EPA United States Environmental Protection Agency

Radiation Protection Program

An Update from the US EPA Radiation Protection Program

Armin Ansari and Sara DeCair
Center for Science and Technology
Radiation Protection Division

43rd Meeting of the Nuclear and Radiation Studies Board, NASEM
November 8, 2023

The Formation of EPA

- Reorganization Plan No. 3 (Dec. 2, 1970)
  - Reorganization of Executive Branch agencies proposed by President Nixon and approved by Congress
  - Established the Environmental Protection Agency
  - Reflected growing environmental concerns in the U.S. (e.g., Love Canal)
- Certain functions transferred to EPA from:
  - Dept. of Health, Education and Welfare
  - Dept. of Agriculture
  - Dept. of Interior
  - The Atomic Energy Commission
  - The Federal Radiation Council

Radiological Protection

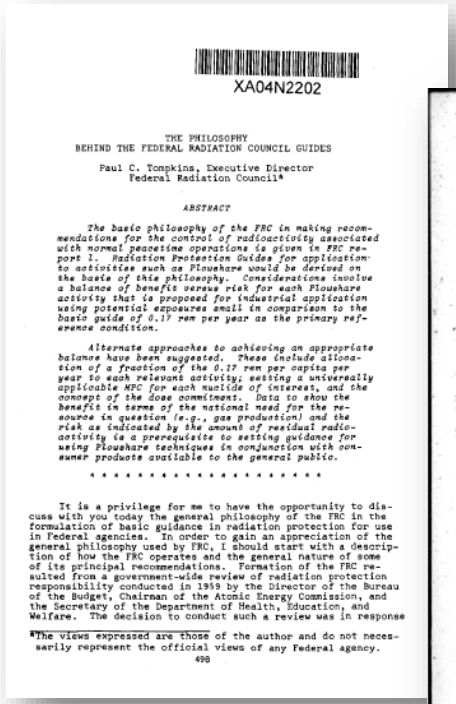
- EPA has the responsibility and the authorities to:
  - Establish generally applicable environmental standards for the protection of the general environment from radioactive material
  - Collect, analysis, and interpret data on environmental radiation levels
  - Develop Protective Action Guides
  - Conduct environmental impact analysis and evaluation
  - Issue Federal Guidance
- Atomic Energy Act (Section 274.H) instructed the Federal Radiation Council (now EPA) to consult:
  - The National Academy of Sciences (NAS)
  - The National Council on Radiation Protection and Measurements (NCRP)
  - Qualified scientists and experts in the fields of biology, medicine, and health physics

…advise the President with respect to radiation matters directly or indirectly affecting health, including guidance for all Federal agencies in the formulation of radiation standards and in the establishment and execution of programs of cooperation with States.

42 U.S. Code § 2021

The Early Years, 1960-69
Federal Radiation Council

Dr. Paul C Tompkins
Executive Director, FRC



XA04N2202

THE PHILOSOPHY
BEHIND THE FEDERAL RADIATION COUNCIL GUIDES

Paul C. Tompkins, Executive Director
Federal Radiation Council*

ABSTRACT

The basic philosophy of the FRC in making recommendations for the control of radioactivity associated with normal peacetime operations is given in FRC report 1. Radiation Protection Guides for application to activities such as Plowshare would be derived on the basis of this philosophy. Considerations involve a balance of benefit versus risk for each Plowshare activity that is proposed for industrial application using potential exposures small in comparison to the basic guide of 0.17 rem per year as the primary reference condition.

Alternate approaches to achieving an appropriate balance have been suggested. These include allocation of a fraction of the 0.17 rem per capita per year to each relevant activity; setting a universally applicable MPC for each nuclide of interest, and the concept of the dose commitment. Data to show the benefit in terms of the national need for the resource in question (e.g., gas production) and the risk as indicated by the amount of residual radioactivity is a prerequisite to setting guidance for using Plowshare techniques in conjunction with consumer products available to the general public.

* * * * * * * * * * * * * * * * * * *

It is a privilege for me to have the opportunity to discuss with you today the general philosophy of the FRC in the formulation of basic guidance in radiation protection for use in Federal agencies. In order to gain an appreciation of the general philosophy used by FRC, I should start with a description of how the FRC operates and the general nature of some of its principal recommendations. Formation of the FRC resulted from a government-wide review of radiation protection responsibility conducted in 1959 by the Director of the Bureau of the Budget, Chairman of the Atomic Energy Commission, and the Secretary of the Department of Health, Education, and Welfare. The decision to conduct such a review was in response

*The views expressed are those of the author and do not necessarily represent the official views of any Federal agency.

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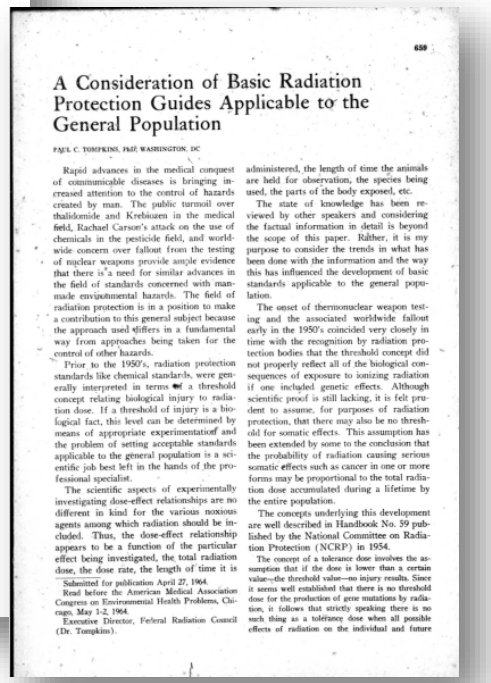

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A Consideration of Basic Radiation Protection Guides Applicable to the General Population

PAUL C. TOMPKINS, PhD, WASHINGTON, DC

Rapid advances in the medical conquest of communicable diseases is bringing increased attention to the control of hazards created by man. The public turmoil over thalidomide and Krebiozen in the medical field, Rachael Carson's attack on the use of chemicals in the pesticide field, and world-wide concern over fallout from the testing of nuclear weapons provide ample evidence that there is a need for similar advances in the field of standards concerned with man-made environmental hazards. The field of radiation protection is in a position to make a contribution to this general subject because the approach used differs in a fundamental way from approaches being taken for the control of other hazards.

Prior to the 1950's, radiation protection standards like chemical standards, were generally interpreted in terms of a threshold concept relating biological injury to radiation dose. If a threshold of injury is a biological fact, this level can be determined by means of appropriate experimentation and the problem of setting acceptable standards applicable to the general population is a scientific job best left in the hands of the professional specialist.

The scientific aspects of experimentally investigating dose-effect relationships are no different in kind for the various noxious agents among which radiation should be included. Thus, the dose-effect relationship appears to be a function of the particular effect being investigated, the total radiation dose, the dose rate, the length of time it is administered, the length of time the animals are held for observation, the species being used, the parts of the body exposed, etc.

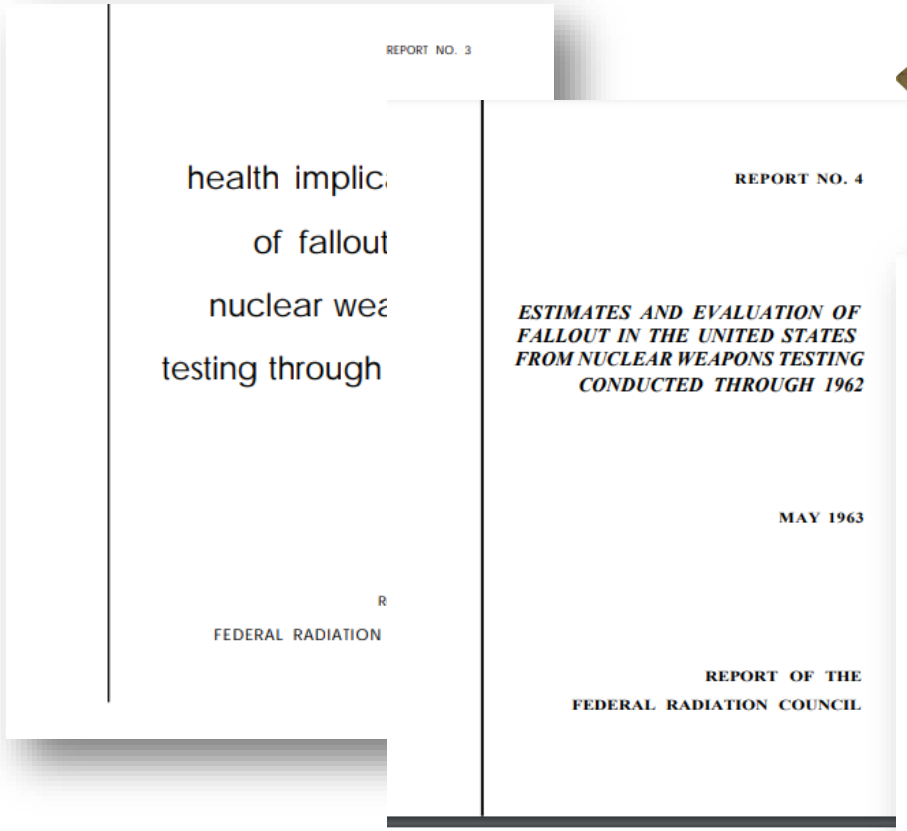
The state of knowledge has been reviewed by other speakers and considering the factual information in detail is beyond the scope of this paper. Rather, it is my purpose to consider the trends in what has been done with the information and the way this has influenced the development of basic standards applicable to the general population.

The onset of thermonuclear weapon testing and the associated worldwide fallout early in the 1950's coincided very closely in time with the recognition by radiation protection bodies that the threshold concept did not properly reflect all of the biological consequences of exposure to ionizing radiation if one included genetic effects. Although scientific proof is still lacking, it is felt prudent to assume, for purposes of radiation protection, that there may also be no threshold for somatic effects. This assumption has been extended by some to the conclusion that the probability of radiation causing serious somatic effects such as cancer in one or more forms may be proportional to the total radiation dose accumulated during a lifetime by the entire population.

The concepts underlying this development are well described in Handbook No. 59 published by the National Committee on Radiation Protection (NCRP) in 1954.

The concept of a tolerance dose involves the assumption that if the dose is lower than a certain value—the threshold value—no injury results. Since it seems well established that there is no threshold dose for the production of gene mutations by radiation, it follows that strictly speaking there is no such thing as a tolerance dose when all possible effects of radiation on the individual and future

Submitted for publication April 27, 1964.
Read before the American Medical Association Congress on Environmental Health Problems, Chicago, May 1-2, 1964.
Executive Director, Federal Radiation Council (Dr. Tompkins).



REPORT NO. 3

health implic
of fallout
nuclear wea
testing through

FEDERAL RADIATION

REPORT NO. 4

ESTIMATES AND EVALUATION OF FALLOUT IN THE UNITED STATES FROM NUCLEAR WEAPONS TESTING CONDUCTED THROUGH 1962

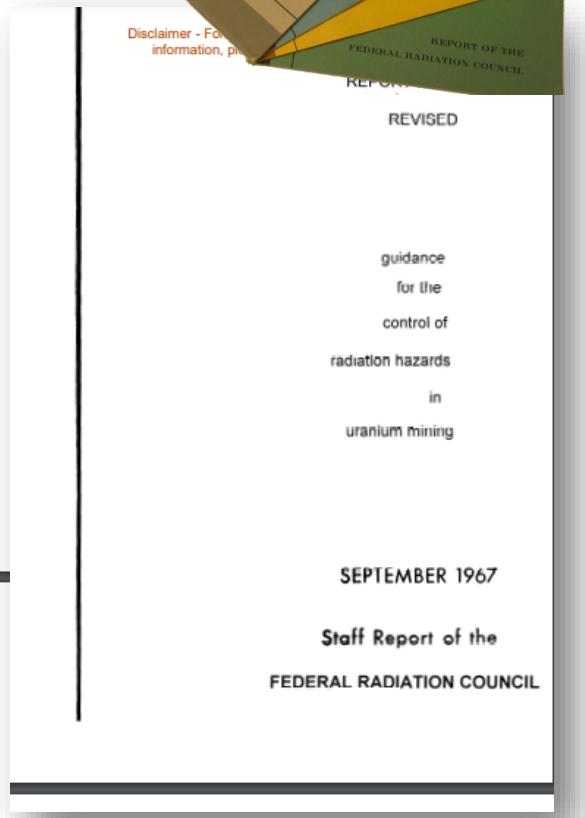
MAY 1963

REPORT OF THE
FEDERAL RADIATION COUNCIL

background material
for the development of
radiation protection
standards

Staff Report of the
FEDERAL RADIATION COUNCIL

REPORT OF THE
FEDERAL RADIATION COUNCIL



Disclaimer - Fo
information, pl

REVISED

guidance
for the
control of
radiation hazards
in
uranium mining

SEPTEMBER 1967

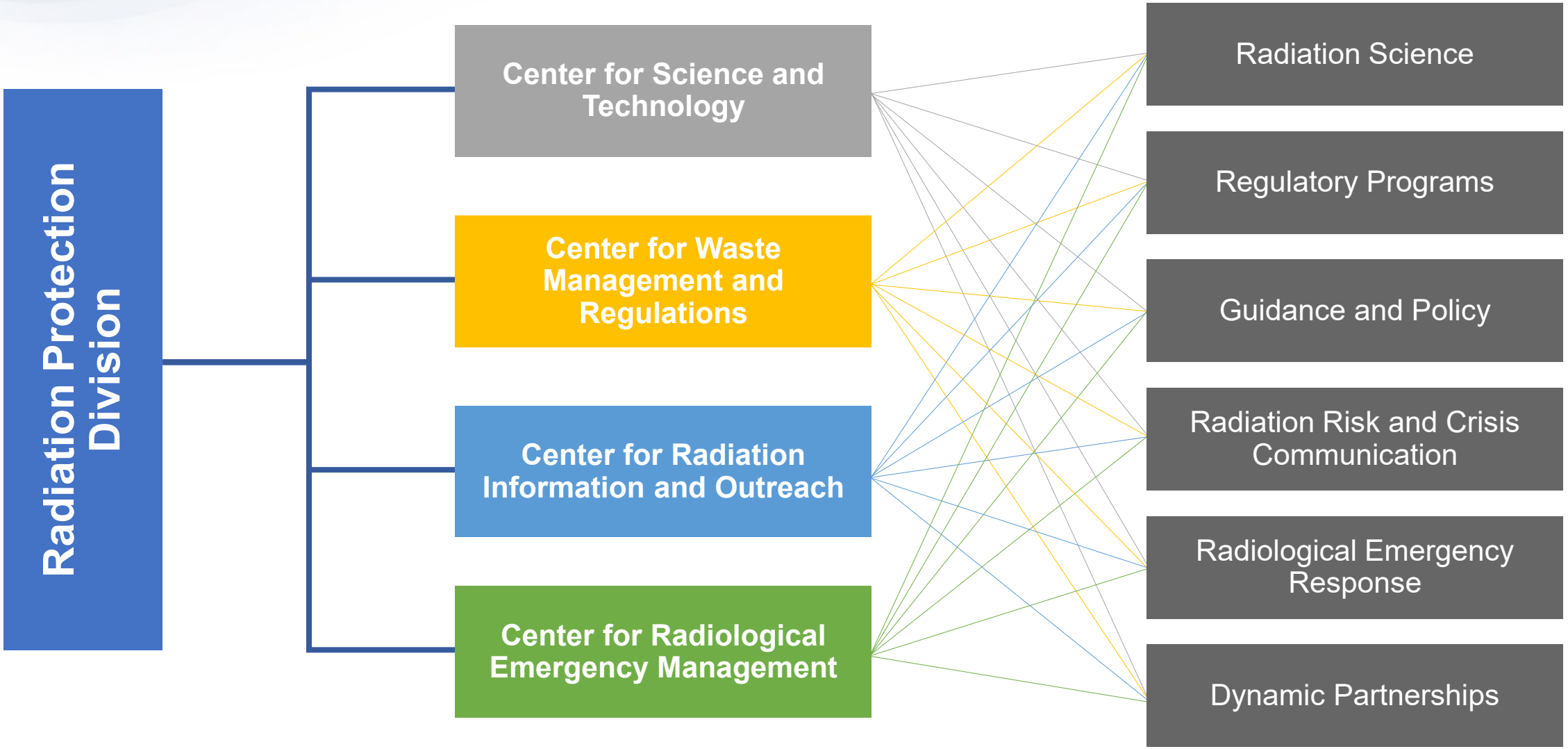
Staff Report of the
FEDERAL RADIATION COUNCIL

https://www.epa.gov/radiation/federal-guidance-radiation-protection

Radiation Protection Program Today

- Comprised of headquartered dedicated division, field and laboratory assets, and robust regional program
  - National Analytical Radiation Environmental Laboratory (Montgomery, AL)
  - National Center for Radiation Field Operations (Las Vegas, NV)
  - Radiation Protection Division (Washington, DC)
  - Regional counterparts
- Primary Authorizing Statutes: Atomic Energy Act; WIPP Land Withdrawal Act; Clean Air Act; Nuclear Waste Policy Act; Energy Policy Act of 1992; 1970 Reorganization Plan No. 3
- Specialized regulatory, response, scientific, and communications program that provides radiological risk assessment across media

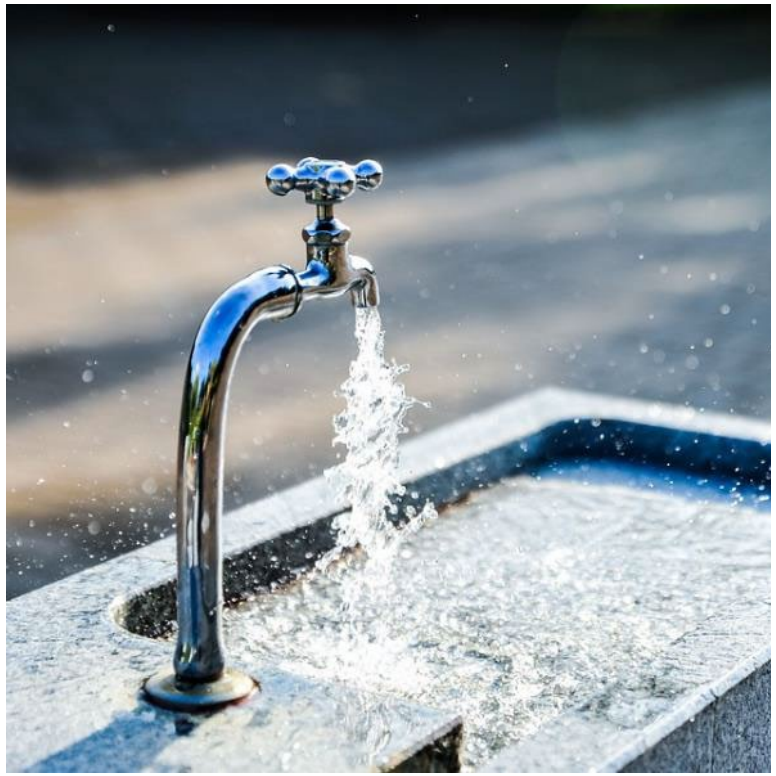
What We Do – Radiation Protection Division



Radiation Protection Authorities

Clean Air Act (CAA)
NESHAP
40 CFR Part 61

Safe Drinking Water Act
(SDWA)
40 CFR Part 141-143



Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Radiation Protection Authorities (cont.)

Uranium Mill Tailings Radiation Control Act (UMTRCA)
40 CFR Part 192

Nuclear Waste Policy Act (NWPA)
40 CFR Part 191

Waste Isolation Plant Land Withdrawal Act (WIPP LWA)
40 CFR Part 191 & 194

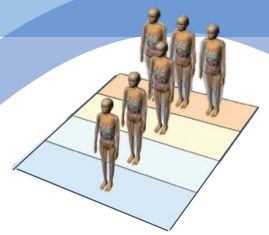
Nuclear Power Related Regulations of Potential Interest to the NRSB

- 40 CFR part 190 (1977) establishes off-site public dose limits from nuclear power operations used for electrical generation
- 40 CFR part 191 (1985 and 1993) generic SNF, HLW and TRU disposal regulation
- -40 CFR part 192 (1983 and 1992) on uranium and thorium mill tailings that is applicable to uranium in-situ recovery
- EPA has a radioactive NESHAP (National Emission Standard for Hazardous Air Pollutant) for phosphogypsum (PG) that allows alternative uses besides stacking PG

Science-Informed Policy Making

Current Research

- Chronic radiation exposure
- Low-dose research
- Dosimetry modeling
- Astronaut exposure
- Age- and sex-dependent radiation risks



Peer-Reviewed Publications

- Builds on robust research
- Rigorous peer review
- EPA authors contribute to scientific understanding

Synthesis of Science

- UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)
- National Academies Biological Effects of Ionizing Radiation (BEIR)

Standards and Recommendations

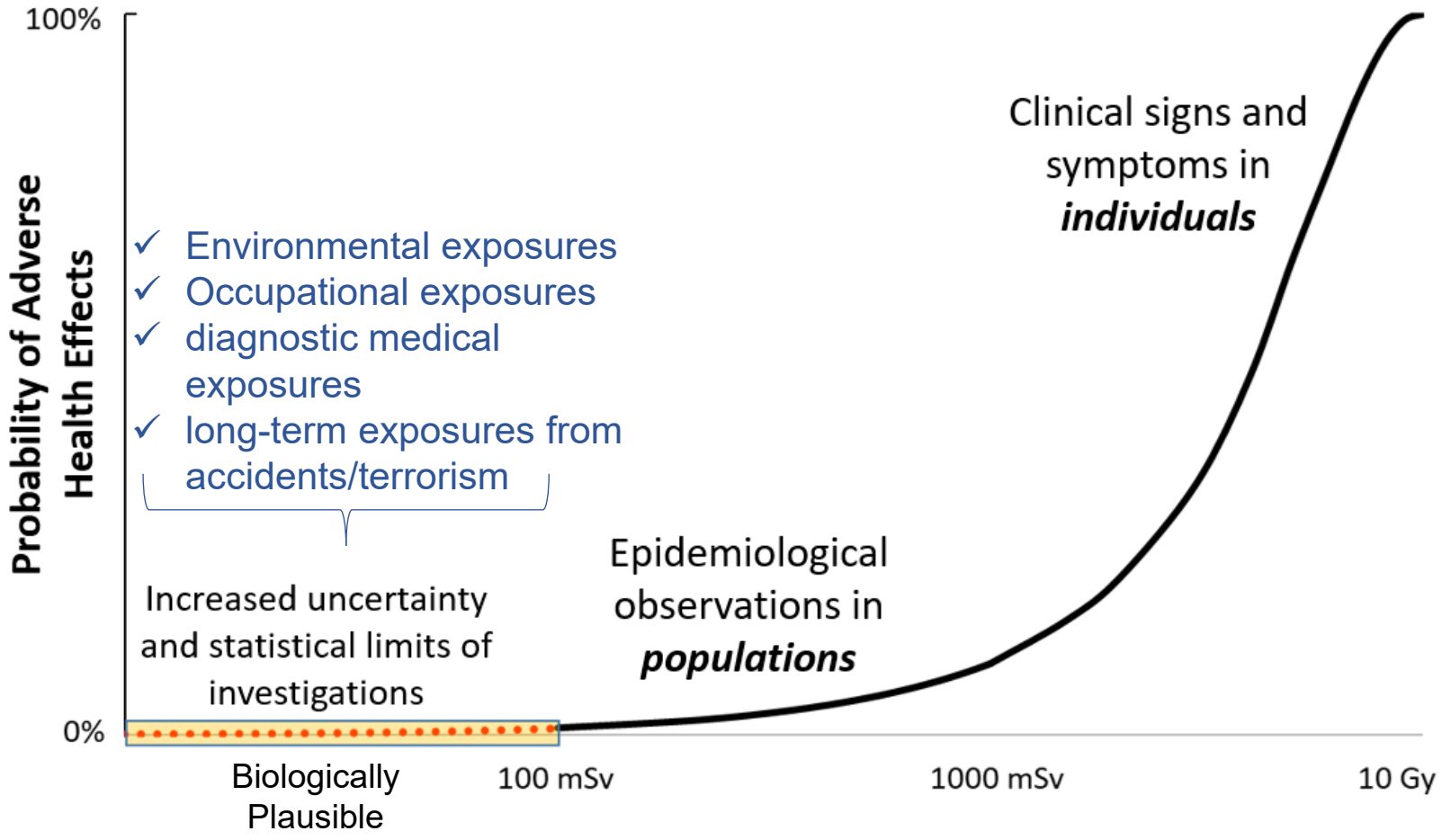
- International Commission for Radiation Protection (ICRP)
- National Council on Radiation Protection and Measurements (NCRP)

Guidance and Policy

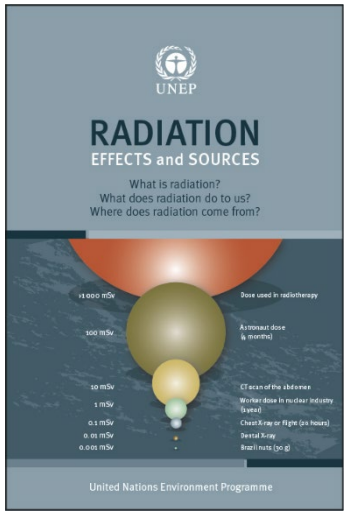
- Federal Guidance
- Presidential Guidance
- Inter- and intra-agency standard setting (e.g., ANSI standards, emergency response)

Radiation science underpins all steps leading to EPA policy and guidance

Range of Health Effects from Exposure to Ionizing Radiation



Adapted from UNEP Booklet
https://www.unscear.org



Radiation risk and crisis Communication

Multiple messages may be needed to suit different audiences and scenarios

Public Concern

- Answers to public questions
- Partner resources and trainings
- Stakeholder meetings and engagement
- Community involvement coordinator integration

Educational Outreach (RadTown)

- Factsheets
- Teacher resources
- Classroom materials

Regulatory and Technical Communication

- Reports and guidance
- Factsheets
- Outreach and communications plans
- Frequently asked questions

Provide clear, actionable information on an unknown, complex, and highly-feared topic

Robust scientific foundation
Message mapping
Risk Communication - SALT Framework

Blue-Sky Communication

- Website content/ maintenance
- Evergreen social media
- State and local networking
- Resource development

Crisis Communication

- Pre-scripted emergency response messages
- Translated materials
- Interagency coordination
- SLTT responder trainings
- EOC training and deployment

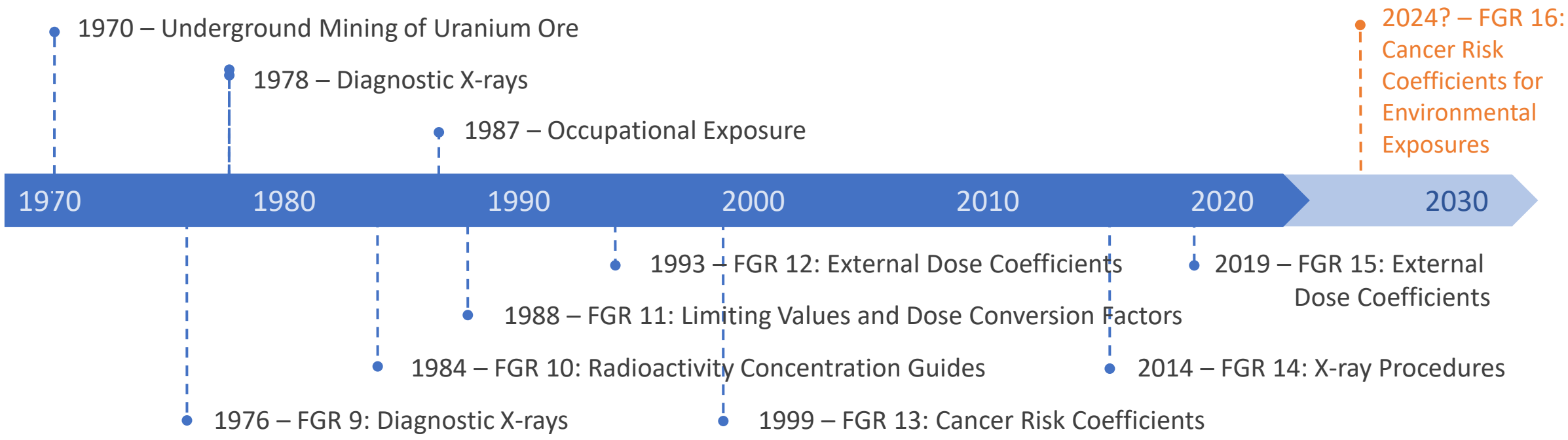
Future Research Needs

Need for clear, attainable objectives, and quality data

- Identifying and supporting future research needs
- Research objective from a public health perspective:
  - To inform policies and practices for radiation protection of the public (including sensitive populations), workers, and patients
- A process similar to the EPA's Data Quality Objectives (DQOs) could prove useful for cohesive and systematic planning and prioritization of future research.

Federal Guidance Reports

Presidential Federal Guidance (Policy Recommendations)

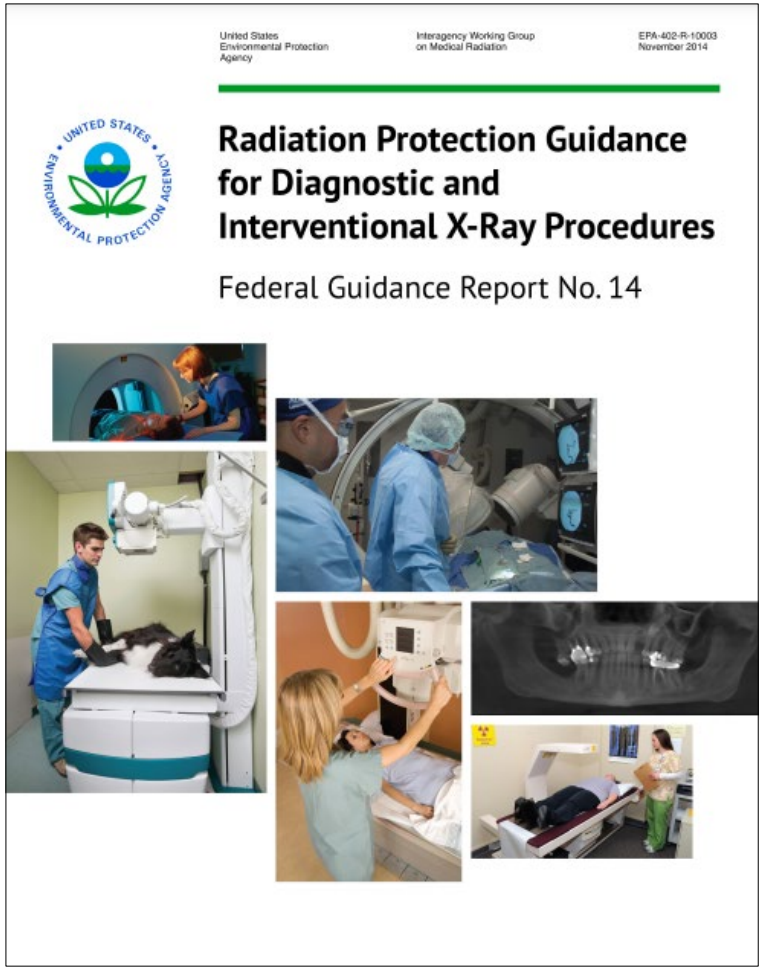


Federal Guidance Technical Reports

FGR 14

Radiation Protection Guidance for Diagnostic and Interventional X-Ray Procedures

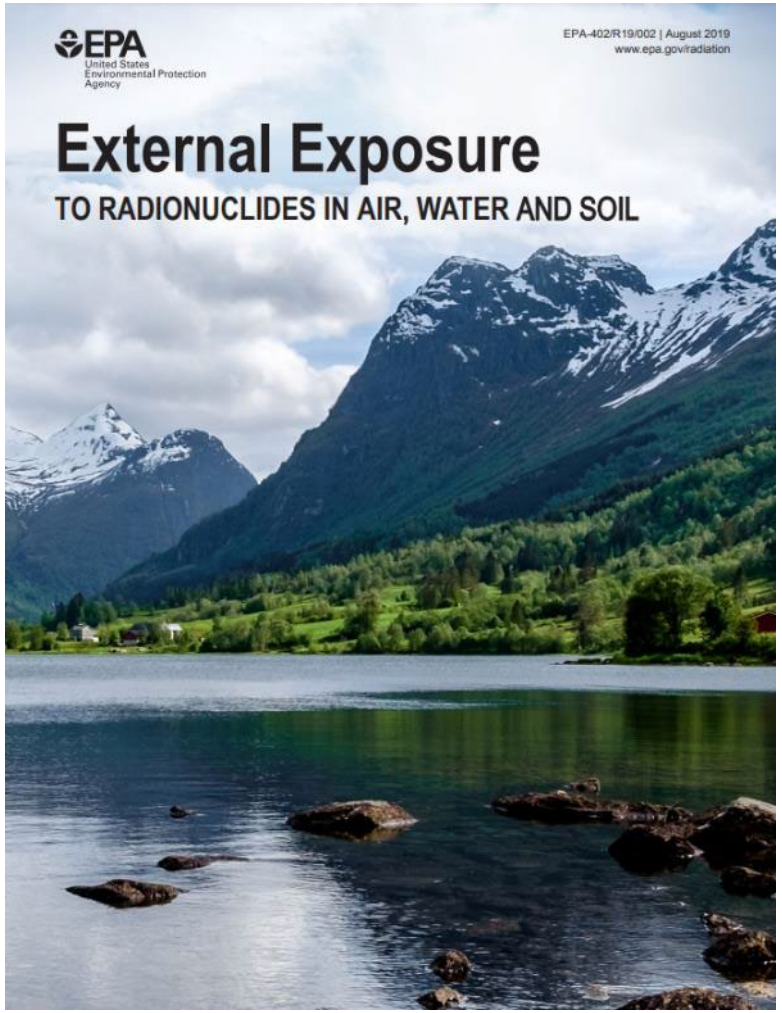
- Update to FGR 9, Radiation Protection Guidance For Diagnostic X Rays (1976)
- Recommends federal health care facilities use ICRP 103 diagnostic reference levels
- Collaborative effort, including EPA, HHS, VA, DOD, OSHA, States, and other subject matter experts.



FGR 15

External Exposure to Radionuclides in Air, Water and Soil

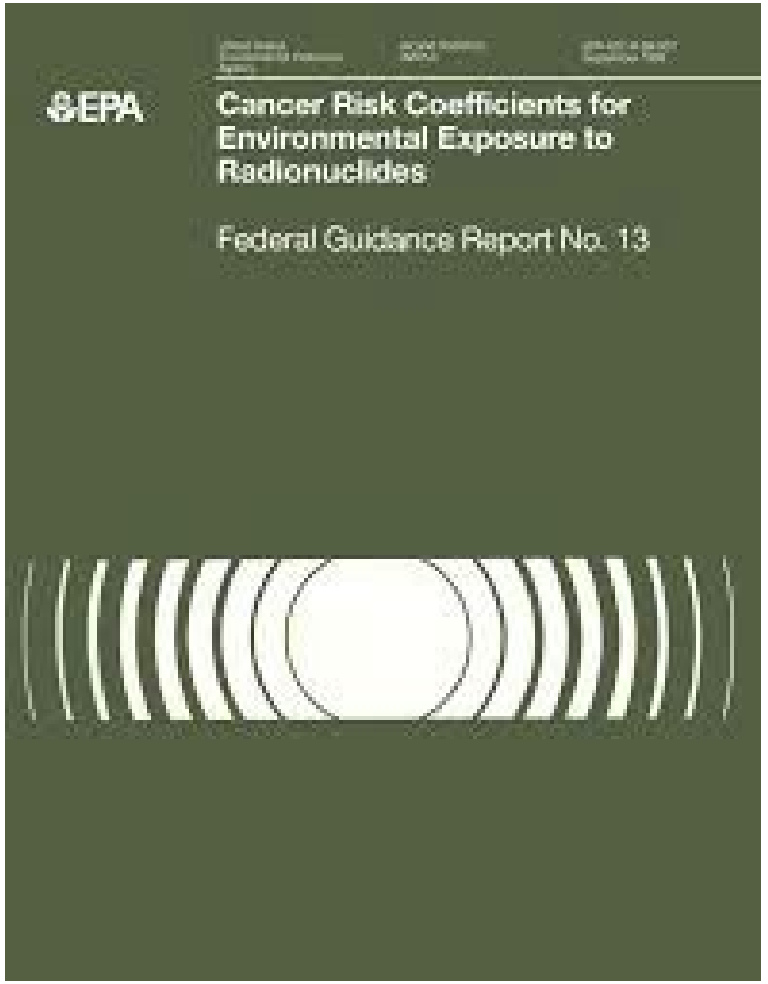
- Provides age-specific dose coefficients for 1,252 radionuclides based on external exposure to radionuclides distributed in air, water or soil.
- Published 2019, update to FGR 12 (1993)
- FGR 15 utilized updated ICRP Publications
  - Six different age groups
  - Updated tissue weighting factors
  - Updated radionuclide decay data



FGR 16 (in development)

Cancer Risk Coefficients for Environmental Exposure to Radionuclides

- Provides radionuclide-specific cancer risk coefficients for internal and external exposure to radionuclides.
- Utilizes ICRP models and data
- Update to FGR 13 (1999), with advances in:
  - Number of radionuclides
  - Nuclear decay data
  - Biokinetic models
  - Dosimetric models
  - U.S. population demographic data
  - Cancer risk models



ICRP Publications Supporting FGR 16

Biokinetic Data

- ICRP Pub. 66
- ICRP Pub. 100
- ICRP Pub. 130
- ICRP Pub. 134
- ICRP Pub. 137
- ICRP Pub. 141

Nuclear Decay Data

ICRP Pub. 107

SAF Data

- ICRP Pub. 133
- German and UF Phantoms
- Stylized models

Usage Data

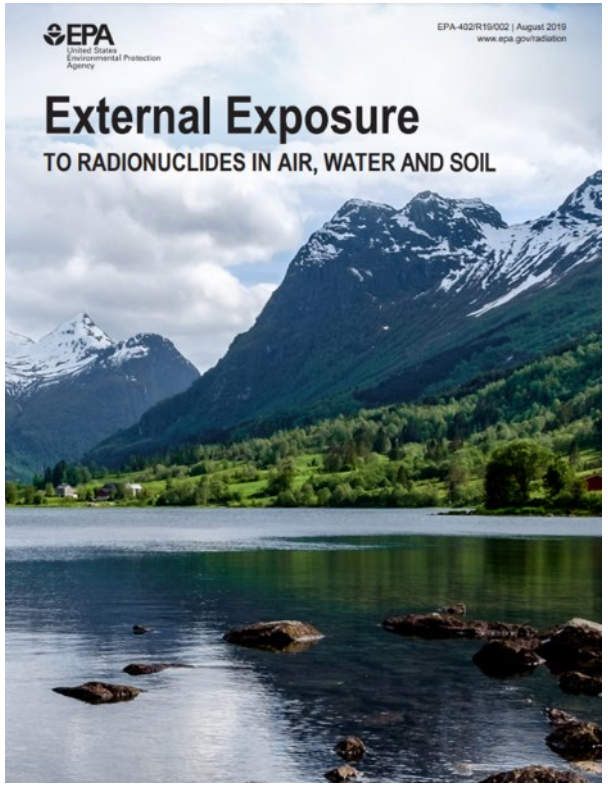
- EPA Exposure Factors Handbook
- ICRP Pub. 66
- ICRP Pub. 89

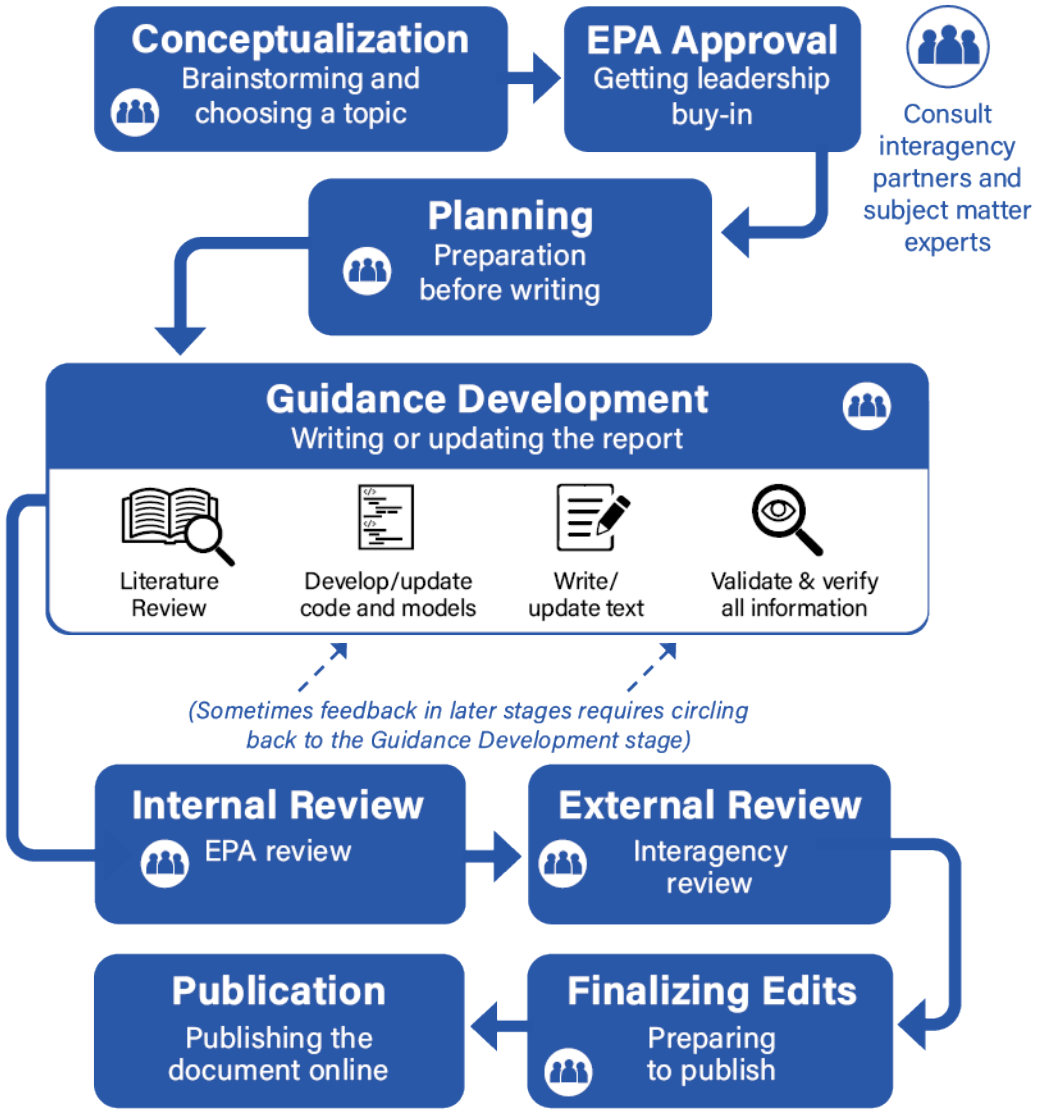
External Dose Coefficients

EPA Federal Guidance Report No. 15 (uses ICRP Pub. 103 and 107)

Cancer Risk Coefficients

How Federal Guidance is Developed





Datasets of Dose Coefficients Reimagined

- The challenge:
  - Dose and risk coefficients needed in dose assessment codes, while available, often require that the data be reformatted or the codes be rewritten to read the data files correctly.
- The response to the challenge:
  - Coordinate with other Federal partners to collect existing datasets of dose and risk coefficients
  - Reformat data in data files to be accessible, with no need for the installation of software. Make data available to those using any operating system (e.g., Windows, MacOS, Linux)
  - Make datasets available to developers of dose assessment codes in formats (e.g., XML, JSON) that make the dose and risk coefficients easier for to incorporate in their codes

“Reference Individual”

- Reference Man (1950’s) based on adult male worker
  - Science has advanced
  - Age at time of exposure, gender
  - Six different age groups including adults (male and female)
  - Significant advances with modern computational phantoms
  - Reference individual and effective dose are compliance constructs.
    - Tissue weighting factors are standard
  - Other factors?
    - Physiological, immunological, genetic and environmental ...
  - We have come a LONG way from the 1950’s, but …

Applied Topics

Ongoing and future work

- Rad NESHAP compliance codes - National Emission Standards for Hazardous Air Pollutants (NESHAP)
  - Maintenance and updates for CAP88-PC, COMPLY, COMPLY-R
  - 40 CFR Part 61, Subpart H, Subpart I, Subpart B.
- MARSSIM - The Multi-Agency Radiation Survey and Site Investigation Manual
  - Revision 2 to be completed soon.
- PAG Manual – The Protective Action Guides and Planning Guidance for Radiological Incidents
  - Identified need for an implementation guide

MARSSIM, Revision 2

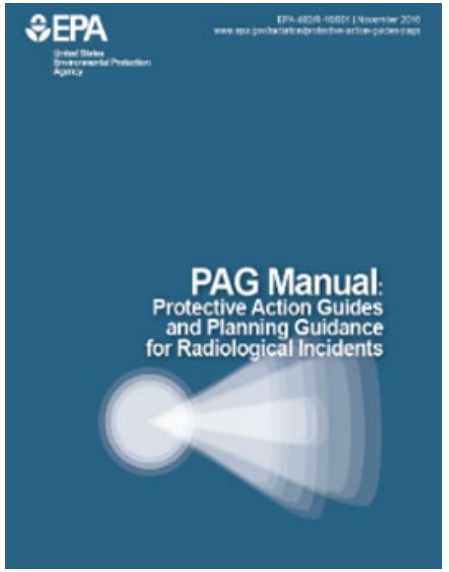
Multi-Agency Radiation Survey and Site Investigation Manual

- Consensus guidance for measurement and evaluation of concentrations of radioactive material at sites
- Partnership with EPA, DOE, DoD, NRC, and involvement with the States
- Widely used across the U.S. and internationally
- Revision 2 will update science and incorporate lessons learned
- Public comment period and review by EPA Science Advisory Board
- Technical Completion of Revision 2 in 2023
- Outreach and training to assist users in 2024

Protective Action Guides (PAG) Manual

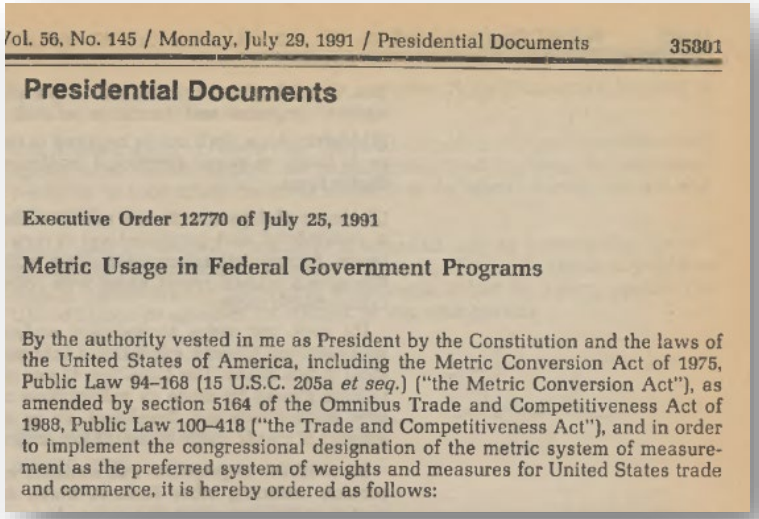
Future ideas being considered

- Drinking water PAG implementation guide providing guidance on:
  - Public messaging regarding the two-tier PAG
  - Use of Derived Response Levels to inform decision making
  - Non-drinking uses of water, such as in critical infrastructure (e.g., hospitals)
  - Other special circumstances, e.g., cisterns, private water wells
- Guidance on better leveraging the many flexibilities in the PAG Manual to reduce secondary and tertiary detriments to those affected
- Purposefully harmonizing Food PAGs with international standards, to aid with consistency, to recover more quickly in the global food trade after a radiation incident



Radiation SI Units

- Metric Conversion Act of 1975, and its later amendments
- Executive Order 12770 signed by President George H.W. Bush
- NIST: National Institute of Standards and Technology
- UNSCEAR: United Nations Scientific Committee on the Effects of Atomic Radiation
- IAEA: International Atomic Energy Agency
- WHO: World Health Organization
- ICRP: International Commission on Radiological Protection
- NCRP: National Council on Radiation Protection & Measurements
- NEA: Nuclear Energy Agency
- IRPA: International Radiation Protection Association
- HPS: Health Physics Society
- RRS: Radiation Research Society
- AAPM: The American Association of Physicists in Medicine
- ACR: American College of Radiology

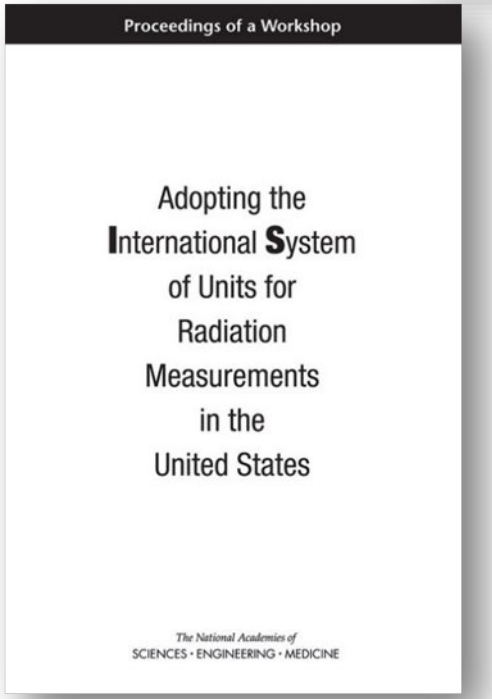

Vol. 56, No. 145 / Monday, July 29, 1991 / Presidential Documents 35801

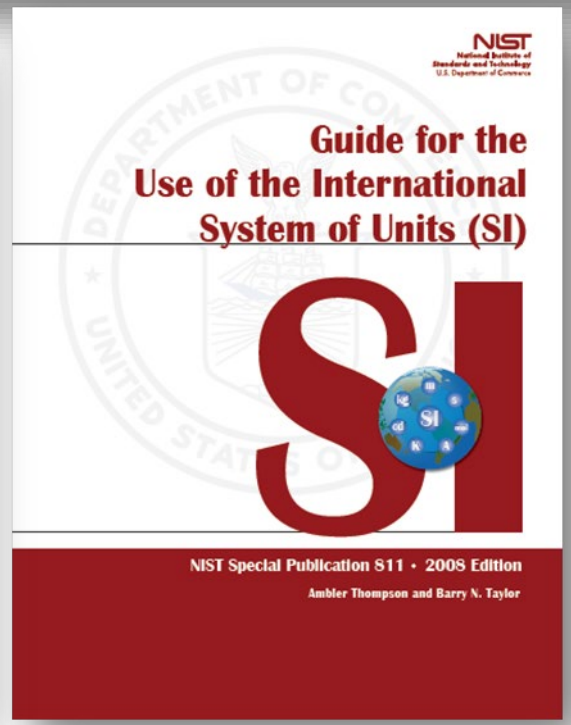
Presidential Documents

Executive Order 12770 of July 25, 1991

Metric Usage in Federal Government Programs

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the Metric Conversion Act of 1975, Public Law 94–168 (15 U.S.C. 205a *et seq.*) ("the Metric Conversion Act"), as amended by section 5164 of the Omnibus Trade and Competitiveness Act of 1988, Public Law 100–418 ("the Trade and Competitiveness Act"), and in order to implement the congressional designation of the metric system of measurement as the preferred system of weights and measures for United States trade and commerce, it is hereby ordered as follows:



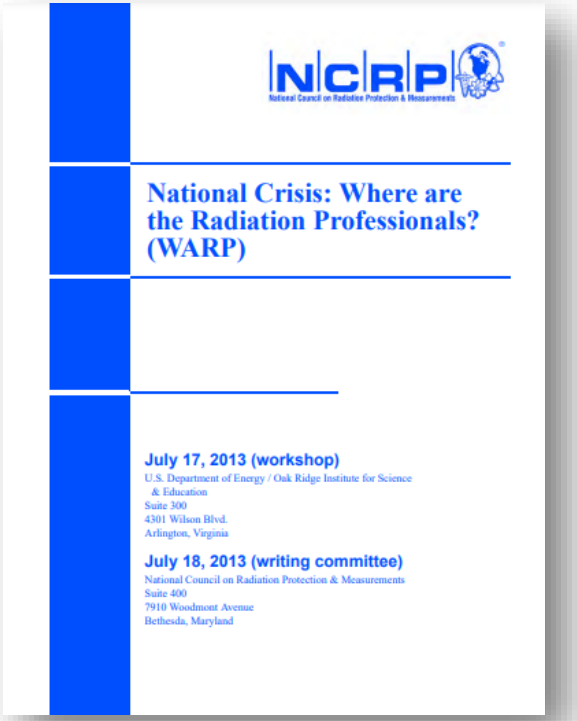


NASEM Workshop, September 29-30, 2016

http://dels.nas.edu/Workshop-Summary/Adopting-International-System-Units/24645

Sustaining and Promoting Expertise in Radiological Protection

- EPA Radiation Protection Program has adopted a multifaceted approach
  - Recognizing the issue as a priority
  - Developing and applying a structured “knowledge transfer” initiative to capture the experience and institutional knowledge of retiring staff
  - Promoting knowledge sharing through mentorships
  - Promoting continuing education and professional development for all staff
  - Supporting staff who seek professional certification
  - Other education opportunities
    - Repository of training and education resources (developed in-house)
    - Self-organized study group!
- International collaboration and technical exchanges to promote radiation protection capacity
  - Emphasis on least developed countries


NCRP

National Crisis: Where are the Radiation Professionals? (WARP)

July 17, 2013 (workshop)
U.S. Department of Energy / Oak Ridge Institute for Science & Education
Suite 300
4301 Wilson Blvd.
Arlington, Virginia

July 18, 2013 (writing committee)
National Council on Radiation Protection & Measurements
Suite 400
7910 Woodmont Avenue
Bethesda, Maryland


Radiation and Environmental Biophysics (2023) 62:175–180
https://doi.org/10.1007/s00411-023-01024-5

REVIEW

Vancouver call for action to strengthen expertise in radiological protection worldwide

W. Rühm[1] · K. Cho[2] · C.-M. Larsson[3] · A. Wojcik[4,5] · C. Clement[6] · K. Applegate[7] · F. Bochud[8] · S. Bouffler[9] · D. Cool[6] · G. Hirth[3] · M. Kai[10] · D. Laurier[11] · S. Liu[12] · S. Romanov[13] · T. Schneider[14]

Received: 18 December 2022 / Accepted: 25 March 2023 / Published online: 25 April 2023
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Internship and Fellowship Opportunities

- Internship Opportunities
  - Pathways/Student Trainee
    - Apply through USAJobs
  - Virtual Student Federal Service Internship (VSFS)
    - US citizens from high school to graduate school
    - Voluntary, part-time, fully virtual
    - Program facilitated by Department of State, apply through USAJobs
  - Volunteer internships
    - Informal, unpaid, non-competitive
- Other Internship & Fellowship Programs
  - ORISE, AAAS, ASPPH, STAR, etc.
    - Placement with a host federal agency
    - Generally do not allow direct transition into full-time position

VSFS VIRTUAL STUDENT FEDERAL SERVICE

ORISE

ASPPH ASSOCIATION OF SCHOOLS & PROGRAMS OF PUBLIC HEALTH

AAAS Science & Technology Policy Fellowships

EPA United States Environmental Protection Agency

Radiation Protection Program

Thank You

www.epa.gov/radiation