

**TOXICOLOGICAL PROFILE FOR
IONIZING RADIATION**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry**

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DISCLAIMER

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UPDATE STATEMENT

A Toxicological Profile for Ionizing Radiation, Draft for Public Comment, was released in February 1998. This edition supersedes any previously released draft or final profile.

Toxicological profiles are revised and republished as necessary, but no less than once every three years. For information regarding the update status of previously released profiles, contact ATSDR at:

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FOREWORD

This toxicological profile is prepared in accordance with guidelines* developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). The original guidelines were published in the *Federal Register* on April 17, 1987. Each profile will be revised and republished as necessary.

The ATSDR toxicological profile succinctly characterizes the toxicologic and adverse health effects information for the hazardous substance described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a hazardous substance's toxicologic properties. Other pertinent literature is also presented, but is described in less detail than the key studies. The profile is not intended to be an exhaustive document; however, more comprehensive sources of specialty information are referenced.

The focus of the profiles is on health and toxicologic information; therefore, each toxicological profile begins with a public health statement that describes, in nontechnical language, a substance's relevant toxicological properties. Following the public health statement is information concerning levels of significant human exposure and, where known, significant health effects. The adequacy of information to determine a substance's health effects is described in a health effects summary. Data needs that are of significance to protection of public health are identified by ATSDR and EPA.

Each profile includes the following:

- (A) The examination, summary, and interpretation of available toxicologic information and epidemiologic evaluations on a hazardous substance to ascertain the levels of significant human exposure for the substance and the associated acute, subacute, and chronic health effects;
- (B) A determination of whether adequate information on the health effects of each substance is available or in the process of development to determine levels of exposure that present a significant risk to human health of acute, subacute, and chronic health effects; and
- (C) Where appropriate, identification of toxicologic testing needed to identify the types or levels of exposure that may present significant risk of adverse health effects in humans.

The principal audiences for the toxicological profiles are health professionals at the Federal, State, and local levels; interested private sector organizations and groups; and members of the public.

This profile reflects ATSDR's assessment of all relevant toxicologic testing and information that has been peer-reviewed. Staff of the Centers for Disease Control and Prevention and other Federal scientists have also reviewed the profile. In addition, this profile has been peer-reviewed by a nongovernmental panel and was made available for public review. Final responsibility for the contents and views expressed in this toxicological profile resides with ATSDR.



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*Legislative Background

The toxicological profiles are developed in response to the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Public Law 99-499) which amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund). This public law directed ATSDR to prepare toxicological profiles for hazardous substances most commonly found at facilities on the CERCLA National Priorities List and that pose the most significant potential threat to human health, as determined by ATSDR and the EPA. The availability of the revised priority list of 275 hazardous substances was announced in the *Federal Register* on November 17, 1997 (62 FR 61332). For prior versions of the list of substances, see *Federal Register* notices dated April 29, 1996 (61 FR 18744); April 17, 1987 (52 FR 12866); October 20, 1988 (53 FR 41280); October 26, 1989 (54 FR 43619); October 17, 1990 (55 FR 42067); October 17, 1991 (56 FR 52166); October 28, 1992 (57 FR 48801); and February 28, 1994 (59 FR 9486). Section 104(i)(3) of CERCLA, as amended, directs the Administrator of ATSDR to prepare a toxicological profile for each substance on the list.

QUICK REFERENCE FOR HEALTH CARE PROVIDERS

Toxicological Profiles are a unique compilation of toxicological information on a given hazardous substance. Each profile reflects a comprehensive and extensive evaluation, summary, and interpretation of available toxicologic and epidemiologic information on a substance. Health care providers treating patients potentially exposed to hazardous substances will find the following information helpful for fast answers to often-asked questions.

Primary Chapters/Sections of Interest

Chapter 1: Public Health Statement: The Public Health Statement can be a useful tool for educating patients about possible exposure to a hazardous substance. It explains a substance's relevant toxicologic properties in a nontechnical, question-and-answer format, and it includes a review of the general health effects observed following exposure.

Chapter 3: Summary of Health Effects of Ionizing Radiation: Specific health effects of ionizing radiation are reported by *route of exposure*, by *type of health effect* (death, systemic, immunologic, reproductive), and by *length of exposure* (acute, intermediate, and chronic). In addition, both human and animal studies are reported in this section.

NOTE: Not all health effects reported in this section are necessarily observed in the clinical setting. Please refer to the Public Health Statement to identify general health effects observed following exposure.

Pediatrics: Three new sections have been added to this Toxicological Profile to address child health issues:

- Section 1.6** **How Can Ionizing Radiation Affect Children?**
- Section 1.7** **How Can Families Reduce the Risk of Exposure to Ionizing Radiation?**
- Section 3.2.2** **Children's Susceptibility**

Other Sections of Interest:

- Section 3.2.1.4** **Teratogenic/Embryotoxic Effects**
 - Section 3.2.3** **Carcinogenic Effects from Ionizing Radiation Exposure**
-

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The following additional material can be ordered through the ATSDR Information Center:

Case Studies in Environmental Medicine: Taking an Exposure History—The importance of taking an exposure history and how to conduct one are described, and an example of a thorough exposure history is provided. Other case studies of interest include *Reproductive and Developmental Hazards*; *Skin Lesions and Environmental Exposures*; *Cholinesterase-Inhibiting Pesticide Toxicity*; and numerous chemical-specific case studies.

Managing Hazardous Materials Incidents is a three-volume set of recommendations for on-scene (prehospital) and hospital medical management of patients exposed during a hazardous materials incident. Volumes I and II are planning guides to assist first responders and hospital emergency department personnel in planning for incidents that involve hazardous materials. Volume III—*Medical Management Guidelines for Acute Chemical Exposures*—is a guide for health care professionals treating patients exposed to hazardous materials.

Fact Sheets (ToxFAQs) provide answers to frequently asked questions about toxic substances.

Other Agencies and Organizations

The National Center for Environmental Health (NCEH) focuses on preventing or controlling disease, injury, and disability related to the interactions between people and their environment outside the workplace. *Contact:* NCEH, Mailstop F-29, 4770 Buford Highway, NE, Atlanta, GA 30341-3724 • Phone: 770-488-7000 • FAX: 770-488-7015.

The National Institute for Occupational Safety and Health (NIOSH) conducts research on occupational diseases and injuries, responds to requests for assistance by investigating problems of health and safety in the workplace, recommends standards to the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA), and trains professionals in occupational safety and health. *Contact:* NIOSH, 200 Independence Avenue, SW, Washington, DC 20201 • Phone: 800-356-4674 or NIOSH Technical Information Branch, Robert A. Taft Laboratory, Mailstop C-19, 4676 Columbia Parkway, Cincinnati, OH 45226-1998 • Phone: 800-35-NIOSH.

The National Institute of Environmental Health Sciences (NIEHS) is the principal federal agency for biomedical research on the effects of chemical, physical, and biologic environmental agents on human health and well-being. *Contact:* NIEHS, PO Box 12233, 104 T.W. Alexander Drive, Research Triangle Park, NC 27709 • Phone: 919-541-3212.

Referrals

The Association of Occupational and Environmental Clinics (AOEC) has developed a network of clinics in the United States to provide expertise in occupational and environmental issues. *Contact:* AOEC, 1010 Vermont Avenue, NW, #513, Washington, DC 20005 • Phone: 202-347-4976 • FAX: 202-347-4950 • e-mail: aoec@dgs.dgsys.com • AOEC Clinic Director: <http://occ-env-med.mc.duke.edu/oem/aoec.htm>

The American College of Occupational and Environmental Medicine (ACOEM) is an association of physicians and other health care providers specializing in the field of occupational and environmental medicine. *Contact:* ACOEM, 55 West Seegers Road, Arlington Heights, IL 60005 • Phone: 847-228-6850 • FAX: 847-228-1856.

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THE PROFILE HAS UNDERGONE THE FOLLOWING ATSDR INTERNAL REVIEWS:

1. Health Effects Review. The Health Effects Review Committee examines the health effects chapter of each profile for consistency and accuracy in interpreting health effects and classifying end points.
2. Minimal Risk Level Review. The Minimal Risk Level Workgroup considers issues relevant to substance-specific minimal risk levels (MRLs), reviews the health effects database of each profile, and makes recommendations for derivation of MRLs.

PEER REVIEW

A peer review panel was assembled for ionizing radiation. The panel consisted of the following members:

1. Herman Cember, Ph.D., CHP, Consultant, Lafayette, IN;
2. Richard Toohey, Ph.D., CHP, Consultant, Oak Ridge, TN;
3. Kenneth Mossman, Ph.D., Professor, Scottsdale, AZ;
4. John Poston, Ph.D., Professor, College Station, TX; and
5. Darrell Fisher, Ph.D., Senior Scientist, Richland, WA.

These experts collectively have knowledge of ionizing radiation's physical and chemical properties, toxicokinetics, key health end points, mechanisms of action, human and animal exposure, and quantification of risk to humans. All reviewers were selected in conformity with the conditions for peer review specified in Section 104(i)(13) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

Scientists from the Agency for Toxic Substances and Disease Registry (ATSDR) have reviewed the peer reviewers' comments and determined which comments will be included in the profile. A listing of the peer reviewers' comments not incorporated in the profile, with a brief explanation of the rationale for their exclusion, exists as part of the administrative record for this compound. A list of databases reviewed and a list of unpublished documents cited are also included in the administrative record.

The citation of the peer review panel should not be understood to imply its approval of the profile's final content. The responsibility for the content of this profile lies with the ATSDR.

CONTENTS

FOREWORD	v
QUICK REFERENCE FOR HEALTH CARE PROVIDERS	vii
CONTRIBUTORS	ix
PEER REVIEW	xi
LIST OF FIGURES	xvii
LIST OF TABLES	xix
1. PUBLIC HEALTH STATEMENT	1
1.1 WHAT IS IONIZING RADIATION?	1
1.2 HOW DOES RADIOACTIVE MATERIAL ENTER AND SPREAD THROUGH THE ENVIRONMENT?	7
1.3 HOW MIGHT I BE EXPOSED TO IONIZING RADIATION?	9
1.4 HOW CAN IONIZING RADIATION ENTER AND LEAVE MY BODY?	13
1.5 HOW CAN IONIZING RADIATION AFFECT MY HEALTH?	15
1.6 HOW CAN IONIZING RADIATION AFFECT CHILDREN?	16
1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO IONIZING RADIATION?	17
1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO IONIZING RADIATION?	18
1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?	19
1.10 WHERE CAN I GET MORE INFORMATION?	21
2. PRINCIPLES OF IONIZING RADIATION	23
2.1 INTRODUCTION	23
2.2 HISTORY, BACKGROUND INFORMATION, AND SCIENTIFIC PRINCIPLES OF IONIZING RADIATION	25
2.2.1 Historical Perspective on Ionizing Radiation	25
2.2.2 Basic Information on Ionizing Radiation	31
2.2.3 Principles of Radioactive Transformation	34
2.2.4 Interaction of Radiation with Matter	37
2.2.5 Characteristics of Emitted Radiation	39
2.2.5.1 Alpha Radiation	39
2.2.5.2 Beta Radiation	40
2.2.5.3 Gamma Radiation	41
2.2.6 Estimation of Energy Deposition in Human Tissues	41
2.3 FUNDAMENTALS OF IONIZING RADIATION DOSIMETRY	43
2.3.1 Dose Units	43
2.3.2 Dosimetry Models	44
2.3.3 Terms Used in Radiation Safety Practice and Regulation	46
2.4 BIOLOGICAL EFFECTS OF RADIATION	51
2.4.1 Radiation Effects at the Cellular Level	53

2.4.2	Radiation Effects at the Organ Level	55
2.4.3	Acute and Delayed Somatic Effects	55
2.4.3.1	Acute Effects	55
2.4.3.2	Delayed Effects	56
2.4.4	Genetic Effects	59
2.4.5	Teratogenic Effects	59
2.4.6	Internal Exposure to Ionizing Radiation	60
2.4.6.1	Inhalation	60
2.4.6.2	Ingestion	62
2.4.6.3	Dermal	62
2.4.7	External Exposure to Ionizing Radiation	63
2.5	MEASURING INTERNAL AND EXTERNAL SOURCES OF IONIZING RADIATION ..	63
2.5.1	Internal Radiation Measurements	64
2.5.2	External Radiation Measurements	70
2.5.3	Field Radiation and Contamination Surveys	72
2.5.3.1	Field Measurements of Ionizing Radiation	72
2.5.3.2	Laboratory Analysis of Environmental Samples	77
2.6	CONCLUSIONS	79
2.7	OTHER SOURCES OF INFORMATION	79
3.	SUMMARY OF HEALTH EFFECTS OF IONIZING RADIATION	81
3.1	INTRODUCTION	81
3.2	HEALTH EFFECTS FROM EXPOSURE TO IONIZING RADIATION	83
3.2.1	Acute (Immediate and Non-Carcinogenic) Effects from Ionizing Radiation Exposure	89
3.2.1.1	Gastrointestinal Effects	101
3.2.1.2	Hematological and Lymphoreticular Effects	104
3.2.1.3	Reproductive Effects	109
3.2.1.4	Teratogenic/Embryotoxic Effects	112
3.2.1.5	Central Nervous System (CNS) Effects	121
3.2.1.6	Respiratory and Cardiovascular Effects	122
3.2.1.7	Ocular Effects	130
3.2.1.8	Dermal Effects	132
3.2.1.9	Genotoxic Effects	137
3.2.2	Children's Susceptibility	152
3.2.3	Carcinogenic Effects from Ionizing Radiation Exposure	155
3.2.3.1	Introduction	155
3.2.3.2	Nuclear Detonations of 1945 in Hiroshima and Nagasaki, Japan	165
3.2.3.3	Human Exposures to ²²⁶ Ra and ²²⁸ Ra: The Radium Dial Painters	170
3.2.3.4	Human Exposures to ²²⁴ Ra via Injection	173
3.2.3.5	Other Human Cancer Studies	176
3.2.3.6	Laboratory Animal Reports	180
3.3	IDENTIFICATION OF DATA NEEDS	191
3.4	CONCLUSIONS	194

4. RADIATION ACCIDENTS	195
4.1 PALOMARES, SPAIN	195
4.2 GOIANIA, BRAZIL	197
4.3 THULE, GREENLAND	199
4.4 ROCKY FLATS, COLORADO	200
4.5 THREE MILE ISLAND, PENNSYLVANIA	202
4.6 CHERNOBYL, UKRAINE	204
4.7 KYSHTYM	208
4.8 WINDSCALE, U.K.	208
4.9 TOMSK	209
4.10 LOST INDUSTRIAL OR MEDICAL SOURCES	210
4.11 IDENTIFICATION OF DATA NEEDS	211
4.12 CONCLUSIONS	211
4.13 OTHER SOURCES OF INFORMATION	212
5. MECHANISMS OF BIOLOGICAL EFFECTS	213
5.1 INTRODUCTION	213
5.2 EVIDENCE OF THE EFFECTS ON DNA	215
5.3 INTERACTIONS OF IONIZING RADIATION WITH DNA	217
5.4 EFFECTS ON OTHER CELLULAR MACROMOLECULES	222
5.5 MECHANISMS OF CARCINOGENESIS	224
5.6 IDENTIFICATION OF DATA NEEDS	228
5.7 SUMMARY	228
6. SOURCES OF POPULATION EXPOSURE TO IONIZING RADIATION	231
6.1 OVERVIEW	231
6.2 COSMIC RADIATION EXPOSURE	232
6.3 TERRESTRIAL RADIATION EXPOSURE	234
6.3.1 Coal Production	235
6.3.2 Crude Oil and Natural Gas Production	236
6.3.3 Phosphate Rock Products	236
6.3.4 Sand	237
6.3.5 Hot Springs and Caves	238
6.4 NATURAL INTERNAL EXPOSURE	238
6.4.1 Inhalation	239
6.4.2 Ingestion	241
6.4.3 Dermal	242
6.5 X RAY AND NUCLEAR MEDICINE EXPOSURES	242
6.6 EXPOSURE FROM CONSUMER PRODUCTS	253
6.7 EXPOSURE FROM OTHER SOURCES	254
6.7.1 Exposure from the Nuclear Fuel Cycle	255
6.7.2 Japanese Atomic Bomb Exposure	259
6.7.3 Exposure from Nuclear Weapons Testing	262
6.7.3.1 Atmospheric Testing	266
6.7.3.2 Underground Testing	269
6.7.4 Occupational Exposure	270
6.8 ADEQUACY OF THE DATABASE	272
6.9 CONCLUSIONS	272
7. REGULATIONS	273

8. LEVELS OF SIGNIFICANT EXPOSURE TO RADIATION AND RADIOACTIVE MATERIAL	293
9. GLOSSARY	335
10. REFERENCES	351

APPENDICES

A. ATSDR MINIMAL RISK LEVELS AND WORKSHEETS	A-1
B. USER'S GUIDE	B-1
C. ACRONYMS, ABBREVIATIONS, AND SYMBOLS	C-1
D. INDEX	D-1

LIST OF FIGURES

1-1	Sources of Radiation Exposure to the Average U.S. Citizen	9
1-2	Detailed Breakdown of Radiation Exposures	9
1-3	EPA Map of Indoor Radon Levels in the United States	10
2-1	Transformation of 100 μCi of ^{32}P	36
2-2	Whole Body Counter	65
2-3	Low Energy Germanium (LEGe) Based Lung Counter	66
2-4	Components of a Scintillation Detector	68
2-5	Liquid Scintillation Counting (LSC) System	68
2-6	Geiger-Mueller Counter with an Energy-compensated Gamma Probe	72
2-7	Geiger-Mueller Counter with a Beta/Gamma Pancake-type Detection Probe	72
2-8	Large Area Alpha Radiation Detector with Digital-Analog Survey Meter	73
2-9	Floor Monitor System with Multidetector Array	73
2-10	<i>In-Situ</i> Gamma Ray Spectrometer	74
4-1	Schematic of Three Mile Island Unit 2 Nuclear Reactor	202
4-2	Aerial View of the Damaged Chernobyl Reactor Facility	204
4-3	Hot Spots of Radioactivity in the Regions Surrounding the Chernobyl Facility	205
4-4	A View of the Sarcophagus Covering the Chernobyl Reactor Facility	207
6-1	Radiation Exposure to the Average U.S. Citizen	231
6-2	Schematic of the Nuclear Fuel Cycle	255
6-3	Replicas of the “Little Boy” and “Fat Man” Bombs Dropped on Hiroshima and Nagasaki	259

LIST OF TABLES

1-1	Approximate Doses of Ionizing Radiation to Individuals	12
2-1	Characteristics of Nuclear Radiations	34
2-2	Effective Half-Lives of Selected Radionuclides in Major Adult Body Organs	40
2-3	Tissue Weighting Factors Used by the USNRC and ICRP to Calculate Effective Dose	48
2-4	Quality Factors Used in USNRC Radiation Safety Regulations	49
2-5	Common and SI Units for Radiation Quantities	51
2-6	Relative Radiosensitivity of Mammalian Cells	54
2-7	Common Analytical Methods for Measuring Radioactive Material Inside and Radiation Outside the Body	64
2-8	Some Internet Sites Related to Ionizing Radiation	80
3-1	ATSDR Priority Listing of Radionuclides Present at Department of Energy NPL Sites	82
3-2	Summary of Some Studies of Humans Exposed to Radiation and Radionuclides	91
3-3	Summary of the Dose Response Effects of Ionizing Radiation in Humans	99
3-4	Genotoxicity of Ionizing Radiation <i>In Vivo</i>	139
3-5	Genotoxicity of Ionizing Radiation <i>In Vitro</i>	142
3-6	Estimated Genetic Effects of 1 Rem (0.01 Sv) of Radiation per Generation	147
3-7	Estimated Lower 95% Confidence Limits of Doubling Dose (in rem) from Chronic Radiation Exposure for Malformations, Stillbirths, Neonatal Deaths, and All Untoward Pregnancy Outcomes (Based on the Hiroshima and Nagasaki Atomic Bombing Data)	150
3-8	Summary of Risks of Developing Cancer After Exposure to Ionizing Radiation	158
3-9	Summary of Radiation Dose Response for Cancer Mortality by Site	162
3-10	Distribution of Osteosarcomas in a Population of Female Dial Painters Exposed to ²²⁶ Ra and ²²⁸ Ra	172
3-11	Distribution of Head Carcinomas in a Population of Female Dial Painters Exposed to ²²⁶ Ra ...	173
3-12	Alpha Doses from Injected ²²⁴ Ra (in rad) by Age Group, Number, and Percentage of Subpopulation Developing Osteosarcoma	175
3-13	Age Distribution, Alpha Dose (in rad), and % Incidence of Osteosarcomas Induced	

by ^{224}Ra Injection	176
4-1 Internet Sites Pertaining to Population Exposures to Ionizing Radiation	212
5-1 Relative Sensitivities of Major Organs and Tissues to the Effects of Ionizing Radiation	216
5-2 Some Effects of Ionizing Radiation on Molecules in Animal Tissues	223
5-3 Some Models That Describe the Induction of Cancer in Animals	225
6-1 Common Terms and Abbreviations	233
6-2 Scientific Units	233
6-3 Radioactive Properties of ^{222}Rn and its Daughter Products	240
6-4 Some Radiopharmaceuticals Used in Medicine	245
7-1 Regulations and Guidelines Applicable to Ionizing Radiation	277
7-2 Regulations and Guidelines Applicable to ^{226}Ra	288
7-3 Regulations and Guidelines Applicable to Strontium Isotopes	291
7-4 FDA Derived Intervention Levels (Bq/kg)	292
8-1 Levels of Significant Exposure to Radiation and Radioactive Material—Inhalation	297
8-2 Levels of Significant Exposure to Radiation and Radioactive Material—Oral	314
8-3 Levels of Significant Exposure to Radiation and Radioactive Material—Dermal	316
8-4 Levels of Significant Exposure to Radiation and Radioactive Material—External	317