm) in the Oil and Gas Industry**

This text brings together in one single comprehensive reference, the fundamentals of radioactivity. It uniquely fills the gap in the market, as no other books deal with environmental radioactivity to this degree. \* Timely and invaluable as the studies of environmental processes and the awareness of the impact of human activity on our environment are increasing \* Links all three main aspects of environmental radioactivity: Principles, Transport and Measurement \* Useful to a wide readership - students, lecturers, researchers, companies and environmental consultants

## **Radionuclide Behaviour in the Natural Environment**

### **IAEA Bulletin**

Naturally Occurring Radioactive Materials in Construction (COST Action NORM4Building) discusses the depletion of energy resources and raw materials and its huge impact not only on the building market, but also in the development of new synthetic building materials, whereby the reuse of various (waste) residue streams becomes a necessity. It is based on the outcome of COST Action TU 1301, where scientists, regulators, and representatives from industry have come together to present new findings, sharing knowledge, experiences, and technologies to stimulate research on the reuse of residues containing enhanced concentrates of natural radionuclides (NORM) in tailor-made building materials. Chapters address legislative issues, measurement, and assessment of building materials, physical and chemical aspects, from raw materials, to residues with enhanced concentrations of natural radionuclides (NORM), processes, building products containing NORM, and end-of-life and reuse requirements. Presents a holistic approach in developing new reuse pathways involving experts on different (technical, chemical, physical, ecological, economical and radiological) aspects of materials Provides practical guidance that address questions and comments regarding the EU-BSS standards linked to the processing of NORM in building materials Investigates realistic legislative scenarios Primarily aimed at industry and actors linked to the industry, but also researchers Contains a strong international network of expert authors and internal reviewers for each chapter

### **International Atomic Energy Agency Bulletin**

### **Environmental Radioactivity**

From the Introduction Low-level radioactivity is related to those radioactive sources of ionizing radiation that are characterized by low activities. Sometimes activity here does not represent total amount of radionuclides but rather their concentration. In other cases, the total activity may be quite high, but we can

measure only a relatively small portion of the material. "Low" may have, for different situations and circumstances, not only considerably different meanings but also different absolute values as far as the activity or activity concentration is concerned. For example, one can refer to low activity in the case of radiocarbon dating, where the concentration of  $^{14}\text{C}$  is actually lower than its natural concentration, and also in the case of radon monitoring where, especially in mines or in some enclosed spaces, its concentration may be several thousand times higher than the outdoor "atural" concentrations. Emphasis is now being placed on the analysis of naturally occurring radionuclides in the environment or on the release of radionuclides from their different man-made sources because liquid and aerial discharge level controls have become more rigorous. In addition, the applicability of low-level methodology increases the extent of different radionuclide applications considerably. Since individual radionuclides differ in their decay scheme and particles emitted as well in their energies, there is no universal method for the accurate measurement of all radioactive sources. Moreover, there is usually a mixture of radionuclides in a sample, causing some difficulties in a selective evaluation of a given radionuclide. Due to the random nature of radioactive disintegrations, the appropriate interpretation of the experimental results would be, in most cases, impossible without elaborate statistical treatment and evaluation of the data obtained. Thanks to the availability of computer-based instrumentation, the measuring data can be, in most cases, processed and evaluated on-line, which makes it possible to control and optimize the experiment in order to extract the maximum amount of information carried by the detector response. The purpose of this book is to provide an introduction to low-level radioactivity assessment and to clarify the nature of its sources, as well as the principal methods used in its measurement. Our evaluation is concentrated on the present-day aspects of low-level methodology. The book may be useful for all who need highly sensitive analysis of natural or artificial radioactivity both within and outside the nuclear field. The attempt of this book is to summarize the sources of environmental radioactivity and their possible radiological impact in terms of resulting doses to the population, and to present a sound review of the measuring methods and techniques for the evaluation of low-level radioactivities encountered in both the environment and in a number of applications where radioactive sources are used as a means of obtaining important information.

## **Low-Level Environmental Radioactivity**

As radiological residue, both naturally occurring and technologically driven, works its way through the ecosystem, we see its negative effects on the human population. Radionuclide Concentrations in Food and the Environment addresses the key issues concerning the relationship between natural and manmade sources of environmental radioactivity

## **Radionuclide Concentrations in Food and the Environment**

Provides the most current information and research available for performing risk assessments on exposed individuals and populations, giving guidance to public health authorities, primary care physicians, and industrial managers Reviews current knowledge on human exposure to selected chemical agents and physical factors in the ambient environment Updates and revises the previous edition, in

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light of current scientific literature and its significance to public health concerns  
Includes new chapters on: airline cabin exposures, arsenic, endocrine disruptors, and nanoparticles

### **The science of the total environment**

#### **Radiation**

The Natural Radiation Environment Symposium (NRE VII), the Seventh in the NRE series, which commenced forty years ago in 1963 at Rice University Texas, was held in Rhodes (Greece) in May 2002. During the intervening four decades the research work presented at these NRE Symposia has contributed to a deeper understanding of natural radiation and in particular of its contribution to human radiation exposures. It is clear from the quality and diversity of the 143 papers in this volume of Radioactivity in the Environment series that the study of the natural radiation environment is an active and continually expanding field of research. The papers in this volume fall into a number of main and topical research areas namely: the measurement and behaviour of natural radionuclides in the environment cosmic radiation measurement and dosimetry the external penetrating radiation field at ground level TENR (Technologically Enhanced Natural Radiation) and NORM (Naturally Occurring Radioactive Materials) studies assessment of the health effects of radon regulatory aspects of natural radiation exposures In these papers the results of many new surveys of natural radionuclide levels in the environment and of improved methods of detection are described. While some of the natural radiation sources investigated are unmodified by human activity, many accounts are given here of exposures to natural sources which have been enhanced by technology. Such TENR and NORM exposures are shown to range from activities such as mining, oil and gas exploitation, the use of industrial by-products as building materials, to space travel to name but a few. In several cases quite high doses to some individuals are shown to occur. Accounts are given here of methods to prevent and reduce exposures to such sources.

#### **SPE Production & Facilities**

This book features information regarding the Chernobyl nuclear accident, the production of elementary particles, radiation exposure, the geopolitical effects of the end of the nuclear arms race between the U.S. and the former Soviet Union, and the future of nuclear power.

#### **Remediation of Contaminated Environments**

Environmental Radioactivity from Natural, Industrial, and Military Sources is the comprehensive source of information on radiation in the environment and human exposure to radioactivity. This Fourth Edition is a complete revision and extension of the classic work, reflecting major new developments and concerns as the Cold War ended, nuclear weapons began to be dismantled, and cleanup of the nuclear weapons facilities assumed center stage. Contamination from accidents involving weapons, reactors, and radionuclide sources are discussed in an updated chapter,

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including the latest information about the effects of the Chernobyl accident. Important revisions are also made to the chapters on natural radioactivity, nuclear fuels and power reactors, radioactive waste management, and various other sources of exposure. Several chapters provide primers for readers who may not be familiar with the fundamentals of radiation biology, protection standards, and pathways for the environmental transport of radionuclides. An Appendix lists the properties of the more important radionuclides found in the environment. The book concludes with a commentary on contemporary social aspects of radiation exposure and risks that offers an alternative view to current, often excessive concerns over radiation, nuclear technology, and waste. Describes every important source of environmental radioactivity Reviews the vexing problems of radioactive waste management and clean-up of contaminated sites Contains measured or projected radiation dose estimates for the major sources Features 126 figures, 80 tables, and more than 1200 references Discusses current problems in historical context The two authors bring more than 75 years of combined experience with environmental radioactivity Provides an understanding of the sources of environmental radioactivity and human exposure from the mining of ores to final disposal of wastes Thoroughly reviews important contamination accidents

### **Radioactivity in the Environment**

#### **The Natural Radiation Environment**

Nuclear engineering could be viewed as the engineering field that ensures optimum and sustainable technological applications of natural and induced radioactive materials in different industrial sectors. This book presents some advanced applications in radiation effects, thermal hydraulics, and radionuclide migration in the environment. These scientific contributions from esteemed experts introduce some nuclear safety principals, current knowledge about radiation types, sources and applications, thermal properties of heat transfer media, and the role of sorption in retarding radionuclide migration in the environment. This book also covers the advances in identifying radiation effects in dense gas-metal systems, application of dense granular materials as high power targets in accelerator driven systems and irradiation facilities, evaluation of boiling heat transfer in narrow channels, and application of fluorescence quenching techniques to monitor uranium migration.

#### **Environmental Remediation and Restoration of Contaminated Nuclear and Norm Sites**

#### **Fundamentals for the Assessment of Risks from Environmental Radiation**

Remediation of Contaminated Environments summarises - amongst other things - what happened to the people and environment around Chernobyl (and other nuclear sites) and what measures need to be taken in future in the event of nuclear accidents etc. plus it has a very important and currently topical use in

detailing what to do in the event of a terrorist dirty bomb attack on a city. Remediation, including characterization of contaminated sites; safety requirements; remediation planning; effectiveness of individual measures in different environments; social, ethical and economic considerations; application of modern decision aiding technologies Applicable to different categories of contaminated environments and contaminants, comprising areas contaminated by radiation accidents and incidents, nuclear weapon tests, natural radionuclides associated with nuclear fuel cycle, fossil material mining and gas and oil production Associated side effects (environmental and social) and human based remediation measures, comprising perception of this activity by the population; with particular regard to stakeholders and population involvement in making decisions on environmental safety and remediation of contaminated sites

## **Principles and Applications in Nuclear Engineering**

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