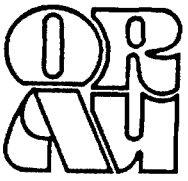

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ORAU 88/F-111

A COMPENDIUM OF MAJOR U.S. RADIATION PROTECTION STANDARDS AND GUIDES: LEGAL AND TECHNICAL FACTS

July 1988

Submitted To:

Committee on Interagency Radiation

Research and Policy Coordination

Prepared By:

W.A. Mills, D.S. Flack, F.J. Arsenault, and E.F. Conti,

with the assistance of

Social, Educational Research and Development, Inc.

The Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) is chartered through the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), Office of Science and Technology Policy, Executive Office of the President, Washington, D.C. 20506.* ***The Energy/Environment Systems Division*** *of Oak Ridge Associated Universities provides technical assistance to CIRRPC.*

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NOTICES

* *Departments of Agriculture, Commerce, Defense, Energy, Health and Human Services, Housing and Urban Development, Interior, Justice, Labor, State, and Transportation; Environmental Protection Agency; Federal Emergency Management Agency; National Aeronautics and Space Administration; Nuclear Regulatory Commission; Office of Management and Budget; Veterans Administration; and the National Security Council.*

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ACKNOWLEDGEMENTS

The preparation of this report required the strong support and willing cooperation of the CIRRPC member agencies in obtaining the necessary data base. The authors wish to express their appreciation to those individuals in the Federal agencies who not only provided information, but also reviewed the drafts and provided useful comments. A special note of appreciation is extended to Elaine Doggett of the ORAU/CIRRPC Technical Assistance Office who devoted many hours and much patience to the careful preparation of Part I.

The authors are especially indebted to Social, Educational Research and Development, Inc. (SERD) for producing Part II of the report, the Facts Sheets. SERD collected the relevant regulations and other materials and produced drafts of the Fact Sheets and accompanying material. The project was conducted by the following SERD staff: Mercedese M. Miller, Project Director; Mark Menscher, Legal Research Associate; Michelle Witt and Richard King, Legal Research Assistants; and Michael Morrissey, Technical Proofreader.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PART I

COMPENDIUM OF RADIATION PROTECTION STANDARDS

PART I

COMPENDIUM OF RADIATION PROTECTION STANDARDS

COMPENDIUM OF MAJOR U.S. RADIATION PROTECTION STANDARDS AND GUIDES

INTRODUCTION

U.S. standards[1/] to protect workers and members of the general public against any potentially harmful effects of ionizing radiation are numerous and complex. Congress has delegated radiation protection responsibilities to multiple Federal agencies, which, in turn, interpret the authority given to them and issue the appropriate standards. Differences in the radiation protection provisions associated with this authority and in the basic rationales behind these provisions, combined with different interpretations of them and the limited discretionary authority given to the agencies in providing protection, all contribute to the complex network of U.S. radiation protection standards.

During a survey of radiation issues of concern conducted by the Committee on Interagency Radiation Research and Policy Coordination[2/] (CIRRPC), government agencies, the Congress, industry, professional organizations, and individuals in the radiation protection community expressed the need for:

- Consistent Federal radiation policies and reviews of existing standards and regulations;
- Mutually consistent and coordinated radiation regulations and standards, particularly those involving multiple agencies and jurisdictions;
- Establishment of radiation levels below regulatory concern (de minimis);
- Coordination of U.S. policies and positions on radiation issues at international meetings;
- Clarification of an "as low as reasonably achievable" (ALARA) policy;
- Scientifically-based standards;
- Examination of "umbrella" dose limits, dose commitment methodology, collective dose application, etc.; and
- Introduction of a risk-based standards system, standardizing radiation risk estimation techniques and approaches to risk comparability.

In addition to these expressed general needs for CIRRPC to address radiation protection policy, standards and regulations, a June 25, 1985 letter to the Science Advisor to the President from the Secretary of Commerce specifically suggested that

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1/ The term standard is used in a generic sense in this report to refer to not only those standards and regulations that are enforceable, but also to Federal or agency guides.

2/ CIRRPC is an interagency committee of eighteen Federal agencies, represented by senior policy makers, and is complemented by a Science Panel whose members are senior radiation scientists from fourteen member agencies. Oak Ridge Associated Universities provides the necessary administrative and technical support to CIRRPC.

CIRRPC study the problem of inconsistency in regulations and the lack of an agreed upon level of radiation exposure at which "no radiation hazard exists," and that it assist agencies in achieving consistent Federal guidelines. The Secretary stated that, "[t]he Federal Government has an obligation to industry to rationalize its regulatory concerns across all the federal agencies and to avoid over-regulation. . . . CIRRPC should strive for the simplest regulatory posture consistent with protection of the public and the environment."

Likewise, the Director, Office of Energy Research, Department of Energy (DOE), expressed his concerns about radiation standards in an August 12, 1985 letter to the Chairman of CIRRPC by suggesting that CIRRPC

> . . . develop and publish for Federal agency use, a coordinated and modernized guide for the development and implementation of radiation protection standards. A concrete initial step toward realization of this goal would be to coordinate a review of existing and proposed radiation protection standards. The objective of such a review would be to help other organizations and agencies develop standards which provide a technically sound and uniform degree of protection to workers and to the public.

It is against this background and interest that CIRRPC initially considered this issue and how it might enhance its knowledge and understanding of the basis of and the relationship between the principle standards promulgated in the United States to limit and control radiation exposures.

Following discussion of the general issue, the CIRRPC Executive Committee approved, with concurrence of the full Committee, an Oak Ridge Associated Universities (ORAU) staff proposal to develop a compendium of Fact Sheets on the major U.S. radiation protection standards and guides, existing or proposed. The compendium was to contain relevant legal or statutory information and detailed technical requirements that state and describe the protection to be achieved. The report was to provide appropriate legislative citations; note any legislative language that gave direction to the development of standards promulgated under the legislation; cite rationales for the standards promulgated; and provide a listing of related standards. Acting on CIRRPC's directions, ORAU was then tasked by the DOE to develop the compendium.

Two consultants with considerable experience in radiation protection regulations were contracted to assist the ORAU staff in developing the report. The research services of Social, Educational Research and Development (SERD), Inc., were contracted to collect the necessary documents, to provide initial drafts of the Fact Sheets, and to assist in the development of a final ORAU report.

This report has been reviewed twice by the CIRRPC member agencies; once to ensure the accuracy of all the legal and technical facts in the compendium, and once to comment on the entire document, including the accompanying text. This final report reflects consideration of all the agencies' comments received during the reviews.

Part I of this report presents information on the selection, preparation and content of the Fact Sheets; an overview of their scopes, applications and modes of control; and the ORAU conclusions and recommendations. Part II contains the Fact Sheets and a User's Guide to finding relevant information in the Fact Sheets.

SELECTION OF STANDARDS

The following three criteria guided selection of the standards to be included in the collection of Fact Sheets. A standard had to meet each of the three criteria to be included.

1. It must have been published in The Federal Register as a proposed or final standard.

2. It must establish substantive public health protection requirements (i.e., it should not merely implement requirements of another standard).

3. Finally, it cannot be solely an intra-agency standard (i.e., limited to controlling exposures within the agency itself).

For example, transportation standards were omitted because they primarily implement requirements of other standards. The last criterion excluded protection requirements issued as "orders" by DOE that control exposures in its contractor-operated facilities.[3/] Finally, standards for limiting diagnostic or therapeutic doses to patients by physicians (except for the Federal Guidance in Fact Sheet 5) were omitted because they apply to special-case situations, which involve consideration of benefit versus risk.

Fact Sheets have been developed for twenty-two existing standards, proposed revisions to two of these, and a proposed new standard (Table 1). Proposed standards included are the Nuclear Regulatory Commission's (NRC) basic radiation protection regulations (10 CFR 20); the Department of Labor (DOL), Mine Safety and Health Administration's (MSHA) regulation to control radon in underground mines (30 CFR 57); and the Environmental Protection Agency's (EPA) proposed guidance on transuranics in the environment. Of the twenty-two final standards, eight are in the form of guides and fourteen are enforceable standards. Seven enforceable standards have been promulgated by the EPA, four by the NRC, two by the DOL, and one by the Food and Drug Administration (FDA). Five of the seven Federal Guides, presently in effect and Presidentially-approved, were recommended by the former U.S. Federal Radiation Council (FRC) and the remaining two by the EPA Administrator, to whom was transferred in 1970 the FRC responsibility to "advise the President on radiation matters directly or indirectly affecting health."

COLLECTION OF DATA

The SERD staff collected materials (technical, legal and background) necessary for development of the Fact Sheets. In addition to collecting the printed materials, a series of visits and telephone and personal interviews were conducted. This included contacts with EPA, the NRC, the Library of Congress, the U.S. Government Printing Office (GPO), the U.S. Senate Committees on Energy and Natural Resources and Environment and Public Works and the U.S. House of Representatives Committee on Energy and Commerce.

3/ Intra-agency requirements for radiation protection are expected to be in accord with Federal guidance, such as that issued in 1960, which places limits on population exposure, and that issued by the Environmental Protection Agency in 1987, which provides the basic guidance for occupational radiation protection.

Table 1. LISTING OF TITLES AND NUMBERS OF FACT SHEETS

FACT SHEET	TITLE
1	Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960)
2	Federal Guidance on Occupational Radiation Exposures (RPGs) (1987)
3	Federal Guidance on Radon Exposures in Uranium Mines (1969)
4	Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961)
5	Federal Guidance on Diagnostic X-Ray Exposures (RPGs) (1978)
6	Proposed Federal Radiation Protection Guidance on Transuranics in the Environment (RPGs) (1977)
7	Federal Protective Action Guide (PAG) for I-131 (1964)
8	Federal Protective Action Guides (PAGs) for Sr-89, Sr-90 and Cs-137 (1965)
9	40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986)
10	40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976)
11	40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977)
12	40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985)
13	40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985)
14	40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982)
15	40 CFR 220-229, EPA Regulations and Criteria for Ocean Dumping of Radioactive Materials (1977)
16A	10 CFR 20, NRC Basic Standards for Radiation Protection (1960)
16B	10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986)
17	10 CFR 60, NRC Requirements for Disposal of High-Level Radioactive Waste in Geologic Repositories (1981)
18	10 CFR 61, NRC Requirements for Land Disposal of Low-Level Radioactive Waste (1975)

Table 1. LISTING OF TITLES AND NUMBERS OF FACT SHEETS (continued)

FACT SHEET	TITLE
19	10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975)
20	29 CFR 1910.96, OSHA Ionizing Radiation Protection Standards (1971)
21	21 CFR 1020, FDA Performance Standards for Ionizing Radiation Emitting Products (1973)
22	Advisory FDA Protective Action Guides (PAGs) for Radioactive Contamination in Food (1982)
23A	30 CFR 57, MSHA Safety and Health Radiation Standards for Underground Metal and Nonmetal Mines (1977)
23B	30 CFR 57, MSHA Proposed Ionizing Radiation Standards for Underground Metal and Nonmetal Mines (1986)

FACT SHEET ORGANIZATION AND FORMAT

The Fact Sheets are primarily listed according to whether they contain Federal guidance or to the agency responsible for issuing the standard. Each Fact Sheet covers a single standard, except for Fact Sheet 12 which covers the EPA remedial action and environmental standards for uranium and thorium mill tailings, as well as the NRC conforming regulation.

To be both useful and informative, the Fact Sheets describe the legal and technical information as briefly as possible. The reader is encouraged to refer to the issuances and background documents for more complete information on the standards, e.g., on the accompanying implementing regulations. The Fact Sheets include available information that explains why and how the requirements came into being. For example, they state the relevant statute(s) and statutory purpose(s) and describe the rationale used in developing the detailed requirements. The Fact Sheets also provide relevant supplemental information, including the names of the agencies responsible for promulgation, implementation or enforcement of the standards and related standards.

Specifically, each Fact Sheet includes the:

- Complete title, including number and date of the Federal Register notice;
- Authorizing statute, including its purpose and radiation protection provisions;
- Responsible agency(ies);
- Description of the standard, including the related issuance(s), effective date, background, general radiation protection provisions and rationale and description of the detailed requirements; and
- Related standards.

OVERVIEW OF FACT SHEETS

One problem that arises when trying to review the Fact Sheets is that the sheer number of parameters, variables and dimensions contained in the standards is an obstacle to their effective comparison.

For example, the standards include radiation protection standards for:

- General population;
- Workers;
- Radon in underground mines;
- Internal emitters in the environment, including transuranic nuclides;
- Protective action guides for certain radionuclides;
- Air emissions;

- At-the-tap drinking water;
- Uranium fuel cycle, excepting mines and radon from uranium mill operations;
- Uranium and thorium mill tailings: active and inactive;
- Mining effluents and underground injections;
- High-level and transuranic waste operations and disposal;
- Ocean dumping;
- Low-level waste;
- ALARA design objectives for commercial light-water reactor effluents; and
- Ionizing radiation emitting products.

Possible ways of categorizing the Fact Sheets in order to examine the relationship between them are presented in this section. One method of categorization, based on modes of control for various source categories, may be particularly useful to CIRRPC.

Figure 1 shows the relationship between those standards that apply to occupational radiation protection. The existing occupational radiation protection standards imposed by the NRC (Fact Sheet 16A) and Occupational Safety and Health Administration (OSHA) (Fact Sheet 20) on regulated industries and those related standards applied by other Federal agencies to their own activities are consistent with the 1960 Federal guidance for occupational radiation protection, the so-called Radiation Protection Guides (RPGs), (Fact Sheet 1). In 1987, the Federal radiation protection guidance for occupational exposure was revised to reflect improvements in both the quantitative and qualitative knowledge of radiation health risks and the changes in radiation protection philosophy for controlling occupational exposures (Fact Sheet 2). For example, there is more emphasis on the concept of "as low as reasonably achievable" and internal and external exposures are combined to give a whole body dose equivalent. The NRC proposed revision to 10 CFR 20 (Fact Sheet 16B) would make the NRC occupational radiation protection requirements consistent with the 1987 Federal guidance and would also update those requirements for protection of the general population contained in the 1960 Federal RPGs.

Additional radiation protection for uranium miners (Fact Sheets 3; 23A) is provided due to their occupational exposure to radon and its daughter products. The proposed revision of 30 CFR 57 (Fact Sheet 23B) provides for combining exposures to radon and thoron daughters and whole-body gamma radiation into a sum rule and for examining whether the standard needs to be applied to more than just uranium mines.

Figures 2 and 3 show the relationships between the standards that control radiation exposures of the general public. Figure 2 presents those standards that set limits on operations, doses to people, or emissions into the environment. Figure 3 includes standards for concentrations of radionuclides in the environment. Some standards contain provisions related to both and, consequently, appear in both figures.

Recently, the National Council on Radiation Protection and Measurements (NCRP) categorized the sources of radiation exposure to which members of the U.S. population are exposed and estimated the collective and average effective dose equivalents received

FIGURE 1.

STANDARDS TO CONTROL OCCUPATIONAL RADIATION EXPOSURES

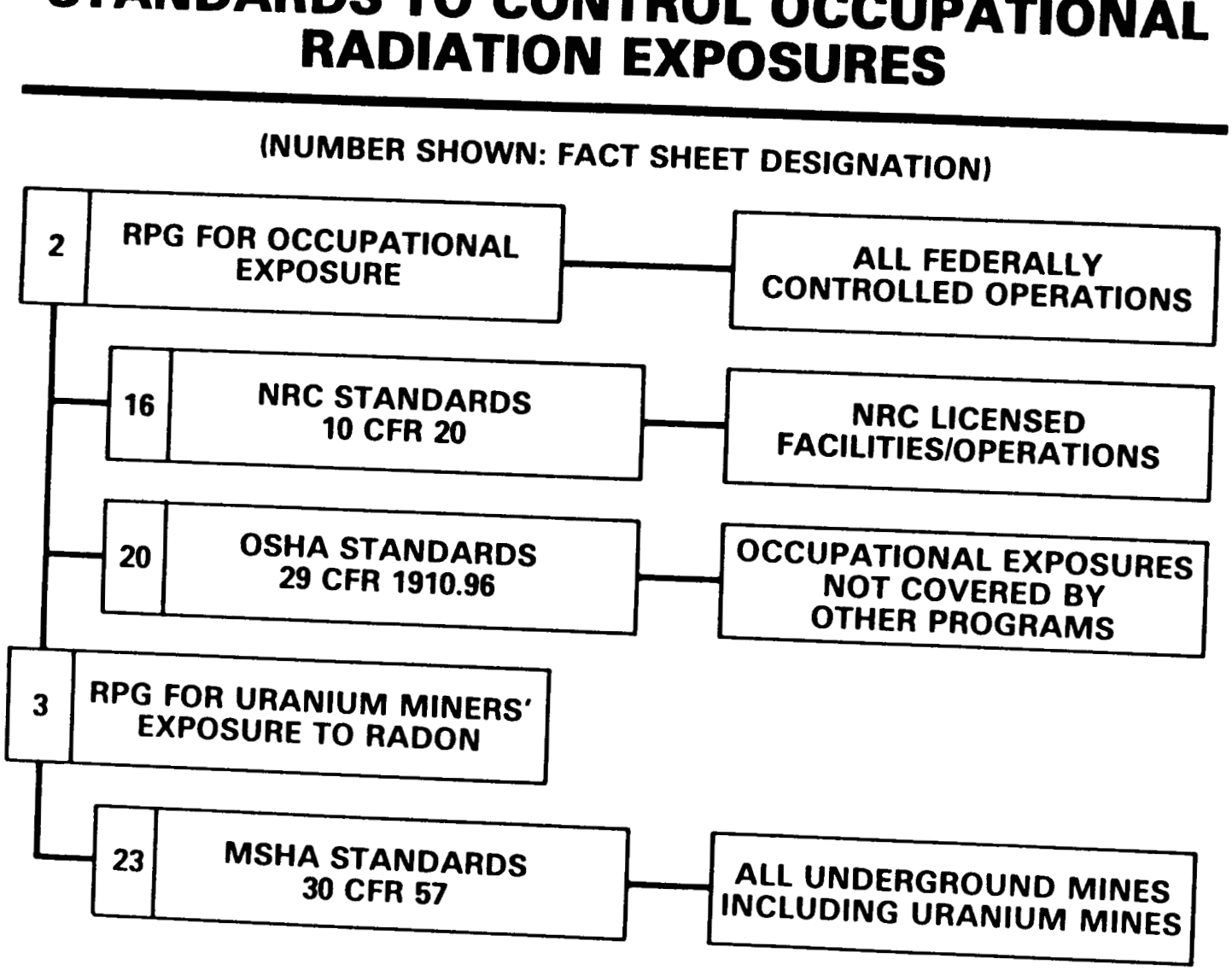


FIGURE 2.

STANDARDS TO CONTROL RADIATION EXPOSURES OF THE GENERAL PUBLIC: EMISSIONS AND DOSE

(NUMBER SHOWN/ FACT SHEET DESIGNATION)

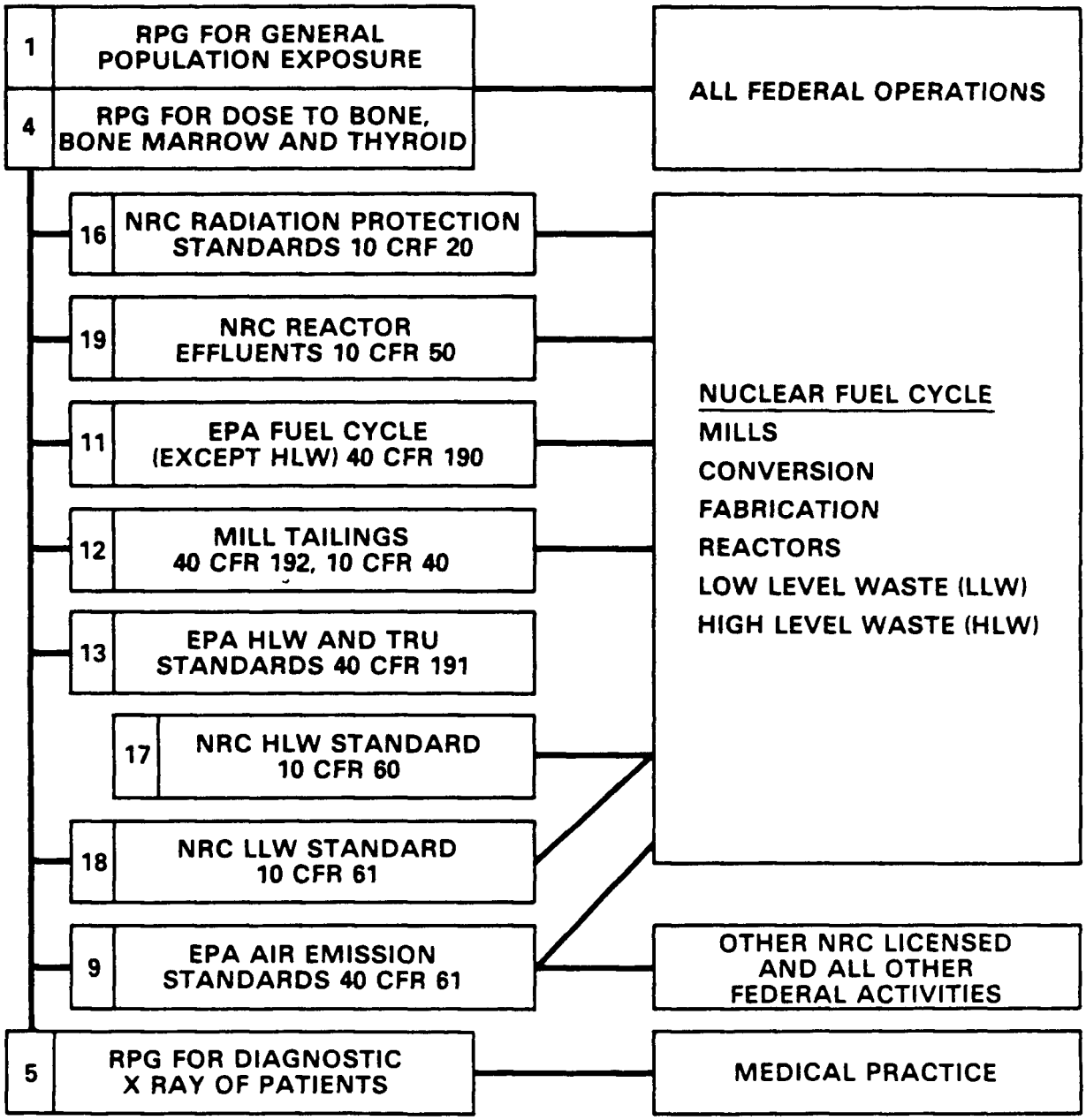
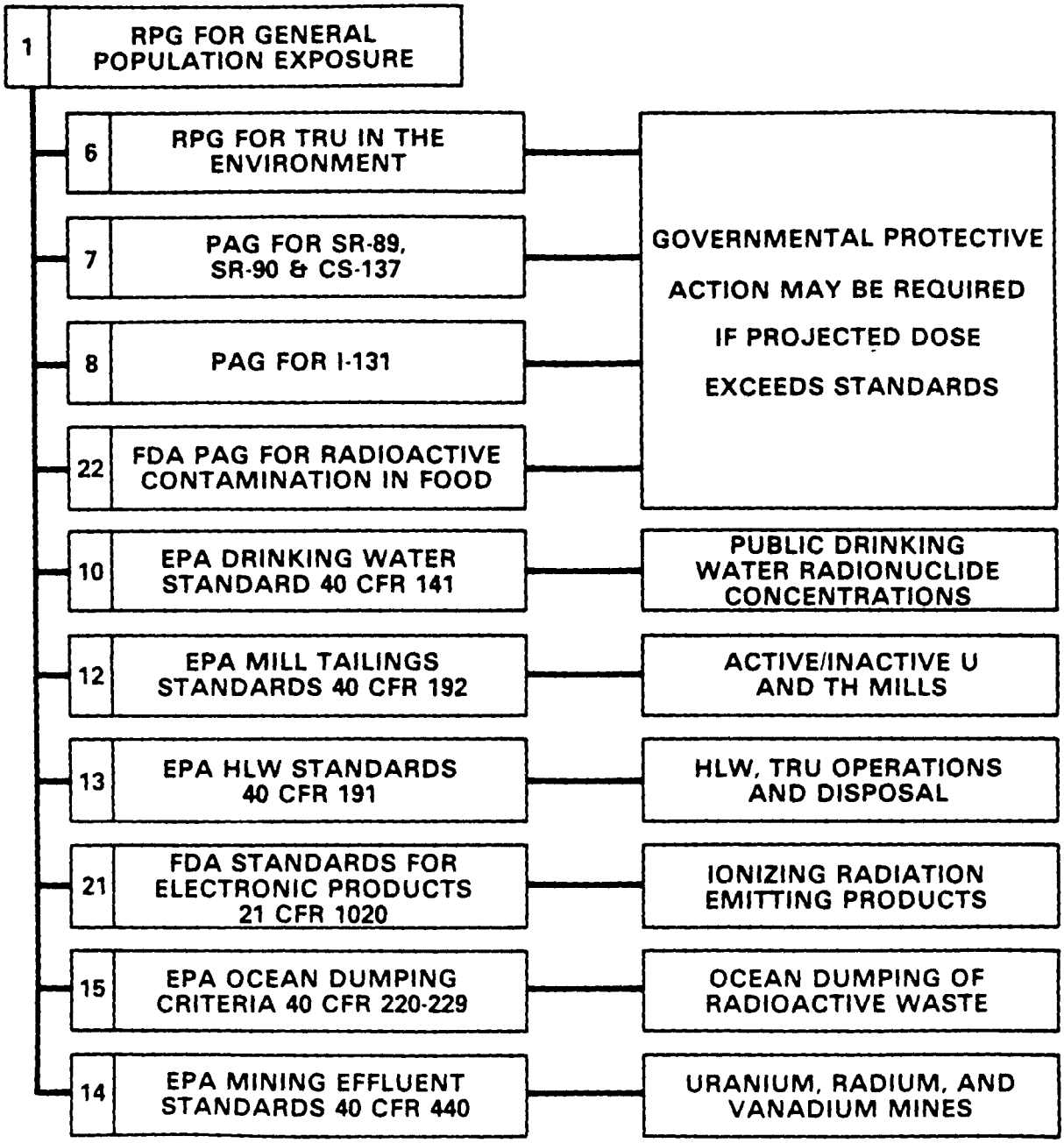


FIGURE 3.

STANDARDS TO CONTROL CONCENTRATIONS OF RADIOACTIVITY OR RADIATION LEVELS IN THE ENVIRONMENT

(NUMBER SHOWN: FACT SHEET DESIGNATION)



from each source category. Their results were issued in the 1987 NCRP Report No. 93, entitled "Exposure of the Population in the United States to Ionizing Radiation." Table 2 showing the average annual effective dose equivalent to the U.S. population from different sources is a modification of a summary table presented in this NCRP Report.

The Fact Sheets were related to the major sources identified in the NCRP report to identify any potential merit in utilizing this relationship in a future CIRRPC study. Table 3 shows, for each NCRP source category, those standards (represented by Fact Sheet numbers) that are applicable to at least some part of the source category. The number of standards applicable to a given source appears to be inversely proportional to the contribution of the source to the exposure of the population. This suggests a possible future evaluation across sources of exposure of the cost-effectiveness achieved in terms of health risk reduction.

Figure 4 categorizes the standards according to their mode(s) of control, that is, whether they apply to: the siting, design or operation of a facility (or activity); releases or emissions of radionuclides from the facility; concentrations or quantities in the environment; or doses to people, either individually or collectively.

Table 4 represents the array considered to have the greatest potential utility to CIRRPC for any future analysis. It relates the applicable standards and their mode(s) of control to some of the specific sources within the NCRP source categories. What remains to be examined is the rationale behind and objective of each standard, the level of constraint imposed by its detailed requirements, and the consistency in protection both within and between the given mode(s) of control. For example, some standards set limits on the basis of acceptable level of risk, others on the application of best control technology or zero degradation of existing conditions. Some standards limit dose from a single source, while others seek to limit dose from multiple sources, a class of sources, or all sources. Some standards set performance requirements (e.g., emission limits), while others specify design or operating features in lieu of performance requirements. With the exception of the standards limiting dose, it is not always clear what level of dose or health risk is implied by the standards. While it should be made clear that all standards are aimed at controlling the exposure of people to radiation, there appears to be no clear intent to be consistent in either the statutory language or the explicit or implicit protection objective of the standards.

Standards are either of the "umbrella" (general) form, such as a 0.5 rem annual population limit for exposure to the individual from all sources in the proposed revision of 10 CFR 20, or are very source specific, such as 20 pCi per meter^2 per second limiting radon emission from a disposal site for uranium mill tailings. The standards may be expressed in a variety of ways: activity per unit volume or mass; dose equivalent or effective dose equivalent; exposure or emission rate; total activity released over a period of time (e.g., 10,000 years); or activity per unit of annual electrical power produced. Furthermore, the numerical limits for the general public vary over a wide range and in some instances are quite low, e.g., the limit for beta particle and photon emitters in at-the-tap drinking water is 4 mrem per year.

While the Atomic Energy Act, under which most of the EPA and NRC standards are established, leaves to the regulatory agencies the manner in which the objective to "protect health or minimize danger to life or property is achieved," the Clean Air Act (Fact Sheet 9) and the Safe Drinking Water Act (Fact Sheet 10) administered by EPA requires them to set limits that would avoid "any adverse effect on the health of persons" and "with an ample margin of safety." As a result of the wide interpretation

TABLE 2.

SOURCES OF IONIZING RADIATION EXPOSURE: AVERAGE ANNUAL EFFECTIVE DOSE EQUIVALENT (H_E) IN THE U.S. POPULATION

	H_E IN MILLISIEVERT** PER YEAR (ROUNDED TOTALS)		PERCENT
TOTAL		3.6	
NATURAL SOURCES		3.0	83
RADON	2		
OTHER	1		
COSMIC	0.27		
COSMOGENIC	0.01		
TERRESTRIAL	0.28		
IN THE BODY	0.39		
OCCUPATIONAL*		0.009	0.2
NUCLEAR FUEL CYCLE		0.0005	0.02
CONSUMER PRODUCTS*		0.09	2
MISCELLANEOUS ENVIRONMENTAL SOURCES*		0.0006	0.02
MEDICAL		0.5	15
DIAGNOSTIC X RAYS	0.39		
NUCLEAR MEDICINE	0.14		

* ESTIMATED NUMBER OF PEOPLE EXPOSED:

OCCUPATIONAL	0.9 MILLION
CONSUMER PRODUCTS	120 MILLION
MISCELLANEOUS ENV. SOURCES	25 MILLION

REF: NCRP REPORT 93 (1987)

** 1 MILLISIEVERT = 100 MILLIREM

TABLE 3.

FACT SHEETS RELATED TO MAJOR RADIATION SOURCE CATEGORIES

SOURCE CATEGORY[1/]	APPLICABLE FACT SHEET (TOTAL NUMBER)
OCCUPATIONAL (0.2%)	2, 3, 16, 20 AND 23 (5)
NUCLEAR FUEL CYCLE (0.02%)	1, 4, 7, 8, 9, 11, 12, 13, 16, 17, 18 AND 19 (12)
CONSUMER PRODUCTS (2%)	1, 10 AND 21 (3)
MISCELLANEOUS ENVIRONMENTAL (0.02%)	1, 4, 6, 7, 8, 9, 14, 15, 16 AND 22 (10)
MEDICAL (15%)	5, 16 AND 21 (3)

1/ VALUES IN PARENTHESIS SHOW PERCENT OF TOTAL ANNUAL INDIVIDUAL DOSE EQUIVALENT PER CAPITA FOR U.S. POPULATION BASED ON NCRP REPORT #93, 1987.

FIGURE 4.

MODE OF CONTROL BY STANDARD ACCORDING TO TYPE OF APPLICATION

(NUMBERS SHOWN: FACT SHEET DESIGNATION)

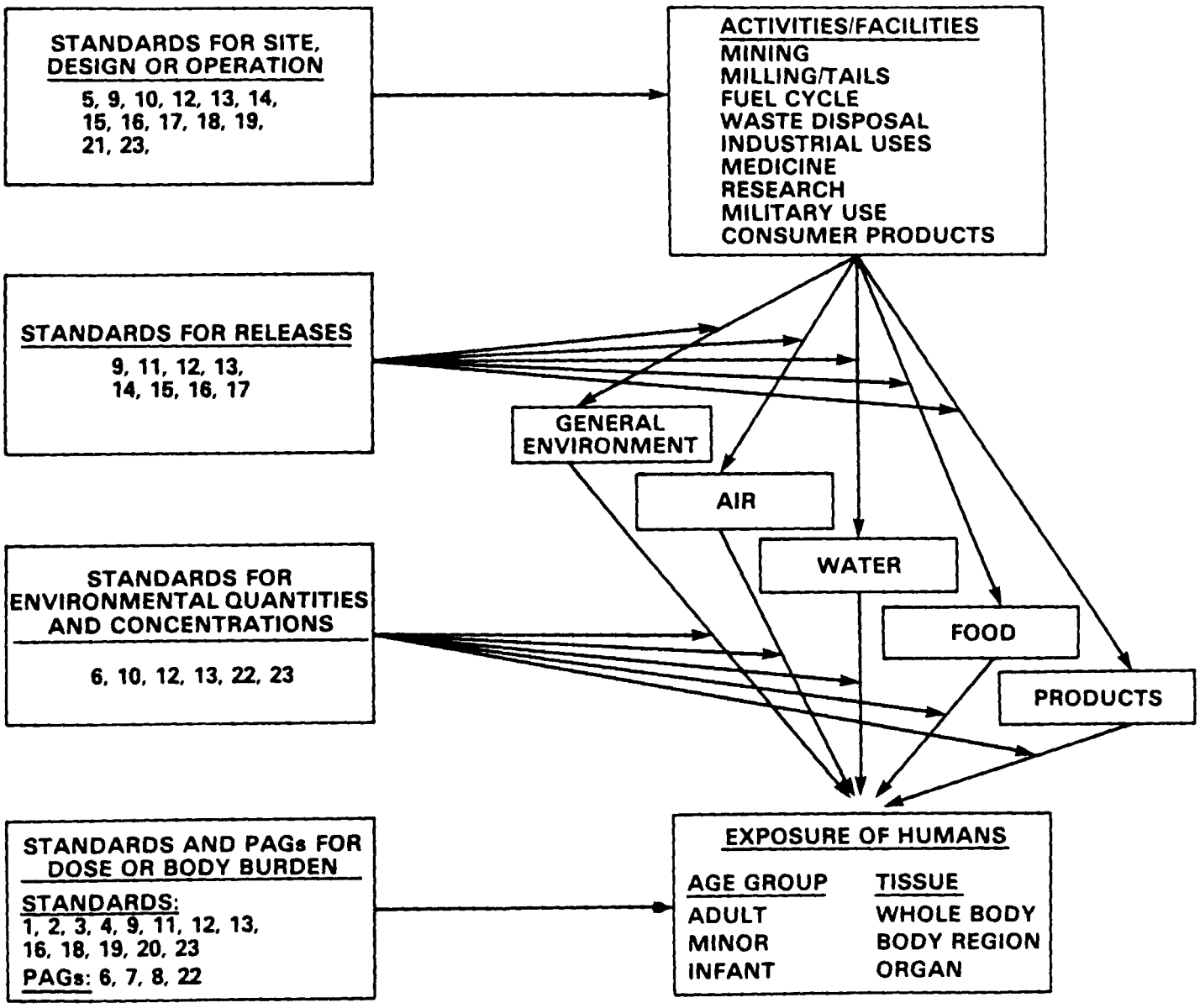


TABLE 4.

FACT SHEETS APPLICABLE TO SOURCES OF EXPOSURE AND MODES OF CONTROL

SOURCES OF EXPOSURE	MODES OF CONTROL			
	SITE, DESIGN AND OPERATION	RELEASES/ EMISSIONS	ENVIRONMENTAL QUANTITIES AND CONCENTRATIONS	DOSE AND BODY BURDEN
FUEL CYCLE				1, 4, 7, 8, 9, 11, 16
ALL FUEL CYCLE		11, 16	12	12
MILL TAILINGS	9, 12	12		19
REACTOR EFFLUENT	19			18
LLW DISPOSAL	16, 18		13	13
HLW & TRU DISPOSAL	13, 17	13, 17	12	
REMEDIAL ACTION				
MISC. ENVIRONMENTAL SOURCES			6	1, 4, 6, 7, 8
ALL MISC. ENV. SOURCES				9, 16
MINING & MILLING EFFL'TS	9, 14	14		9
OTHER NRC LICENSED		16		
FEDERAL FACILITIES				
PHOSPHORUS PLANTS		9		22
OCEAN DUMPING	15	15	22	
FOOD				
CONSUMER PRODUCTS				1
ALL CONSUMER PRODUCTS				10
DRINKING WATER	10		10	
ELECTRONIC PRODUCTS	21			
				5
MEDICAL				16
DIAGNOSTIC X-RAYS	5, 21	16		
NUCLEAR MEDICINE				2
				16
OCCUPATIONAL				20
ALL OCCUPATIONAL				3, 23
NRC LICENSED			23	
OTHER EMPLOYERS				
UNDERGROUND MINES	23			

of this guidance to agencies provided in these statutes, agencies use an equally wide range of rationales in developing and promulgating standards: control technology capabilities and cost may or may not be a consideration (ALARA); current emission levels may be the basis; or a level of health risk expressed as annual or lifetime risk may be the operative criterion. Overall, ALARA and non-degradation appear to be the principle criteria for protecting members of the general public. A level of lifetime risk no greater than that found in other industries is the principal criterion for protecting workers.

The interplay between standards has resulted in a lowering of the limits over time. This can be illustrated by the relationship among several standards, each of which relates to the limits on effluents from licensed commercial nuclear power plants. The applicable Federal guidance (Fact Sheet 1) sets the annual limit for an individual member of the general population at 500 mrem. Consistent with that guidance, NRC's 10 CFR 20 (Fact Sheet 16A) sets the same limit; however, the individual licensees are held to limits that have been individually determined and are usually implicit in the detailed licensing conditions. The NRC's proposed revision of 10 CFR 20 (Fact Sheet 16B) states explicitly that the applicable annual limit of 500 mrem is based on exposure from all sources, including the sum of internal and external doses. An individual licensee will be in compliance with the annual limit of 500 mrem from all sources if he can demonstrate that sources under his control will not cause any individual to receive an annual dose equivalent in excess of 100 mrem. However, the EPA standard for the NRC-licensed fuel cycle, 40 CFR 190, (Fact Sheet 11) sets an annual limit for individual licensees of 25 mrem for whole body and most body organs, making the NRC limit effectively inoperative for this segment of its licensing purview. In addition to these applicable standards, for nuclear power plants the NRC sets ALARA design and operating conditions at 3 mrem per year for liquid effluents and 5 mrem per year for gaseous effluents.

This suggests that the rationales given in support of whole body dose equivalent limits have generally become more restrictive over time: from "no undue hazard" (Fact Sheet 1, published in 1960), to "no observable health effects" and "ample margin of safety" (Fact Sheet 16A, published in 1960), to ALARA (Fact Sheet 19, published in 1975), and cost effectiveness in risk reduction (Fact Sheet 11, published in 1977).

CONCLUSIONS AND RECOMMENDATIONS

A cursory review of the legal and technical facts contained in many of the basic U.S. radiation protection standards suggests that the standards are numerous and complex, principally control activities that make relatively small contributions to the overall U.S. population dose, have become more restrictive over time, and follow no common rationale in achieving public health objectives. CIRRPC can use the data base in these Fact Sheets to determine whether further review, analysis or coordination of U.S. standards is required to meet its policy coordination responsibilities. For example, using the Fact Sheets to examine protection and/or to compare cost-benefit tradeoffs in greater detail for consistency and trends over time would appear to have merit.

Should revisions of this compendium be undertaken it is recommended that the following suggestions be considered:

1. Consideration should be given to broadening the selection criteria for developing Fact Sheets to include other agency standards that control

basic radiation protection and, perhaps as suggested by one agency, existing memoranda of understanding between agencies.

2. Every two years the existing Fact Sheets should be updated to reflect any proposed or approved changes, and additional Fact Sheets in the same format should be added to reflect new regulations.

3. New or revised Fact Sheets should be reviewed by the responsible agencies so that recommended changes can be incorporated prior to publication.

Implementing these recommendations would enhance the usefulness of the compendium as a reference publication and ensure that it is current and factual.

PART II

RADIATION PROTECTION STANDARDS:
LEGAL AND TECHNICAL FACTS

PART II

RADIATION PROTECTION STANDARDS:

LEGAL AND TECHNICAL FACTS

LISTING OF FACT SHEETS

LISTING OF FACT SHEETS (CONTINUED)

NOTE: Quoted material contained in the following Fact Sheets was taken from a combination of the Federal statutes, laws, codes and other background documents cited in the particular Fact Sheets. Because the quoted material is extensive and the sources readily apparent, individual passages of material are not footnoted to keep the document as unencumbered and useful as possible.

FACT SHEET 1

FEDERAL GUIDANCE ON OCCUPATIONAL AND POPULATION RADIATION EXPOSURES (RPGs) (1960)

COMPLETE TITLE

FEDERAL RADIATION COUNCIL, RADIATION PROTECTION GUIDANCE FOR FEDERAL AGENCIES, MEMORANDUM FOR THE PRESIDENT, 25 FR 4402, May 18, 1960

1. AUTHORIZING STATUTE

Executive Order 10831 and Public Law 86-373 (added section 274 to the Atomic Energy Act of 1954).

Effective Date: September 23, 1959.

1.1 Statutory Purpose:

Section 274(h) established the Federal Radiation Council (FRC), noting that the "Council shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Council shall 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. . . ."

1.2 Radiation Protection Provisions:

The FRC has published eight staff reports. Three of these reports (3, 4, and 6) deal with doses from atmospheric fallout. The remaining five reports provide background on Federal guidance.

2. RESPONSIBLE AGENCIES

The Federal Radiation Council (FRC). The FRC consisted of the Secretary of Agriculture, the Secretary of Health, Education and Welfare (HEW) [now Health and Human Services (HHS)], the Secretaries of Defense, Labor, and Commerce and the Chairman of the Atomic Energy Commission (AEC) [now Department of Energy (DOE) and Nuclear Regulatory Commission (NRC)].

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF FEDERAL GUIDANCE ON OCCUPATIONAL AND POPULATION RADIATION EXPOSURES (RPGs) (1960)

Issuances:

25 FR 4402, May 18, 1960.

Effective Date: May 13, 1960, signed by President Dwight D. Eisenhower.

Background:

FRC Staff Report No. 1, "Background Material for the Development of Radiation Protection Standards," May 13, 1960.

3.1 General Radiation Protection Provisions:

Radiation Protection Guides (RPGs) set dose limits for radiation workers and the general population.

3.2 Rationale for Detailed Requirements:

3.2.1 RPGs are established "to allow the beneficial use of ionizing radiation, while assuring that man is not exposed to undue hazard." FRC considered the benefits of energy, industrial, and medical uses of ionizing radiation, balanced with the known health hazards associated with acute or chronic radiation exposure.

3.2.2 FRC assumed a linear relationship between biological effect and the amount of dose, which permits one to relate a very low dose to an assumed biological effect even though the effect is not detectable except at higher doses. In this way the actual biological effect should not exceed the amount assumed.

3.2.3 In addition, FRC, due to the lack of data, especially with respect to the biological effects at very low doses and low dose-rates, found that it could not assume that there is a level of radiation exposure below which there is absolute certainty that no effect may occur.

3.3 Description of Detailed Requirements:

3.3.1 "There should not be any man-made radiation exposure without the expectation of benefit resulting from such exposure. . . . Activities resulting in man-made radiation exposure should be authorized for useful applications provided recommendations set forth herein are followed."

3.3.2 Radiation Protection Guide (RPG). RPG is defined as "the radiation dose which should not be exceeded without careful consideration of the reasons for doing so; every effort should be made to encourage the maintenance of radiation doses as far below this guide as practicable."

3.3.3 The following RPGs apply to normal peacetime operations:

Type of Exposure		Condition	Dose (rem)
Radiation Worker			
(a)	Whole body, head and trunk, active blood-forming organs, gonads, or lens of eye	Accumulated Dose	5 times number of years beyond age 18
		13 weeks	3
(b)	Skin of whole body and thyroid	Year	30
		13 weeks	10
(c)	Hands and forearms, feet and ankles	Year	75
		13 weeks	25
(d)	Bone	Body burden	0.1 microgram of radium-226 or its biological equivalent
(e)	Other organs	Year	15
		13 weeks	5
Population			
(a)	Individual	Year	0.5 (whole body)
(b)	Average	30 years	5 (gonads)

Notes to above detailed requirements:

(1) When "the individual whole-body doses for the population are not known, a suitable sample of the exposed population should be developed whose protection guide for annual whole-body dose will be 0.17 rem per capita per year." (This can be modified to meet special situations.)

(2) "The annual individual whole-body dose of 0.5 rem is likely in the immediate future to assure that the gonadal exposure guide (5 rem in 30 years) is not exceeded."

(3) The "[g]uides do not differ substantially from . . . recommendations . . . made by the National Committee on Radiation Protection and Measurements, the National Academy of Sciences, and the International Commission on Radiological Protection."

(4) "There can be no single permissible or acceptable level of exposure without regard to the reason for permitting the exposure. It should be general practice to reduce exposure to radiation. . . . [E]xposure . . . should result from a real determination of its necessity."

(5) The guides are not intended to apply to natural background radiation exposure or the exposure of patients for medical reasons.

(6) The guides are set well below the level where biological damage has been observed in humans.

(7) There can be different Radiation Protection Guides with different numerical values, depending upon the circumstances.

3.3.4 Radioactivity Concentration Guide (RCG). RCG is defined as "the concentration of radioactivity in the environment which is determined to result in whole-body or organ doses equal to the [RPG]."

No specific RCGs are given. "However, concentration guides now used by the agencies appear appropriate on an interim basis."

3.3.5 The guides may "be exceeded only after the Federal agency having jurisdiction over the matter has carefully considered the reason for doing so in light of recommendations [3.3.1 through 3.3.4 above]."

4. RELATED STANDARDS

Federal Guidance on Occupational Radiation Exposures (RPGs) (1987). (See FACT SHEET 2.)

Federal Guidance on Radon Exposures in Uranium Mines (1969). (See FACT SHEET 3.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

Proposed Federal Radiation Protection Guidance on Transuranics in the Environment (RPGs) (1977). (See FACT SHEET 6.)

40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986). (See FACT SHEET 9.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985). (See FACT SHEET 13.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

40 CFR 220-229, EPA Regulations and Criteria for Ocean Dumping of Radioactive Materials (1977). (See FACT SHEET 15.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

10 CFR 61, NRC Requirements for Land Disposal of Low-Level Radioactive Waste (1975). (See FACT SHEET 18.)

10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975). (See FACT SHEET 19.)

29 CFR 1910.96, OSHA Ionizing Radiation Protection Standards (1971). (See FACT SHEET 20.)

21 CFR 1020, FDA Performance Standards for Ionizing Radiation Emitting Products (1973). (See FACT SHEET 21.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

40 CFR 194, EPA Advance Notice of Proposed Rulemaking: Radiation Protection Criteria for Cleanup of Land and Facilities Contaminated With Residual Radioactive Materials, 51 FR 22264, June 19, 1986.

40 CFR 193, EPA Advance Notice of Proposed Rulemaking for Low-Level Radioactive Waste Disposal, 48 FR 39563, August 31, 1978.

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

30 CFR 57, MSHA Safety and Health Radiation Standards for Underground Metal and Nonmetal Mines (1977). (See FACT SHEET 23A.)

30 CFR 57, MSHA Proposed Ionizing Radiation Standards for Underground Metal and Nonmetal Mines (1986). (See FACT SHEET 23B.)

NRC Safety Goals for the Operations of Nuclear Power Plants; Policy Statement, August 4, 1986.

FACT SHEET 2

FEDERAL GUIDANCE ON OCCUPATIONAL RADIATION EXPOSURES (RPGs) (1987)

COMPLETE TITLE

RADIATION PROTECTION GUIDANCE TO FEDERAL AGENCIES FOR OCCUPATIONAL EXPOSURE, 52 FR 2822, January 27, 1987

1. AUTHORIZING STATUTE

Executive Order 10831 and Public Law 86-373, which added section 274 to the Atomic Energy Act of 1954, and the President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88).

Effective Date: December 2, 1970.

1.1 Statutory Purpose:

Reorganization Plan No. 3 modified Section 274(h) of the Atomic Energy Act to read "the Administrator [of the EPA] shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Administrator shall 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. . . ."

1.2 Radiation Protection Provisions:

The Administrator has published two staff reports that apply to all Federal agencies concerned with radiation protection. Recommendations based on one of these reports were published by Presidential Order as Federal Radiation Protection Guidance. The other provided Radioactivity Concentration Guides.

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF FEDERAL GUIDANCE ON OCCUPATIONAL RADIATION EXPOSURES (RPGs) (1987)

Issuances:

52 FR 2822, January 27, 1987.

Effective Date: January 20, 1987, signed by President Ronald Reagan.

Background:

Federal Guidance Report No. 10, "The Radioactivity Concentration Guides," EPA 520/1-84-010 (December 1984); "Federal Radiation Protection Guidance for Occupational Exposure—Response to Comments," EPA 520/1-84-011 (May 1984); FRC Staff Report No. 1, "Background Material for the Development of Radiation Protection Standards," May 13, 1960 and 24 FR 4402, May 18, 1960; 44 FR 53785, September 17, 1979; and 46 FR 7836, January 23, 1981.

3.1 General Radiation Protection Provisions:

The recommendations replace that part of existing guidance [Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960), see FACT SHEET 1] which applies to workers and includes both qualitative guidance on radiation protection and numerical guides for maximum allowed dose equivalents. The portions of that guidance which apply to the general public are not changed by this guidance. The most significant changes from the 1960 guidance are: the RPG for whole-body dose is reduced by more than half [i.e., from 3 rem per quarter and 5(N-18) (where N is the age of the worker) to 5 rem effective dose equivalent incurred in any year]; the guidance on internal doses takes into account the sum of the risks to all organs, rather than continue to be based only on the most significantly exposed organ; the RPGs for whole-body effective dose equivalent apply to the appropriately weighted sum of the doses from both internal and external exposures; and the dose to the embryo and the fetus is limited to a level well below that for adult workers.

3.2 Rationale for Detailed Requirements:

3.2.1 The 5 rem/year RPG for whole-body exposure complies with the current internationally accepted value; there exist essential jobs requiring near 5 rem per year exposure; and risks to the few workers in these jobs are not high compared to other industrial hazards.

3.2.2 It is assumed that any exposure carries some risk; thus it is important to avoid unnecessary exposures at any level.

3.3 Description of Detailed Requirements:

3.3.1 All occupational exposure should be justified by the net benefit of the activity causing the exposure. The justification should include comparable consideration of alternatives not requiring radiation exposure.

3.3.2 For any justified activity, a sustained effort should be made to ensure the collective dose is "as low as is reasonably achievable" (ALARA).

3.3.3 The radiation dose to individuals should conform to the numerical RPGs specified below. Individual doses should be maintained as far below these RPGs as is reasonably achievable.

Radiation Protection Guides (RPGs):

A. "Radiation doses received as a result of occupational exposure should not exceed the limiting values for assessed dose to individual workers specified below. These are given separately for protection against different types of effects on health and apply to the sum of doses from external and internal sources of radiation."

B. "For cancer and genetic effects, the limiting value is specified in terms of a derived quantity called the effective dose equivalent. For other health effects, the limiting values are specified in terms of the dose equivalent to specific organs or tissues."

C. For cancer and genetic effects, "[t]he effective dose equivalent, H_E, received in any year by an adult worker should not exceed 5 rem (0.05 sievert).[1/] The effective dose equivalent is defined as:

$$H_E = \sum_T w_T \; H_T,$$

where w_T is a weighting factor and H_T is the annual dose equivalent averaged over organ or tissue T. Values of w_T and their corresponding organs and tissues are:

Gonads	0.25
Breasts	0.15
Red bone marrow	0.12
Lungs	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder[2/]	0.30

For the case of uniform irradiation of the whole body, where H_T may be assumed the same for each organ or tissue, the

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1/ The unit of dose equivalent in the system of special quantities for ionizing radiation currently in use in the United States is the "rem." In the recently-adopted international system (SI) the unit of dose equivalent is the "sievert." One sievert = 100 rem.

2/ "Remainder" means the five other organs with the highest doses. The weighting factor for each such organ is 0.06.

effective dose equivalent is equal to the dose equivalent to the whole body."

D. For other health effects, the dose equivalent, H_T, received in any year by an adult worker (in addition to the limitation on effective dose equivalent) should not exceed the following:

Lens of the eye	15 rem
Any other organ or tissue (including the skin)	50 rem
Any extremity[1/]	50 rem

E. The annual intake of radionuclides in the workplace should be limited such that (a) "the anticipated magnitude of the committed effective dose equivalent from such intake plus any annual effective dose equivalent from external exposure will not exceed 5 rem (0.05 sievert); and (b) the anticipated magnitude of the committed dose equivalent to any organ or tissue from such intake plus any annual dose equivalent from external exposure will not exceed 50 rem (0.5 sievert). The committed effective dose equivalent from internal sources of radiation, $H_{E,50}$, is defined as

$$H_{E,50} = \sum_T w_T \; H_{T,50},$$

where w_T is defined as in [3.3.3.C above], and the committed dose equivalent, $H_{T,50}$, is the sum of all dose equivalents to organ or tissue T that may accumulate over an individual's anticipated remaining lifetime (taken as 50 years) from radionuclides that are retained in the body."

F. "Occupational dose equivalents to individuals under the age of eighteen should be limited to one-tenth of the [RPGs] for adult workers."

G. "Exposure of an unborn child should be less than that of adult workers. . . . [I]n any case, it should not exceed 0.5 rem (0.005 sievert) during the entire gestation period."

H. In exceptional circumstances the RPGs may be exceeded, but only if the Federal agency having jurisdiction carefully considers the reasons for doing so and publicly discloses them.

Notes to above detailed requirements:

(1) "Occupational exposure of workers does not include that due to normal background radiation and exposure as a patient" for medical reasons.

(2) "The existing Federal guidance (34 FR 576 and 36 FR 12921) for limiting exposure for underground miners to radon decay products applies

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1/ "Extremity" means the forearms and hands, or the lower legs and feet.

independently of, and is not changed by these recommendations." (See FACT SHEET 3.)

(3) "The values specified by the International Commission on Radiological Protection (ICRP) for quality factors and dosimetric conventions for the various types of radiation, the models for reference persons, and the results of their dosimetric methods and metabolic models may be used for determining conformance to these recommendations."

(4) "'Annual Limits on Intake' (ALIs) and/or 'Derived Air Concentrations' (DACs) may be used to limit radiation exposure from intake of or immersion in radionuclides. The ALI or DAC for a single radionuclide is the maximum intake in a year or average air concentration for a working year, respectively, for a reference person that, in the absence of any external dose, satisfies the conditions on committed effective dose equivalent and committed dose equivalent of Recommendation 4. ALIs and DACs may be derived from different chemical or physical forms of radioactive materials."

(5) "The numerical values provided by these recommendations do not apply to workers responsible for the management of or response to emergencies."

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Radon Exposures in Uranium Mines (1969). (See FACT SHEET 3.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

29 CFR 1910.96, OSHA Ionizing Radiation Protection Standards (1971). (See FACT SHEET 20.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

FACT SHEET 3

FEDERAL GUIDANCE ON RADON EXPOSURES IN URANIUM MINES (1969)

COMPLETE TITLE

FEDERAL RADIATION COUNCIL REPORT NO. 8, GUIDANCE FOR THE CONTROL OF RADIATION HAZARDS IN URANIUM MINING, 34 FR 576, JANUARY 15, 1969

1. AUTHORIZING STATUTE

Executive Order 10831 and Public Law 86-373 (added section 274 to the Atomic Energy Act of 1954).

Effective Date: September 23, 1959.

1.1 Statutory Purpose:

Section 274(h) established the Federal Radiation Council (FRC), noting that the "Council shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Council shall 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. . . ."

1.2 Radiation Protection Provisions:

The FRC has published eight staff reports. Three of these reports (3, 4, and 6) deal with doses from atmospheric fallout. The remaining five reports provide background on Federal guidance.

2. RESPONSIBLE AGENCIES

The Federal Radiation Council (FRC). The FRC consisted of the Secretary of Agriculture, the Secretary of Health, Education and Welfare (HEW) [now Health and Human Services (HHS)], the Secretaries of Defense, Labor, and Commerce and the Chairman of the Atomic Energy Commission (AEC) [now Department of Energy (DOE) and Nuclear Regulatory Commission (NRC)].

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

The Mine Safety and Health Administration (MSHA). MSHA, under The Department of Labor (DOL), and formerly known as The Mining Enforcement and Safety Administration (MESA) and The Bureau of Mines, is responsible for promulgating

regulations for the metal and nonmetal mining industry to ensure that the Agency's standards appropriately address the hazards of ionizing radiation.

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF FEDERAL GUIDANCE ON RADON EXPOSURES IN URANIUM MINES (1969)

Issuances:

32 FR 11183, August 1, 1967; 34 FR 576, January 15, 1969; 35 FR 19218, December 18, 1970; 36 FR 9480, May 25, 1971; and 36 FR 12921, July 9, 1971.

Effective Date: July 1, 1971 (signed by President Richard M. Nixon on December 15, 1970).

Background:

FRC Staff Report No. 8, "Guidance for the Control of Radiation Hazards in Uranium Mining," September 1967 (Revised); Interagency Uranium Mining Radiation Review Group Report, summaries of subgroup reports, and conclusions of the National Academy of Sciences/National Research Council report, "Epidemiologic Studies of Uranium Miners," 36 FR 9480, May 25, 1971.

3.1 General Radiation Protection Provisions:

Recommendations are made to control the occupational exposure of miners to radionuclides (radon daughters) that are produced by radon decay in underground uranium mines. This is achieved by a limit on exposure to radon daughters, as well as requirements for recordkeeping and monitoring of mine air.

3.2 Rationale for Detailed Requirements:

3.2.1 "In prior reports the Federal Radiation Council has expressed the philosophy that guidance for radiation protection involves achieving a balance between the risk of radiation-induced injury and the benefits derived from the practice causing the exposure to radiation. An implicit part of such a balance is a necessity for considering the relation between the difficulties involved in reducing radiation exposure by a given amount and the risk that might be associated with that amount of exposure."

3.2.2 "It has been observed that underground uranium miners have a higher incidence of lung cancer than is found in the male population in the same geographic area. Continued exposure to the radioactive decay products of the naturally occurring gas radon-222 has been implicated as an important cause of this increased incidence. The decay products of radon-222 (radon daughters) of interest are: polonium-218, lead-214, bismuth-214 and polonium-214. . . . The principal radiation hazard is associated with the inhalation of mine air containing radionuclides that irradiate lung tissue nonuniformly. The most serious result is the development of lung cancer, which

generally does not appear for 10 to 20 years after the individual started uranium mining."

3.2.3 ". . . available data indicate a higher than expected mortality rate in the lower exposure categories (i.e., less than 840 WLM) as well as in the higher exposure categories (i.e., larger than 840 WLM)."

3.2.4 The EPA Administrator reached the following conclusions:

A. The major areas of consideration in connection with determining radiation protection guidance for uranium mining are:

i. Health protection of uranium miners.

ii. "Technical feasibility of achieving various levels of exposure."

iii. "Economic impact of achieving various levels of exposure."

B. "The primary objective of EPA guidance for underground uranium mining is to protect miners from radiation-induced lung cancer."

C. "A standard of 4 WLM per year is technically feasible."

D. "A standard of 4 WLM per year would not have a severe impact on the underground uranium mining community, provided additional time is allowed for compliance in certain instances."

E. "A standard greater than 4 WLM per year would probably result in dosages exceeding those permitted for other occupational radiation exposure situations."

F. "The risk of lung cancer appears to be enhanced by cigarette smoking in combination with the inhalation of radioactive materials; therefore, smoking by underground uranium miners should continue to be discouraged."

3.3 Description of Detailed Requirements:

3.3.1 Working Level (WL). WL is defined as "any combination of radon daughters in one liter of air that will result in the ultimate emission of 1.3 X 10^5 MeV of potential alpha energy. . . . Inhalation of air containing a radon daughter concentration of 1 WL for 170 hours results in an exposure of 1 Working Level Month (WLM)."

3.3.2 The occupational exposure to radon daughters in underground uranium mines must be controlled so that no individual miner will receive an exposure of more than 4 WLM per year as of January 1, 1971.

3.3.3 "Areas in underground uranium mines, whether normally or occasionally occupied, [must] be monitored for the concentration of radon daughters in mine air."

3.3.4 Appropriate records of the exposure received by individuals working in uranium mines from radon daughters in the mine air must be established and maintained.

4. RELATED STANDARDS

Federal Guidance on Occupational Radiation Exposures (RPGs) (1987). (See FACT SHEET 2.)

30 CFR 57, MSHA Safety and Health Radiation Standards for Underground Metal and Nonmetal Mines (1977). (See FACT SHEET 23A.)

30 CFR 57, MSHA Proposed Ionizing Radiation Standards for Underground Metal and Nonmetal Mines (1986). (See FACT SHEET 23B.)

FACT SHEET 4

FEDERAL GUIDANCE ON LIMITING CERTAIN INTERNAL RADIATION EXPOSURES (RPGs) (1961)

COMPLETE TITLE

FEDERAL RADIATION COUNCIL, RADIATION PROTECTION GUIDANCE FOR FEDERAL AGENCIES, MEMORANDUM FOR THE PRESIDENT, 26 FR 9057, September 26, 1961

1. AUTHORIZING STATUTE

Executive Order 10831 and Public Law 86-373 (added section 274 to the Atomic Energy Act of 1954).

Effective Date: September 23, 1959.

1.1 Statutory Purpose:

Section 274(h) established the Federal Radiation Council (FRC), noting that the "Council shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Council shall 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. . . ."

1.2 Radiation Protection Provisions:

The FRC has published eight staff reports. Three of these reports (3, 4, and 6) deal with doses from atmospheric fallout. The remaining five reports provide background on Federal guidance.

2. RESPONSIBLE AGENCIES

The Federal Radiation Council (FRC). The FRC consisted of the Secretary of Agriculture, the Secretary of Health, Education and Welfare (HEW) [now Health and Human Services (HHS)], the Secretaries of Defense, Labor, and Commerce and the Chairman of the Atomic Energy Commission (AEC) [now Department of Energy (DOE) and Nuclear Regulatory Commission (NRC)].

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF FEDERAL GUIDANCE ON LIMITING CERTAIN INTERNAL RADIATION EXPOSURES (RPGs) (1961)

Issuances:

26 FR 9057, September 26, 1961.

Effective Date: September 20, 1961, signed by President John F. Kennedy.

Background:

FRC Staff Report No. 2, "Background Material for the Development of Radiation Protection Standards," September, 1961.

3.1 General Radiation Protection Provisions:

Recommendations are made "to limit exposure of members of population groups to radiation from radioactive materials deposited in the body as a result of their occurrence in the environment." This is achieved through: "Radiation Protection Guides (RPGs) for certain organs of individuals in the general population, as well as averages over suitable samples of exposed groups; guidance on general principles of control applicable to all radionuclides occurring in the environment; and specific guidance for exposure of population groups to radium-226, iodine-131, strontium-90, and strontium-89."

3.2 Rationale for Detailed Requirements:

3.2.1 ". . . any radiation exposure of the population involves some risk; *the magnitude of which increases with increases of exposure.*"

3.2.2 *"Establishment of radiation protection standards involves a balancing* of the benefits to be derived from the controlled use of radiation and atomic energy against the risk of radiation exposure."

3.2.3 "Specific attention was directed to problems associated with radium-226, iodine-131, strontium-90, and strontium-89. Radium-226 is an important naturally occurring radioactive material. The other three were present in fallout from nuclear weapons testing. They could, under certain circumstances, also be major constituents of radioactive materials released to the environment from large scale *atomic energy installations used for peaceful purposes.*"

3.2.4 "*Concentrations of iodine-131 in the diets of small children,* particularly in milk, equal to those permitted under current standards would lead to radiation doses to the child's thyroid which . . . would be too high. In the case of iodine-131 in milk, consumption of milk and retention of iodine by the child may be at least as great as by the adult, while the relatively small size of the child's thyroid makes the radiation dose much larger (10 times) than in the case of the adult." In addition, irradiation of a child's thyroid involves greater risk, due to evidence that the adult thyroid is more radioresistant.

3.3 Description of Detailed Requirements:

3.3.1 Radiation Protection Guide (RPG). RPG is defined as "the radiation dose which should not be exceeded without careful consideration of the reasons for doing so; every effort should be made to encourage the maintenance of radiation doses as far below this guide as practicable."

3.3.2 The following RPGs apply to public exposure during normal peacetime operations:

Organ	RPG for Individuals	RPG for Average of "Suitable Sample" of Exposed Population Group
Thyroid	1.5 rem per year	0.5 rem per year
Bone marrow	0.5 rem per year	0.17 rem per year
Bone	1.5 rem per year	0.5 rem per year
Bone (alternate guide)	0.003 micrograms of Ra-226 in the adult skeleton or the biological equivalent of this amount of Ra-226	0.001 micrograms of Ra-226 in the adult skeleton or the biological equivalent of this amount of Ra-226

Note to above detailed requirements:

RPGs for "suitable sample" are one-third of those applying to individuals.

3.3.3 Control of population exposure to radionuclides in the environment is accomplished either by restricting the entry into the environment of the materials or by limiting the human intake of materials already in the environment. Controls of exposure should be based on an evaluation of population exposure with respect to the RPG. The total daily intake, averaged over periods of the order of a year, constitutes an appropriate criterion.

3.3.4 The radiological health activities of Federal agencies in connection with environmental contamination by radioactive materials should be based on a graded scale of appropriate actions related to ranges of intake of radioactive materials by an exposed population group which, when averaged over periods of time of about a year, do not exceed the upper value of Range II.

Generally the Graded Scale should be as follows:

Ranges of Transient Rates of Daily Intake	Graded Scale of Action
Range I	Periodic confirmatory surveillance as necessary.
Range II	Quantitative surveillance and routine control.
Range III	Evaluation and application of additional control measures as necessary.

3.3.5 The following guidance on daily intake (in micromicrocuries per day) for normal peacetime operations is to be applied to the average of suitable samples of an exposed population group:

Radionuclides	Range I	Range II	Range III
Radium-226	0 - 2	2 - 20	20 - 200
Iodine-131	0 - 10	10 - 100	100 - 1,000
Strontium-90	0 - 20	20 - 200	200 - 2,000
Strontium-89	0 - 200	200 - 2,000	2,000 - 20,000

1/ In the case of iodine-131, the suitable sample would include only small children. For adults, the RPG for the thyroid would not be exceeded by rates of intake higher by a factor of 10 than those applicable to small children.

Note to above detailed requirements:

"The upper limit of Range II is based on an annual RPG . . . considered as an acceptable risk for a lifetime." The upper limit for strontium is even lower because there is no known operational requirement for an intake as high as the RPG. The "values listed in the tables are much smaller than any single intake from which an individual might be expected to sustain injury."

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Proposed Federal Radiation Protection Guidance on Transuranics in the Environment (RPGs) (1977). (See FACT SHEET 6.)

40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986). (See FACT SHEET 9.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985). (See FACT SHEET 13.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975). (See FACT SHEET 19.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

NRC Safety Goals for the Operations of Nuclear Power Plants; Policy Statement, August 4, 1986.

FACT SHEET 5

FEDERAL GUIDANCE ON DIAGNOSTIC X-RAY EXPOSURES (RPGs) (1978)

COMPLETE TITLE

GUIDANCE TO FEDERAL AGENCIES FOR DIAGNOSTIC X-RAYS, 43 FR 4377, February 1, 1978

1. AUTHORIZING STATUTES:

Executive Order 10831 and Public Law 86-373, which added section 274 to the Atomic Energy Act of 1954, and the President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88).

Radiation Control for Health and Safety Act of 1968, Public Law 90-602; the Public Health Service Act, 42 U.S.C. 351 et seq.; and the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. 321 et seq.

Effective Dates:

Public Law 86-373, September 23, 1959; Radiation Control for Health and Safety Act of 1968 (Public Law 90-602), October 18, 1968.

1.1 Statutory Purposes:

1.1.1 Reorganization Plan No. 3 modified Section 274(h) of the Atomic Energy Act to read "the Administrator [of the EPA] shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Administrator shall 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. . . ."

1.1.2 The purpose of the Radiation Control for Health and Safety Act is "to provide . . . an electronic product radiation control program which shall include the development and administration of performance standards to control the emission of electronic product radiation . . . and the undertaking . . . of research and investigation into the effects and control of such radiation emissions."

1.2 Radiation Protection Provisions:

1.2.1 The Administrator has published two staff reports that apply to all Federal agencies concerned with radiation protection. Recommendations based on one of these reports were published by Presidential

Order as Federal Radiation Protection Guidance. The other provided Radioactivity Concentration Guides.

1.2.2 Under the Radiation Control for Health and Safety Act, the Public Health Service Act, and the Federal Food, Drug, and Cosmetic Act, the Assistant Secretary for Health in the Department of Health and Human Services (HHS), has the responsibility (which has been delegated to the Food and Drug Administration) of developing a program of radiation protection which includes: research and training concerning radiation hazards, recommendations for radiation users, advice to states, information for the public, performance standards for electronic products that emit radiation, and regulations for the sale, distribution, and use of medical devices. (These programs are described in 21 CFR 1000 to 21 CFR 1050 and/or FDA publications.)

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

The Department of Health and Human Services (HHS). The Assistant Secretary for Health has delegated the responsibility of setting policy for health care and the use of radiation in the healing arts to The Food and Drug Administration (FDA).

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF FEDERAL GUIDANCE ON DIAGNOSTIC X-RAY EXPOSURES (RPGs) (1978)

Issuances:

43 FR 4377, February 1, 1978.

Effective Date: January 26, 1978, signed by President Jimmy Carter.

3.1 General Radiation Protection Provisions:

Recommendations are made to reduce exposure from diagnostic use of x-rays in Federal facilities and Federally-sponsored programs by eliminating clinically unproductive examinations, assuring the use of optimal examination techniques, and requiring appropriate equipment. Also, Entrance Skin Exposure Guides (ESEGs) are set for various x-ray examinations.

3.2 Rationale for Detailed Requirements:

3.2.1 "Technique appropriate to the equipment and materials available should be used to maintain exposure as low as is reasonably achievable without loss of requisite diagnostic information."

3.2.2 According to a 1972 National Academy of Sciences/National Research Council report, "medical diagnostic radiology accounts for at least 90% of the total man-made radiation dose to which the U.S. population is exposed."

3.3 Description of Detailed Requirements:

3.3.1 "General radiographic or fluoroscopic examinations should be prescribed only by licensable Doctors of Medicine or Osteopathy or, for specified limited procedures, postgraduate physician trainees and qualified allied medical professionals under their direct supervision; specialized studies should be prescribed only by those physicians with expertise to evaluate examinations in the particular specialty. Exception for specified procedures may be made for dentists and podiatrists."

3.3.2 "Prescription of x-ray studies should be for the purpose of obtaining diagnostic information, should be based on clinical evaluation of symptomatic patients, and should state the diagnostic objective and detail relevant medical history."

3.3.3 "Routine or screening examinations, in which no prior clinical evaluation of the patient is made, should not be performed unless exception has been made for specified groups of people on the basis of a careful consideration of the magnitude and medical benefit of the diagnostic yield, radiation risk, and economic and social factors."

3.3.4 "Prescription of x-ray examinations of pregnant or possibly pregnant patients should assure that medical consideration has been given to possible fetal exposure and appropriate protective measures are applied."

3.3.5 "X-ray equipment used in Federal facilities should meet the Federal Diagnostic X-Ray Equipment Performance Standard."

3.3.6 "Techniques appropriate to the equipment and materials available should be used to maintain exposure as low as is reasonably achievable without loss of requisite diagnostic information; measures should be undertaken to evaluate and reduce, where practicable, exposures for routine nonspecialty examinations which exceed the following Entrance Skin Exposure Guides (ESEG):

Examination (Projection)	ESEG (milliroentgens)*
Chest (P/A)	30
Skull (Lateral)	300
Abdomen (A/P)	750
Cervical Spine (A/P)	250
Thoracic Spine (A/P)	900
Full Spine (A/P)	300
Lumbo-Sacral Spine (A/P)	1,000
Retrograde Pyelogram (A/P)	900
Feet (D/P)	270
Dental (Bitewing or Peripheral)	700

* Entrance skin exposure determined by the Nationwide Evaluation of X-Ray Trends program for a patient having the following body part/thickness: head/15 cm, neck/13 cm, thorax/23 cm, abdomen/23 cm, and feet/8 cm."

3.3.7 "X-ray examinations for dental purposes should be prescribed only by licensable Doctors of Dental Surgery or Dental Medicine or properly supervised postgraduate dentists on the basis of prior clinical evaluation or pertinent history."

4. RELATED STANDARDS

21 CFR 1020, FDA Performance Standards for Ionizing Radiation Emitting Products (1973). (See FACT SHEET 21.)

10 CFR 35, Human Uses of Byproduct Material, 30 FR 8200, June 26, 1965. (Prescribes NRC regulations governing the licensing of byproduct material for human uses.)

FACT SHEET 6

PROPOSED FEDERAL RADIATION PROTECTION GUIDANCE ON TRANSURANICS IN THE ENVIRONMENT (RPGs) (1977)

COMPLETE TITLE

PERSONS EXPOSED TO TRANSURANIUM ELEMENTS IN THE ENVIRONMENT, (PROPOSED) FEDERAL RADIATION PROTECTION GUIDANCE ON DOSE LIMITS, 42 FR 60956, November 30, 1977

1. AUTHORIZING STATUTE

Executive Order 10831 and Public Law 86-373, which added section 274 to the Atomic Energy Act of 1954, and the President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88).

Effective Date: September 23, 1959.

1.1 Statutory Purpose:

Reorganization Plan No. 3 modified Section 274(h) of the Atomic Energy Act to read "the Administrator [of the EPA] shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Administrator shall 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. . . ."

1.2 Radiation Protection Provisions:

The Administrator has published two staff reports that apply to all Federal agencies concerned with radiation protection. Recommendations based on one of these reports were published by Presidential Order as Federal Radiation Protection Guidance. The other provided Radioactivity Concentration Guides.

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF PROPOSED FEDERAL RADIATION PROTECTION GUIDANCE ON TRANSURANICS IN THE ENVIRONMENT (RPGs) (1977)

Issuances: 42 FR 60956, November 30, 1977.

Effective Date: The guidance was published in proposed form on November 30, 1977. Public comment deadline was February 28, 1978. The guides have not been signed by the President.

3.1 General Radiation Provisions:

3.1.1 The proposed guidance contains "recommendations intended to assure protection of the public health by limiting the radiation doses persons may receive from transuranium elements present in the environment as a result of existing or possible future unplanned contamination. The guidance considers both the inhalation and ingestion pathway of transuranium elements . . . and establish[es] a maximum dose rate to lung and bone."

3.1.2 "The scope of the proposed guidance includes all transuranium element contamination in the general environment from all sources."

3.2 Rationale for Detailed Requirements:

3.2.1 "Two primary criteria used in deriving the guidance were: that any added risk to an individual from exposure to transuranium elements be very small, and that any actions required by implementation of the guidance be practical in terms of overall economic requirements."

3.2.2 "The agency has found that the costs of remedial actions and benefits of risk reduction differ so greatly between contaminated sites that generic guidance applicable to all sites cannot be provided by formal benefit-cost procedures."

3.3.3 "The [health] risk at the proposed guidance level is estimated to be less than one chance in a million per year and less than ten chances per hundred thousand in a lifetime that an individual would develop a cancer from continuous exposure at the stated dose rates."1/

1/ "The radiation risk due to inhalation of transuranium elements is primarily lung cancer. Additional risks may result from translocation of a small fraction of the transuranium elements from the lung to other body organs, especially to the liver and bone. On the basis of models, it was estimated that, for a cohort of 100,000 persons followed through their entire lifetimes, the continuous inhalation over their lifetimes of transuranium aerosols leading to an average annual [intake] to the pulmonary tissue of 1 mrad/year per person could potentially result in 10 premature cancer deaths. For an average lifespan of 71 years, the annual risk to each person from lifetime exposure at this level is about one per million per year.

"The radiation risk due to ingestion of transuranium elements is primarily bone and liver cancers. In a cohort of 100,000 persons, continuous ingestion over a

3.2.4 "The costs of implementing the guidance can be expected to vary by location, contamination level, and other factors. A minimum cost of $500.00 per acre has been assumed for estimating the total cost . . . [of bringing contaminated] areas . . . into compliance. It can be concluded that the costs of implementing the guidance at the reference level would be reasonable and achievable, but that the cumulative costs increase rapidly when lower guidance limits are considered."

3.3 Description of Detailed Requirements:

3.3.1 "The annual alpha radiation dose to members of the critical segment of the exposed population as the result of exposure to transuranium elements in the general environment should not exceed either:

"1 millirad per year to the pulmonary lung, or
"3 millirad per year to the bone."

3.3.2 "For newly contaminated areas, control measures should be taken to minimize both residual levels and radiation exposures of the general public. The control measures are expected to result in levels well below those specified [above]. Compliance . . . should be achieved within a reasonable period of time."

3.3.3 The recommendations are to be used only for guidance on possible remedial actions in instances of existing, or possible future unplanned contamination. They are not to be used as limits for planned releases.

3.3.4 Definitions:

Critical segment of the exposed population is defined as "that group of persons within the exposed population receiving the highest radiation dose to the pulmonary region of the lung or to the bone."

(cont.)

lifetime of a transuranium radionuclide at a level causing an average skeletal (bone) dose rate of 3 mrad per year 70 years after the start of ingestion could potentially result in less than 6 premature deaths from such cancers.

"Genetic damage is possible as a result of assimilation of transuranium elements in gonadal tissue. . . . [I]t can be estimated [with uncertainty] that, for continuous ingestion at the limits set by this proposed guidance, the total dose to gonadal tissue over 30 years of chronic exposure would be about 10 millirad. Such a gonadal dose to each of the parents is estimated to produce 1 to 20 genetic defects per 100,000 live births in the first generation. This number can be compared to the approximately 6,000 genetic defects normally observed in 100,000 live births.

"It must be recognized that these estimates are not precise, and have an uncertainty of at least a factor of three for cancer risk."

Millirad per year to the pulmonary lung is defined as "the equilibrium dose rate following chronic inhalation. This dose rate is calculated by dividing the alpha energy absorbed per year in the pulmonary lung by its mass."

Millirad per year to the bone is defined as "that dose rate attained after 70 years of chronic exposure. This dose rate is calculated by dividing the alpha energy absorbed in the bone during the 70th year by the bone mass."

General environment is defined as "the total terrestrial, atmospheric, and aquatic environments outside the boundaries of federally licensed facilities or outside the boundaries of sites under the direct control of a Federal agency."

3.3.5 "For practical reasons of facilitating implementation of the proposed guidance, derived numerical values for [transuranic] soil or air concentrations, which can reasonably be predicted to result in dose rates less than the guidance recommendations, could be substituted for site-specific values." The agency suggests the following would establish a reasonable "screening level:"

A. "A soil contamination level of 0.2 $\mu Ci/m^2$, for samples collected at the surface to a depth of 1 cm and for particle sizes under 2 mm."

B. "A derived air concentration based on an activity median aerodynamic particle diameter (AMAD) not to exceed 0.1 µm, which . . . could be equated to a limiting concentration of about 1 fCi/m^3 for alpha emitting transuranium nuclides."

"Areas which do not exceed the 'screening level' would generally be considered in compliance with the guidance. . . . [Areas] that exceed it would require more intensive evaluation to determine actual dose rates to exposed populations."

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

40 CFR 194, EPA Advance Notice of Proposed Rulemaking: Radiation Protection Criteria for Cleanup of Land and Facilities Contaminated With Residual Radioactive Materials, 51 FR 22264, June 19, 1986.

FACT SHEET 7

FEDERAL PROTECTIVE ACTION GUIDE (PAG) FOR I-131 (1964)

COMPLETE TITLE

FEDERAL RADIATION COUNCIL, RADIATION PROTECTION GUIDANCE FOR FEDERAL AGENCIES, MEMORANDUM FOR THE PRESIDENT, 29 FR 12056, August 22, 1964

1. AUTHORIZING STATUTE

Executive Order 10831 and Public Law 86-373 (added section 274 to the Atomic Energy Act of 1954).

Effective Date: August 23, 1959.

1.1 Statutory Purpose:

Section 274(h) established the Federal Radiation Council (FRC), noting that the "Council shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Council shall 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. . . ."

1.2 Radiation Protection Provisions:

The FRC has published eight staff reports. Three of these reports (3, 4, and 6) deal with doses from atmospheric fallout. The remaining five reports provide background on Federal guidance.

2. RESPONSIBLE AGENCIES

The Federal Radiation Council (FRC). The FRC consisted of the Secretary of Agriculture, the Secretary of Health, Education and Welfare (HEW) [now Health and Human Services (HHS)], the Secretaries of Defense, Labor, and Commerce and the Chairman of the Atomic Energy Commission (AEC) [now Department of Energy (DOE) and Nuclear Regulatory Commission (NRC)].

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF FEDERAL PROTECTIVE ACTION GUIDE (PAG) FOR I-131 (1964)

Issuances:

29 FR 12056, August 22, 1964.

Effective Date: July 31, 1964, signed by President Lyndon B. Johnson.

Background:

FRC Staff Report No. 5, "Background Material for the Development of Radiation Protection Standards," July 1964.

3.1 General Radiation Protection Provisions:

Recommendations are made to limit the exposure of members of the population to iodine-131 due to the ingestion of contaminated food, particularly fresh milk. This is achieved by a Protective Action Guide (PAG) for iodine-131.

3.2 Rationale for Detailed Requirements:

3.2.1 "The Council [FRC] is concerned with a balance between the risk of radiation exposure and the impact on the public well-being associated with alterations of the normal production, processing, distribution, and use of food."

3.2.2 "Protective actions are appropriate when the health benefits associated with the reduction in exposure to be achieved are sufficient to offset the undesirable features of protective actions. The PAG represents the Council's judgement as to where this balance should be for the conditions considered most likely to occur."

3.2.3 "A basic assumption in the development of the guidance in this memorandum is that a condition requiring protective action is unusual and should not be expected to occur frequently."

3.2.4 ". . . the Protective Action Guides are not intended to authorize deliberate releases expected to result in absorbed doses of these magnitudes."

3.2.5 ". . . the relatively high [fission] yield of iodine-131 and the short radioactive half-life (8 days) . . . make it the radionuclide most likely to reach concentrations justifying protective actions. This is especially true if the deposition occurs within a few days after the fission event. Protective action against iodine-131 must be taken promptly to be effective."

3.2.6 ". . . it is assumed that children one year of age . . . are the critical segment of the population."

3.2.7 The transmission of iodine-131 is most likely through the pasture-cow-milk-man food chain.

3.3 Description of Detailed Requirements:

3.3.1 Protective Action Guide (PAG). PAG is defined as "the projected absorbed dose to individuals in the general population which warrants protective action following a contaminating event." The projected dose is the dose that would be received by individuals in the population group from the contaminating event if no protective action is taken.

3.3.2 The PAG for iodine-131 is 30 rad to the thyroid for individuals.

3.3.3 The PAG for iodine-131 is 10 rad to the thyroid of a "suitable sample" of the exposed population group (made up of one-year-old infants).

3.3.4 If the projected dose exceeds the PAG, protective action is indicated.

3.3.5 "A protective action is an action or measure taken to avoid most of the exposure to radiation that would occur from future ingestion of foods contaminated (acute) with radioactive materials."

3.3.6 The types of actions which may be taken are:

A. "Altering production, processing, or distribution practices affecting the movement of radioactive contamination through the food chain and into the human body. This action includes storage of food supplies and animal feeds to allow for radioactive decay."

B. "Diverting affected products to uses other than human consumption."

C. "Condemning [affected] foods."

Measures that require alterations of the diet are generally less desirable than those listed and should not be undertaken except on the advice of competent medical authorities.

3.3.7 Two actions appear to provide the most acceptable combination of maximum effectiveness and minimum undesirable consequences for iodine-131 contamination:

A. Diversion of fresh milk to provide unaffected milk in the contaminated area and to use the affected milk in the production of dairy products that may be stored until the iodine-131 has effectively decayed, a matter of a few weeks.

B. Substitution of stored feed for pasture, until most of the iodine-131 has decayed.

4. RELATED STANDARDS

Federal Protective Action Guides (PAGs) for Sr-89, Sr-90 and Cs-137 (1965). (See FACT SHEET 8.)

Advisory FDA Protective Action Guides (PAGs) for Radioactive Contamination in Food (1982). (See FACT SHEET 22.)

Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, September 1975, Revised June 1980, EPA-520/1-75-001. (Provides action levels and guidance for their use by state and local agencies in developing radiological emergency plans.)

FACT SHEET 8

FEDERAL PROTECTIVE ACTION GUIDES (PAGs) FOR Sr-89, Sr-90 and Cs-137 (1965)

COMPLETE TITLE

FEDERAL RADIATION COUNCIL, RADIATION PROTECTION GUIDANCE FOR FEDERAL AGENCIES, MEMORANDUM FOR THE PRESIDENT, 30 FR 6953, May 22, 1965

1. AUTHORIZING STATUTE

Executive Order 10831 and Public Law 86-373 (added section 274 to the Atomic Energy Act of 1954).

Effective Date: September 23, 1959.

1.1 Statutory Purpose:

Section 274(h) established the Federal Radiation Council (FRC), noting that the "Council shall consult qualified scientists and experts in radiation matters, including the President of the National Academy of Sciences, the Chairman of the National Committee on Radiation Protection and Measurement, and qualified experts in the field of biology and medicine and in the field of health physics. . . . The Council shall 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. . . ."

1.2 Radiation Protection Provisions:

The FRC has published eight staff reports. Three of these reports (3, 4, and 6) deal with doses from atmospheric fallout. The remaining five reports provide background on Federal guidance.

2. RESPONSIBLE AGENCIES

The Federal Radiation Council (FRC). The FRC consisted of the Secretary of Agriculture, the Secretary of Health, Education and Welfare (HEW) [now Health and Human Services (HHS)], the Secretaries of Defense, Labor, and Commerce and the Chairman of the Atomic Energy Commission (AEC) [now Department of Energy (DOE) and Nuclear Regulatory Commission (NRC)].

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88) abolished the FRC and transferred its function to the Administrator of EPA.

All Federal Agencies. Federal guidance applies to all Federal agencies that have radiation protection responsibility.

3. DESCRIPTION OF FEDERAL PROTECTIVE ACTION GUIDES (PAGs) FOR Sr-89, Sr-90 and Cs-137 (1965)

Issuances:

30 FR 6953, May 22, 1965.

Effective Date: May 20, 1965, signed by President Lyndon B. Johnson.

Background:

FRC Staff Report No. 7, "Background Material for the Development of Radiation Protection Standards," May 1965.

3.1 General Radiation Protection Provisions:

Recommendations are made to limit the exposure of members of the population to strontium-90, strontium-89, and cesium-137 due to the ingestion of food. This is achieved by establishing Protective Action Guides (PAGs) for these radionuclides for three different dietary pathways of exposure.

3.2 Rationale for Detailed Requirements:

3.2.1 "The PAG represents a consensus as to when, under the conditions considered most likely to occur, intervention is indicated to avoid radiation exposure that would otherwise result from a transient environmental contamination condition. This judgment involves health, economic, sociologic, and political factors for which the relative values are different than for the RPG. These factors for the PAG may include agricultural policies, the known feasibility of protective actions, related health impacts, and similar considerations involved in the national interest."

3.2.2 "Protective actions are appropriate when the health benefits associated with the reduction in exposure to be achieved are sufficient to offset the undesirable features of the protective actions. The PAG represents the Council's judgment as to where this balance should be for the conditions considered most likely to occur."

3.2.3 "The Council [FRC] is concerned with a balance between the risk of radiation exposure and the impact on the public well-being associated with alterations of the normal production, processing, distribution, and use of food."

3.3 Description of Detailed Requirements:

A. Protective Action Guide (PAG). PAG is defined as "the projected absorbed dose to individuals in the general population that warrants protective action following a contaminating event." The projected dose is the dose that would be received by individuals in the population group from the contaminating event if no protective action were taken.

Dietary Pathway		Strontium-89, Strontium-90, Cesium-137
I. Transmission through pasture-cow-milk-man chain.		
	Individual	10 rad in the first year to the bone marrow or whole body
	Suitable sample of the exposed population (One-year-old infants)	3 rad in the first year to the bone marrow or whole body
Total dose from Category I not to exceed 15 rad (Total dose for Sr-89 and Cs-137 is assumed the same as the dose in the first year; total dose for Sr-90 is assumed to be five times the dose in the first year.)		
II. Transmission through feed crops to animals including dairy cattle, and plant crops used directly for human consumption.		
	Individual	5 rad in the first year to the bone marrow or whole body
	Suitable sample of the exposed population (One-year-old infants)	2 rad in the first year to the bone marrow or whole body
III. Long-term transmission through soil into plants		
	Individual	0.5 rad in the first year to the bone marrow or whole body
	Suitable sample of the exposed population (One-year-old infants)	0.2 rad in the first year to the bone marrow or whole body

The setting of PAGs is not intended to authorize deliberate releases expected to result in absorbed doses of these magnitudes.

4. RELATED STANDARDS

Proposed Federal Radiation Protection Guidance on Transuranics in the Environment (RPGs) (1977). (See FACT SHEET 6.)

Federal Protective Action Guide (PAG) for I-131 (1964). (See FACT SHEET 7.)

Advisory FDA Protective Action Guides (PAGs) for Radioactive Contamination in Food (1982). (See FACT SHEET 22.)

Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, September 1975, Revised June 1980, EPA-520/1-75-001. (Provides action levels and guidance for their use by state and local agencies in developing radiological emergency plans.)

FACT SHEET 9

40 CFR 61, EPA AIR EMISSION STANDARDS FOR RADIONUCLIDES (1985, 1986)

COMPLETE TITLE

40 CFR 61, NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS; STANDARDS FOR RADIONUCLIDES, 50 FR 5190, February 6, 1985; STANDARD FOR RADON-222 EMISSIONS FROM UNDERGROUND URANIUM MINES, 50 FR 15386, April 17, 1985; STANDARDS FOR RADON-222 EMISSIONS FROM LICENSED URANIUM MILL TAILINGS, 51 FR 34056, September 24, 1986

1. AUTHORIZING STATUTE

Section 120 of the Clean Air Act Amendments of 1977 (Public Law 95-95) (42 U.S.C. 7401 et seq.).

Effective Date: Clean Air Act, December 31, 1970; Amendments of 1977, August 7, 1977.

1.1 Statutory Purpose:

The purposes of the Clean Air Act are: "to protect . . . the Nation's air resources . . . to promote public health and welfare and . . . productive capacity; to initiate and accelerate national research and development to achieve the prevention and control of air pollution; to provide technical and financial assistance to State and local governments in connection with the development and execution of their air pollution prevention and control programs; and to encourage and assist . . . regional air pollution control programs."

1.2 Radiation Protection Provisions:

Section 122(a) of the Clean Air Act provides: "the Administrator [of the Environmental Protection Agency (EPA)] shall . . . determine whether or not emissions of radioactive pollutants (including source material, special nuclear material, and by-product material) . . . will cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health. If the Administrator makes an affirmative determination, . . . he shall . . . include such substance in the list published under section . . . 112(b)(1)(A) in the case of a substance which . . . causes, or contributes to air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness." This listing for radionuclides was made and issued in 44 FR 76738, December 27, 1979.

Section 112(b) of the Act provides: "The Administrator shall . . . publish (and shall from time to time thereafter revise) a list which includes each hazardous air pollutant for which he intends to establish an emission standard under this section." In addition, the Administrator "shall

publish . . . regulations establishing emission standards for such pollutant . . . and shall establish such standards at the level which in his judgment provides an ample margin of safety to protect the public health."

Section 112(c) provides that any emission standard shall become effective upon promulgation for "new sources," and apply 90 days after promulgation for "existing sources."

Section 112(e) provides: "[if] in the judgment of the Administrator, it is not feasible to prescribe or enforce an emission standard, . . . he may instead promulgate a design, equipment, work practice, or operational standard, . . . which in his judgment is adequate to protect the public health . . . with an ample margin of safety."

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). EPA is responsible for listing hazardous air pollutants, and once listed, promulgating, implementing, and enforcing emission standards or design, equipment, work practice, or operational standards.

The Nuclear Regulatory Commission (NRC). Under Clean Air Act §122, the NRC must be consulted by the EPA before any source material, special nuclear material, or by-product material (or component or derivative thereof) is listed. This consultation was noted in 44 FR 76738, December 27, 1979. Pursuant to the Act, the EPA and NRC entered into a Memorandum of Understanding, published in 45 FR 72980, November 3, 1980.

Department of Energy (DOE). DOE facilities are regulated under the Clean Air Act §§112 and 122.

States. Under section 112(d)(1) of the Clean Air Act, any State may develop and submit to the Administrator (of EPA) a procedure for implementing and enforcing emission standards for hazardous air pollution for stationary sources located in such State. If the Administrator finds a State's procedure adequate, the Federal authority is then delegated to the State. (So-called "automatic" delegation, agreed upon between EPA and some States for other pollutants, is not applicable to the "radionuclides" category.)

3. DESCRIPTION OF 40 CFR 61, EPA AIR EMISSION STANDARDS FOR RADIONUCLIDES (1985, 1986)

Issuances:

40 CFR 61, 50 FR 5190, February 6, 1985, for DOE facilities, NRC-licensed facilities and non-DOE Federal facilities, and elemental phosphorus plants; 50 FR 15386, April 17, 1985 for underground uranium mines; and 51 FR 34056, September 24, 1986 for uranium mill tailings.

Effective Dates:

For DOE, NRC-licensed and non-DOE Federal facilities, and elemental phosphorus plants final rules became effective, February 6, 1985 for new sources. For existing sources, the standards did not apply until May 7, 1985.

For underground uranium mines, the final rule became effective on April 17, 1985. For existing sources, the standards did not apply until 90 days after the effective date.

For uranium mill tailings, the final rule became effective on September 24, 1986.

Background:

"Radionuclides: Background Information Document for Final Rules, Volumes 1 and 2," EPA 520/1-84-022-1 (October 1984), EPA 520/1-84-022-2 (October 1984); "Radionuclides Background Information Document: Standard for Radon-222 Emissions for Underground Uranium Mines," EPA 520/2-85-010 (April 10, 1985); "Background Information Document—Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings," EPA 520/1-86-009 (August 15, 1986); and "Economic Analysis—Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings," EPA 520/1-86-010 (August 1986).

3.1 General Radiation Protection Provisions:

The EPA has promulgated standards under §112 of the Clean Air Act to limit exposure of the public due to emissions from the following source categories: DOE facilities; certain NRC-licensed facilities and non-DOE Federal facilities; elemental phosphorus plants; and underground uranium mines and licensed uranium mill tailings. Excluded from the standards are: facilities regulated under 40 CFR 190, 191, and 192; any low-energy accelerator; or any user of sealed radiation. The standards prescribe dose limits to members of the public from radionuclides emitted into the air from DOE and NRC facilities. The standard for elemental phosphorus plants limits the total emissions of polonium-210 into the air from these plants. The standard for underground uranium mines establishes a work practice that requires the installation of bulkheads in abandoned parts of these mines, to limit radon-222 emissions into the air. The standard for licensed uranium mill tailings also establishes a work practice that requires "phased disposal" or "continuous disposal" of mill tailings in order to limit radon-222 emissions into the air.

3.2 Rationale for Detailed Requirements:

3.2.1 DOE, NRC, non-DOE Federal facilities, and elemental phosphorus plants.

EPA attempted to withdraw its proposed standards for DOE, NRC, and non-DOE Federal facilities and for elemental phosphorus plants on the grounds that current emission control and operational practices provided an ample margin of safety in protecting the public health. However, the Sierra Club filed suit to compel action in U.S. District Court, and the court ordered EPA to promulgate standards or "delist" radionuclides as a hazardous air pollutant. The

EPA believes that although current emission levels for these three source categories represent an ample margin of safety, radionuclides cannot be delisted because radionuclide emissions from underground uranium mines appear to reach levels that warrant regulation.

EPA set limits that reflect current emission levels achieved by existing control technology and operating practices at DOE, NRC-licensed and non-DOE Federal facilities and at elemental phosphorous plants. EPA noted that the DOE and NRC policy of keeping radionuclide emissions "as low as reasonably achievable" (ALARA) has generally led to low emissions, and expects the policy to continue.

3.2.2 Radon-222 emissions from underground uranium mines.

To regulate radon-222 emissions from underground uranium mines, EPA took a risk-benefit approach. EPA cites: "convincing evidence that exposure to radon-222 gas and its decay products causes or contributes to lung cancer"; also "the increased lifetime risk to individuals living near an underground uranium mine could be about one chance in one hundred of incurring lung cancer because of the emissions." In addition, "several fatal cancers per year may result in the total population due to these emissions."

Because conventional radon-222 control technology was either prohibitively expensive, or not particularly effective, and any reduction in risk to the population might be achievable only by increasing the risk to miners, EPA concluded that bulkheading, while not highly effective, would be the least costly practice, and would not significantly increase miner exposure.

3.2.3 Radon-222 emissions from licensed uranium mill tailings.

To regulate radon-222 emissions from licensed uranium mill tailings, EPA also took a risk-benefit approach. Citing lung cancer as the dominant health hazard from tailings, the EPA estimated that the individual lifetime risk of developing a fatal cancer (for individuals living near tailing piles where predicted concentrations of the pollutant are highest) may be as high as 1 in 100, based on median risk estimates assuming 70 years of exposure. The U.S. population risk is estimated to be 1 to 5 deaths per year under current industry and regulatory conditions. EPA believes that these risks are significant and that there is a need for standards under the Clean Air Act to protect public health with an ample margin of safety.

The standard "requires the use of work practices that will reduce radionuclide emissions, and therefore risks, to the practical minimum." The standard "reflects consideration of the magnitude of the risks, the costs and availability of further controls and associated risk reduction potential, and the potential societal impacts of regulatory alternatives."

3.3 Description of Detailed Requirements:

3.3.1 Standards for DOE, NRC-licensed and non-DOE Federal facilities (excluding facilities regulated under 40 CFR 190, 191, or 192; any low-energy accelerator; or any user of sealed radiation sources):

Organ	Dose Equivalent Rate To Any Member of the Public
Whole body	25 mrem/year
Critical organ	75 mrem/year

(Excludes doses due to radon-220, radon-222, and their decay products.)

EPA will grant a waiver of the above limits, and issue alternative standards if a facility operator demonstrates:

No member of the public will receive a continuous exposure, excluding natural background and medical exposures, of more than 100 mrem/year effective dose equivalent and a noncontinuous exposure of more than 500 mrem/year effective dose equivalent from all sources.

3.3.2 Standard applicable to owners and operators of calciners and nodulizing kilns at elemental phosphorus plants:

Emissions of polonium-210 to air shall not exceed a total of 21 curies in a calendar year.

3.3.3 Standard for radon-222 emissions from underground uranium mines.

Applicable to an owner or operator of a mine which:

(1) Has mined or will mine over 100,000 tons of ore during the life of the mine; or

(2) Has had or will have an annual ore production greater than 10,000 tons, unless it can be demonstrated that the mine will not exceed a total ore production of 100,000 tons during the life of the mine.

The owner or operator of an underground uranium mine to which this rule is applicable shall install and maintain bulkheads to isolate all abandoned and temporarily abandoned areas.

The owner or operator of such a mine may apply to the Administrator of EPA for an alternative standard if compliance with the above requirement will result in increased radon-222 exposure in active areas of the mine, will require workers to enter unsafe areas, or will otherwise be impractical to achieve because of unusual circumstances. The alternative standard must be shown by the

applicant to be necessary to provide for the health and safety of the workers and to minimize exposure to the general population to the extent practical.

3.3.4 Standard for radon-222 emissions from licensed uranium mill tailings.

Applicable to licensed sites that manage uranium by-product materials during or following the processing of uranium ores, commonly referred to as uranium mills, and their associated tailings. This subpart applies during the period of operation of the mill.

A. "All new tailings impoundments built after September 24, 1986, shall be designed and constructed to meet one of the two following work practice standards:

i. "Phased disposal in lined tailings impoundments that are not more than 40 acres in area and meet requirements of 40 CFR 192.32(a). The owner shall have no more than two impoundments in operation (open) at any one site at any one time;

ii. "Continuous disposal of tailings such that the tailings are dewatered and immediately disposed with no more than 10 acres being uncovered at any time and operated in accordance with 40 CFR 192.32(a)."

B. Owners who do not intend to build a new tailings impoundment, must certify so within 2 years of September 24, 1986. These owners will be able to use existing piles for new tailings until December 31, 1992, unless they receive an exception or extension from the Administrator.

C. Owners who wish to build new tailings piles must follow the following schedule:

i. Apply for approval of construction as soon as possible, but no later than 2 years from September 24, 1986.

ii. Within 60 days of approval apply to NRC for a license to construct a new tailings impoundment.

iii. Begin construction within 90 days after obtaining a license (season permitting).

In no event shall an owner following this schedule place new tailings on existing tailings piles after December 31, 1992, unless the owner has received an exception or extension from the Administrator.

D. New tailings shall not be placed on any existing tailings pile after December 31, 2001. No exceptions or extensions will be effective after that date.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985). (See FACT SHEET 13.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975). (See FACT SHEET 19.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

FACT SHEET 10

40 CFR 141, EPA INTERIM DRINKING WATER STANDARDS FOR RADIONUCLIDES (1976)

COMPLETE TITLE

40 CFR 141, INTERIM PRIMARY DRINKING WATER REGULATIONS, PROMULGATION OF REGULATIONS ON RADIONUCLIDES, 41 FR 28402, July 9, 1976

1. AUTHORIZING STATUTE

Title XIV - Safety of Public Water Systems of the Public Health Service Act, as amended by the Safe Drinking Water Act (SDWA), as amended, (P.L. 93-523).

Effective Date: December 16, 1974.

1.1 Statutory Purpose:

SDWA applies to public water systems and establishes primary drinking water regulations which specify contaminants that, in the judgment of the Environmental Protection Agency (EPA), "may have any adverse effect on the health of persons." Under the regulations, EPA will set a maximum contaminant level (MCL) for each contaminant.

1.2 Radiation Protection Provisions:

Under the SDWA, the EPA established national interim primary drinking water regulations for radioactivity, setting MCLs for various radionuclides.1/

1/ The EPA published an Advance Notice of Proposed Rulemaking Dealing With Radionuclides Under the Safe Drinking Water Act (51 FR 34836) on September 30, 1986. This provided

> advance notice of a proposed rule for Maximum Contaminant Level Goals (MCLGs) and National Primary Drinking Water Regulations (NPDWR) including Maximum Contaminant Levels (MCLs) for radionuclides in drinking water. MCLGs and MCLs are being considered for radium-226, radium-228, natural uranium, radon, gross alpha, and gross beta and photon emitters. . . . MCLGs are non-enforceable health goals which are to be set at levels which will result in no known or anticipated adverse health effects with an adequate margin of safety. When the MCLGs are proposed, the Agency will also propose MCLs and monitoring requirements. MCLs are enforceable standards and are to be set as close to the MCLGs as feasible, taking into account cost, availability of treatment technologies and other practical considerations.

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). The EPA is responsible for the promulgation and enforcement of primary drinking water regulations.

States. The States have primary enforcement responsibility for public water systems during any period for which the EPA determines that such State: has adopted drinking water regulations which are no less stringent than the national regulation; and has adopted and is implementing adequate procedures for the enforcement of such state regulations (including monitoring and inspection activities).

Indian Tribes. The EPA is authorized to treat Indian Tribes as States under the SDWA.

3. DESCRIPTION OF 40 CFR 141, EPA INTERIM DRINKING WATER STANDARDS FOR RADIONUCLIDES (1976)

Issuances:

41 FR 28402, July 9, 1976.

Effective Date: June 24, 1977.

Background:

"National Interim Primary Drinking Water Regulations," Office of Water Supply, EPA 570/9-76-003 (July 1976) (Statement of Basis and Purpose is included therein as appendices).

3.1 General Radiation Protection Provisions:

Under the SDWA, the EPA has established MCLs for radium-226, radium-228, gross alpha particle activity, and beta particle and photon radioactivity from man-made radionuclides in community water systems. EPA has also promulgated monitoring requirements for radioactivity in these community water systems. The EPA maximum contaminant levels apply to the need for treatment by the water supply operator and are not ambient water quality criteria, except for groundwater. A "public water supply" has at least 15 connections or serves at least 25 individuals.

3.2 Rationale for Detailed Requirements:

3.2.1 "Because of these many uncertainties [of data for low-level doses at low dose-rates], it is necessary to rely upon the considered

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(cont.)
The legislative history provides further guidance on selecting MCLGs: "[t]he recommended maximum level . . . must include an adequate margin of safety, unless there is no safe threshold for a contaminant. In such a case, the level should be set at zero level. (House Report No. 93-1185, July 10, 1974, at 20)."

judgements of experts on the biological effects of ionizing radiation." (UNSCEAR, NAS, NCRP)

3.2.2 "It is the present policy of the EPA to assume a linear, nonthreshold relationship between the magnitude of the radiation dose received at environmental levels of exposure and ill health produced as a means to estimate the potential health impact of actions it takes in developing radiation protection . . . criteria, guides, or standards. This policy is adopted in conformity with the generally accepted assumption that there is some potential ill health attributable to any exposure to ionizing radiation and that the magnitude of this ill health [is] directly proportional to the magnitude of the dose received."

3.2.3 "The linear hypothesis by itself precludes the development of acceptable levels of risk based solely on health considerations. Therefore, in establishing radiation protection positions, the EPA will weigh not only the health impact, but also social, economic and other considerations associated with the activities addressed."

3.2.4 "The MCL of 15 pCi/l for gross alpha particle limit . . . is based on a consideration of the radiotoxicity of other alpha particle emitting contaminants relative to radium. The 15 pCi/l gross alpha particle limit . . . is based on the conservative assumption that if the radium concentration is 5 pCi/l and the balance of the alpha particle activity is due to the next most radiotoxic alpha particle emitting chain starting with lead-210, the dose to bone will not be unduly increased. Though less precise than setting maximum contaminant levels for lead-210 specifically, the establishment of a limit on gross alpha particle activity is more in keeping with the current capability of State laboratories while providing significant public health protection."

3.3 Description of Detailed Requirements:

3.3.1 MCLs for radium-226, radium-228, and gross alpha particle activity in community water systems:

A. Combined radium-226 and radium-228: 5 pCi/l.

B. Gross alpha particle activity (including radium-226, but excluding radon and uranium): 15 pCi/l.

3.3.2 MCLs for beta particle and photon radioactivity from man-made radionuclides in community water systems:

A. "The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem."

B. "Except for the radionuclides listed in [the table which follows], the concentration of man-made radionuclides causing 4 millirem total body or organ dose shall be calculated on

the basis of a 2 liter per day drinking water intake using the 168-hour data listed in . . . NBS Handbook 69, as amended, August 1963, U.S. Department of Commerce."

TABLE - AVERAGE ANNUAL CONCENTRATIONS ASSUMED TO PRODUCE A TOTAL BODY OR ORGAN DOSE OF 4 MREM/YR:

Radionuclide	Critical Organ	pCi per liter
Tritium	Total body	20,000
Strontium-90	Bone marrow	8

C. "If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 millirem/year."

D. To determine compliance with B above, the detection limits shall not exceed the concentrations listed below:

Radionuclide	Detection Limit
Tritium	1,000 pCi/l
Strontium-89	10 pCi/l
Strontium-90	2 pCi/l
Iodine-131	1 pCi/l
Cesium-134	10 pCi/l
Gross beta	4 pCi/l
Other radionuclides	1/10 of the applicable limit

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975). (See FACT SHEET 19.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of this standard.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

FACT SHEET 11

40 CFR 190, EPA ENVIRONMENTAL STANDARDS FOR URANIUM FUEL CYCLE (1977)

COMPLETE TITLE

40 CFR 190, ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR NUCLEAR POWER OPERATIONS, 42 FR 2858, January 13, 1977

1. AUTHORIZING STATUTE

Atomic Energy Act of 1954, as amended (P.L. 83-703), and the President's Reorganization Plan No. 3 of 1970 (5 U.S.C. App. 609, 84 Stat. 2086-88).

Effective Date: August 30, 1954.

1.1 Statutory Purpose:

The policy of the United States under the Atomic Energy Act is:

1.1.1 to develop, use, and control atomic energy so as to maximize its contribution to the general welfare and to make the maximum contribution to the common defense and security of the country; and

1.1.2 to develop, use, and control atomic energy so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

1.2 Radiation Protection Provisions:

Section 161 of the Atomic Energy Act of 1954 (The General Authority section) empowers the Atomic Energy Commission (AEC) [Nuclear Regulatory Commission (NRC) and Environmental Protection Agency (EPA)] to establish rules, regulations, and standards to govern the possession or use of nuclear materials as the AEC [(NRC), (EPA)] deems necessary or desirable to "protect health or minimize danger to life or property."

Section 274(b) of the Atomic Energy Act of 1954 authorizes the Commission "to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission . . . with respect to . . . byproduct materials, . . . source materials, . . . [and] special nuclear materials in quantities not sufficient to form a critical mass." However, §274(c) provides that "[n]o agreement entered into pursuant to subsection b. shall provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of . . . the construction and operation of any production or utilization facility; . . . [and the export, import, and disposal of any nuclear material] as defined in the regulations or orders of the Commission."

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 (5 U.S.C. App. 609, 84 Stat. 2086-88) transferred to EPA from the former Atomic Energy Commission the more explicit responsibility to establish generally applicable radiation standards. The Plan defined standards as "limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material."

The Nuclear Regulatory Commission (NRC). The NRC is responsible for the implementation and enforcement of the radiation standards established by EPA. "The authority to regulate fuel cycle facilities resides in the . . . NRC or, in some cases, the States, under agreement with NRC."

States. As of 1988, twenty-nine States have entered into agreements with NRC under Section 274 of the Atomic Energy Act of 1954, as amended, where the States have assumed jurisdiction to regulate fuel cycle facilities, and other operations consistent with NRC regulations and EPA standards.

3. DESCRIPTION OF 40 CFR 190, EPA ENVIRONMENTAL STANDARDS FOR URANIUM FUEL CYCLE (1977)

Issuances:

Final, 42 FR 2858, January 13, 1977; Proposed, 40 FR 23420, May 29, 1975.

Effective Date:

For the standard in 3.3.1 below, December 1, 1979, except that for doses arising from operations associated with the milling of uranium ore, the effective date is December 1, 1980; for the standard in 3.3.2 below, December 1, 1979, except January 1, 1983 for krypton-85 and iodine-129 generated by the fission process.

Background:

"Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle," Volumes I, II and III, EPA 520/4-76-016 A, B, C (November 1, 1976); "Environmental Analysis of the Uranium Fuel Cycle, Parts I-IV," EPA 520/4-76-017 (July 1976).

3.1 General Radiation Protection Provisions:

3.1.1 The standards specify the levels below which normal operations of the uranium fuel cycle are determined to be environmentally acceptable. "'Uranium fuel cycle' means the operations of milling uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing uranium fuel, to the extent that these directly support the production of electrical power for public use utilizing nuclear energy, but excludes mining operations, operations at waste disposal sites, transportation of any radioactive materials in support of these

operations, and the reuse of recovered non-uranium special nuclear and by-product materials from the cycle."

3.1.2 The standards are expressed in terms of limits on individual doses to members of the public and on quantities of certain long-lived radioactive materials released to the general environment.

3.2 Rationale for Detailed Requirements:

3.2.1 The EPA has concluded that environmental radiation standards for nuclear power operations (nuclear fuel cycle) should include consideration of:

(1) "the total radiation dose to populations;

(2) "the maximum dose to individuals;

(3) "the risk of health effects attributable to these doses, including the future risks arising from the release of long-lived radionuclides; [and]

(4) "the effectiveness and costs of the technology available to mitigate these risks through effluent control."

3.2.2 EPA assumes "that a potential for health effects due to ionizing radiation exists at all levels of exposure and that at the low levels of exposure characteristic of environmental levels of radiation the number of these effects will be directly proportional to the dose of radiation achieved (a linear non-threshold dose-effect relationship)."

3.2.3 The standards generally represent the lowest radiation levels at which the EPA has determined that the costs of control are justified by the reduction in health risk.

3.2.4 The standard for individual whole-body dose limits the combined internal and external dose equivalent from gaseous and liquid effluents as well as exposure to gamma and neutron radiation from all operations of the fuel cycle. EPA determined that this limit is readily satisfied at all sites by levels of control that are cost-effective for the reduction of potential risk achieved; and, based on present operating experience at existing sites, it can be readily achieved in practice. The dose limit to the thyroid reflects, to the extent that current capability for risk-estimation permits comparison, a level of biological risk comparable to that represented by the standard for the whole body. The principal potential doses to internal organs (other than the thyroid) are to the lung via inhalation of airborne particulates and to bone due to ingestion via water and other pathways. The impact on populations due to effluents from these operations is generally quite small (due to remote locations and lack of widespread dispersion); however, significant lung doses are possible to individuals living or working near these operations, particularly in the case of mills and conversion facilities. EPA

determined that the use of well-established, efficient, and inexpensive control technology for particulate effluents can readily achieve the level of control to meet the dose limit to internal organs.

3.2.5 The long-lived radionuclides produced in the fuel cycle are of particular concern because of their potential for extreme persistance in the environment (iodine-129, half-life 17 million years). The long-lived radionuclides should only be discharged to the environment after careful consideration of the trade-offs between the societal benefits of the power generated, the current and projected health risks to populations, and the costs and effectiveness of methods available to limit their release. Since the anticipated maximum dose to any single individual is very small, the primary concern is the cumulative risk to population groups over long periods of time. It is therefore important to assure that any permitted discharge is offset by a beneficial product, i.e., a quantity of electricity, and that every reasonable effort is made to minimize discharges.

3.3. Description of Detailed Requirements:

3.3.1 The annual dose equivalent to any member of the public as the result of exposures to planned discharges of radioactive materials (radon and its daughters excepted) to the general environment from uranium fuel cycle operations and to radiation from these operations shall not exceed:

Organ	Annual Dose Equivalent (millirem)
Whole body	25
Thyroid	75
Any other organ	25

3.3.2 The total quantity of radioactive materials entering the general environment from the entire uranium fuel cycle, per gigawatt-year of electrical energy produced by the fuel cycle, shall contain less than 50,000 curies of krypton-85, 5 millicuries of iodine-129, and 0.5 millicuries combined of plutonium-239 and other alpha-emitting transuranic radionuclides with half-lives greater than one year.

3.3.3 "The standards . . . may be exceeded if:

A. The regulatory agency has granted a variance based upon its determination that a temporary and unusual operating condition exists and continued operation is in the public interest, and

B. Information is promptly made a matter of public record[.]"

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986). (See FACT SHEET 9.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975). (See FACT SHEET 19.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

NRC Safety Goals for the Operations of Nuclear Power Plants; Policy Statement, August 4, 1986.

FACT SHEET 12

40 CFR 192, EPA, AND 10 CFR 40, NRC, ENVIRONMENTAL STANDARDS FOR U AND Th MILL TAILINGS (1983, 1985)

COMPLETE TITLE

40 CFR 192, HEALTH AND ENVIRONMENTAL STANDARDS FOR REMEDIAL ACTIONS AT INACTIVE URANIUM PROCESSING SITES, 48 FR 590, January 5, 1983; ENVIRONMENTAL STANDARDS FOR URANIUM AND THORIUM MILL TAILINGS AT LICENSED COMMERCIAL PROCESSING SITES, 48 FR 45926, October 7, 1983; and 10 CFR 40, URANIUM MILL TAILINGS REGULATIONS; CONFORMING NRC REQUIREMENTS TO EPA STANDARDS, 50 FR 41852, October 16, 1985

1. AUTHORIZING STATUTE

Section 275 of the Atomic Energy Act (42 U.S.C. 2022), as added by §206 of the Uranium Mill Tailings Radiation Control Act of 1978 (P.L. 95-604) (UMTRCA).

Effective Date: November 8, 1978.

1.1 Statutory Purpose:

1.1.1 In §2 of UMTRCA, Congress stated its finding that uranium mill tailings ". . . may pose a potential and significant radiation health hazard to the public, . . . and . . . that every reasonable effort should be made to provide for stabilization, disposal, and control [of tailings] in a safe and environmentally sound manner . . . in order to prevent or minimize . . . other environmental hazards from such tailings."

1.1.2 Congress further stated that the purposes of the UMTRCA are to provide at inactive mill sites ". . . a program of assessment and remedial action . . . including, where appropriate, the reprocessing of tailings to extract residual uranium and other mineral values where practicable, . . . and a program to regulate mill tailings during uranium or thorium ore processing at active mill operations and after termination of such operations, in order to stabilize and control tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public."

1.2 Radiation Protection Provisions:

1.2.1 "UMTRCA established two programs to protect public health, safety, and the environment from uranium mill tailings, one for certain designated sites which are now inactive (i.e., at which all milling has stopped and which are not under license) and another for active sites" (those sites licensed by the NRC or a State pursuant to §274 of the Atomic Energy Act).

1.2.2 "Tailings at the inactive uranium milling sites are defined in UMTRCA as residual radioactive materials. The program for inactive sites covers the disposal of tailings and the cleanup of onsite and offsite locations contaminated with tailings."

1.2.3 "Tailings in active uranium milling sites are defined in UMTRCA as uranium byproduct materials. The program for active sites covers the final disposal of tailings and the control of effluents and emissions during and after milling operations."

1.2.4 Section 274(b) of the Atomic Energy Act of 1954 authorizes the Commission "to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission . . . with respect to . . . byproduct materials, . . . source materials, . . . [and] special nuclear materials in quantities not sufficient to form a critical mass." However, §274(c) provides that "[n]o agreement entered into pursuant to subsection b. shall provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of . . . the construction and operation of any production or utilization facility; . . . [and the export, import, and disposal of any nuclear material] as defined in the regulations or orders of the Commission."

2. RESPONSIBLE AGENCIES

Department of Energy (DOE). The UMTRCA directs the DOE to conduct necessary remedial actions at designated inactive processing sites to achieve compliance with the standards established by EPA, with the concurrence of the NRC and in cooperation with the States.

Environmental Protection Agency (EPA). The UMTRCA requires the EPA to set standards for the stabilization, disposal, and control of tailings and the control of effluents and emissions, for inactive and active uranium milling sites.

Nuclear Regulatory Commission (NRC). The NRC is responsible for enforcing compliance with the EPA standards at active uranium mill sites. NRC has amended its regulations governing the disposal of uranium mill tailings found in 10 CFR 40, Appendix A, to conform to certain of EPA's requirements for active uranium processing sites.

States. The State in which the site is located can perform remedial actions in cooperation with the DOE at inactive sites and, pursuant to an NRC-State agreement under §274 of the Atomic Energy Act, be responsible for assuring compliance with EPA standards at active mill sites.

Indian Tribes. DOE must consult affected Indian tribes and the Secretary of the Interior, when appropriate, on remedial actions.

3. DESCRIPTION OF 40 CFR 192, EPA, AND 10 CFR 40, NRC, ENVIRONMENTAL STANDARDS FOR U AND Th MILL TAILINGS (1983, 1985)

Issuances:

48 FR 590, January 5, 1983; 48 FR 45926, October 7, 1983; 10 CFR 40; and 50 FR 41852, October 16, 1985.

Effective Dates:

For standards at inactive sites, March 7, 1983. For standards at active sites, December 6, 1983. For NRC Regulations (10 CFR 40), November 15, 1985.

3.1 General Radiation Protection Provisions:

3.1.1 The standards for inactive sites require two types of remedial actions: control and cleanup. Control is the operation which places the tailings in piles in a stable way that gives reasonable assurances that the health hazards will be controlled and limited for a long period of time, and that the limits on releases of radon from tailings piles are met. Cleanup is the mill tailings removal operation which reduces the potential health consequences of tailings that have been dispersed from tailings piles by natural forces or removed by man and used elsewhere in buildings or land. The standard for cleanup limits the radon decay-product concentration and gamma radiation levels in buildings affected by tailings and the radium-226 concentration in contaminated land.

3.1.2 The standards for active sites are also divided into two parts. "The first part applies to management of tailings during the active life of the pile, and during the subsequent 'closure period,' i.e., after cessation of operations but prior to final disposal, including the period when the tailings are drying out." The standards for tailings at operating mills subject mill tailings to the ground water protection requirements now specified under the Solid Waste Disposal Act (SWDA) and extend these requirements by adding two chemical elements and radioactivity limits. "The second part specifies the conditions to be achieved by final disposal." They contain the same standards for control of uranium tailings after closure, as do the regulations for inactive sites. The standards in both parts apply to thorium mills with only minor modifications.

3.2 Rationale for Detailed Requirements:

3.2.1 EPA chose "optimized cost-benefit" alternatives for standards at inactive processing sites. Their objective was to establish standards that take account of the trade-offs between costs and benefits in a way that assures adequate protection of the public health, safety, and the environment; that can be implemented using presently available techniques and measuring instruments; and that are reasonable in terms of overall costs and benefits. (EPA concluded that "nondegradation" alternatives' small incremental increase in health benefits did not justify large additional costs; that the final standard provided much greater protection at only a small increase

above "least cost" alternatives, and that "least cost" alternatives placed primary emphasis on institutional controls that were not long-term controls.)

3.2.2 EPA considers the single most important goal of control to be the effective isolation and stabilization of tailings for as long a period as is reasonably feasible because tailings will remain hazardous for hundreds of thousands of years. EPA selected the 200- to 1,000-year control period because there is a reasonable expectation that readily achievable controls will remain effective for at least this period of time.

3.2.3 The radon emission limit of 20 $pCi/m^2/s$ was chosen to reduce the excess risk of fatal lung cancer from three to four chances in a hundred to an excess risk level of a few chances in a thousand. EPA set the radon air concentration standard at 0.5 pCi/l at the edge of the tailings, which provides approximately the same protection as the 20 $pCi/m^2/s$ emission standard.

3.3 Description of Detailed Requirements:

3.3.1 Standards for Remedial Action at Inactive Uranium Processing Sites:

Control of Tailings Piles:

A.	Longevity	Up to 1000 years, to the extent reasonably achievable, but at least 200 years.
B.	Radon emissions from disposal site	20 $pCi/m^2/s$ averaged over the entire surface of the disposal site over a one-year period, or 0.5 pCi/liter in air outside the disposal site.
C.	Water protection	Use existing State and Federal standards; apply site-specific measures where needed.

Cleanup of Buildings:

A.	Indoor radon decay products	To the extent practicable achieve 0.02 WL; in no event exceed 0.03 WL; WL (Working Level) is any combination of radon daughters in 1 liter of air which gives rise to the emission of 1.3×10^5 MeV of potential alpha energy.
B.	Indoor gamma radiation	20 microR/hr (above background).

Cleanup of Land:

A.	Surface	The concentration of radium-226 in land averaged over any area of 100 square meters shall not exceed background level by more than: 5 pCi/g averaged over the first 15 cm of soil below the surface; and
B.	Buried	15 pCi/g of radium-226 averaged over 15 cm thick layers of soil more than 15 cm below the surface.

Exceptions:

A.	Procedure	Supplemental standards (may be applied on generic or site-specific basis).
B.	Applicability	Where health and safety would be endangered, or where costs clearly outweigh benefits, or where inaccessible tailings pose minimal hazards.
C.	When radionuclides other than radium-226 are present in sufficient quantity to constitute a significant hazard.	Standards above, and ALARA for other radionuclides.

3.3.2 Environmental Standards for Uranium and Thorium Mill Tailings at Licensed (Active) Commercial Processing Sites:

A. Standards during operations and prior to the end of the closure period.

i. New tailings impoundments must be constructed to meet the requirements of 40 CFR 264.221 of the Solid Waste Disposal Act (except the requirements of 40 CFR 264.228(a)(2)(iii)(E) do not apply).

ii. Uranium by-product materials (tailings) shall be managed to conform to the groundwater protection standards in 40 CFR 264.92 except:

a. molybdenum and uranium are added to the list of hazardous constituents referenced in 40 CFR 264.93.

b. a combined limit for radium-226 and radium-228 of 5pCi/liter, and a limit for gross alpha-particle activity (excluding radon and uranium) of 15

pCi/liter, is added to the concentration limits for radioactive materials in groundwater referenced in Table 1 of 40 CFR 264.94.

c. the NRC may establish alternate concentration limits, provided they are ALARA, and the standards of 40 CFR 264.94(a) are satisfied at all points further than 500 meters from the site boundary.

iii. Uranium by-product material (tailings) shall be managed to conform to the provisions of 40 CFR 190 and 40 CFR 440.

iv. Every effort shall be made to maintain radiation doses from surface impoundments of tailings as far below the Federal Radiation Protection Guides (25 FR 4402, May 18, 1960; see FACT SHEET 1) as practicable.

B. Standards for after the closure period.

i. Disposal areas shall comply with the closure performance standards in 40 CFR 264.111 with respect to nonradiological hazards, and

ii. Disposal areas shall be designed to provide reasonable assurances of control of radiological hazards to be effective for one-thousand years, to the extent reasonably achievable, in any case, for at least 200 years, and

iii. Radon-222 emissions from tailings to the atmosphere will not exceed an average of 20 $pCi/m^2/s$ over the entire surface of the disposal site over periods of at least one year, but short compared to 100 years.

iv. The requirements of B(i) above (the closure requirements of 40 CFR 264.11) shall not apply to any portion of a site which contains a concentration of radium-226 in land, averaged over areas of 100 square meters, which does not exceed background level by more than:

a. 5 pCi/g averaged over the first 15 cm below the surface, and

b. 15 pCi/g averaged over 15 cm-thick layers more than 15 cm below the surface.

v. Corrective actions shall be taken within 18 months of finding that EPA groundwater protection levels of 40 CFR 264.100 are exceeded.

C. Environmental standards for thorium mill tailings at licensed (active) commercial processing sites.

i. The provisions in A and B above apply to thorium by-product material tailings with the following additions: provisions applicable to uranium shall also apply to thorium; provisions applicable to radon-222 shall also apply to radon-220; and provisions applicable to radium-226 shall also apply to radium-228.

ii. Operations under A above shall be conducted in such a manner as to provide a reasonable assurance that the annual dose equivalent to any member of the public does not exceed:

Organ	Dose
Whole body	25 millirem
Thyroid	75 millirem
Any other organ	25 millirem

as a result of exposure to the planned discharge of radioactive materials (radon-220 and its daughters excepted) to the general environment.

3.3.3 10 CFR 40, Uranium Mill Tailings Regulations; Conforming NRC Requirements to EPA Standards:

The requirements of 10 CFR 40 are identical to those found in B and C above. In addition 10 CFR 40, Appendix A, requires milling operations to be conducted so that all airborne effluent releases are reduced to ALARA levels.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986). (See FACT SHEET 9.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985). (See FACT SHEET 13.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

10 CFR 61, NRC Requirements for Land Disposal of Low-Level Radioactive Waste (1975). (See FACT SHEET 18.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

40 CFR 194, EPA Advance Notice of Proposed Rulemaking: Radiation Protection Criteria for Cleanup of Land and Facilities Contaminated With Residual Radioactive Materials, 51 FR 22264, June 19, 1986.

40 CFR 193, EPA Advance Notice of Proposed Rulemaking for Low Level Radioactive Waste Disposal, 48 FR 39563, August 31, 1978.

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

FACT SHEET 13

40 CFR 191, EPA ENVIRONMENTAL STANDARDS FOR MANAGEMENT AND DISPOSAL OF HIGH-LEVEL AND TRANSURANIC RADIOACTIVE WASTE (1985)

COMPLETE TITLE

40 CFR 191, ENVIRONMENTAL STANDARDS FOR THE MANAGEMENT AND DISPOSAL OF SPENT NUCLEAR FUEL, HIGH-LEVEL AND TRANSURANIC RADIOACTIVE WASTES, 50 FR 38066, September 19, 1985

1. AUTHORIZING STATUTE

The Atomic Energy Act of 1954 (AEA), as amended (P.L. 83-703); Reorganization Plan No. 3 of 1970 (35 FR 15623); and the Nuclear Waste Policy Act of 1982 (NWPA).

Effective Date: Atomic Energy Act, August 30, 1954; Nuclear Waste Policy Act, January 7, 1983.

1.1 Statutory Purpose:

The purposes of the NWPA are to:

1.1.1 Establish a schedule for the siting, construction, and operation of repositories which will provide reasonable assurance that the public and the environment will be adequately protected from the hazards posed by high-level radioactive waste and spent nuclear fuel disposed of in these repositories;

1.1.2 Establish Federal responsibility and policy for disposal of such waste;

1.1.3 Define the relationship between Federal and State governments and Indian tribes with respect to waste disposal; and

1.1.4 Establish a nuclear waste fund, composed of payments made by generators and owners of such waste, that will insure that the costs of the disposal of the waste are borne by the persons responsible for generating it.

1.2 Radiation Protection Provisions:

Section 121 of the NWPA gives the Environmental Protection Agency (EPA) the responsibility to "promulgate generally applicable standards for protection of the general environment from offsite releases from radioactive material in repositories."

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). The President's Reorganization Plan No. 3 (5 U.S.C. App. 609, 84 Stat. 2086-88) transferred to EPA from the former Atomic Energy Commission the responsibility to establish generally applicable radiation standards. Under this authority, EPA is responsible for promulgating generally applicable standards for the management and disposal of spent nuclear fuel and high-level and transuranic wastes, including radiation protection standards for members of the public.

The Nuclear Regulatory Commission (NRC). The NRC is responsible for the implementation and enforcement of the radiation standards established by EPA under the Atomic Energy Act at NRC-regulated DOE High-Level Waste (HLW) facilities.

The Department of Energy (DOE). DOE is responsible for development of guidance for site selection, site characterization, waste package and repository design, construction, operation, decommissioning and permanent closure of HLW repositories.

States and Indian Tribes. Affected States and Indian Tribes are granted automatic party status in NRC licensing proceedings.

3. DESCRIPTION OF 40 CFR 191, EPA ENVIRONMENTAL STANDARDS FOR MANAGEMENT AND DISPOSAL OF HIGH-LEVEL AND TRANSURANIC RADIOACTIVE WASTE (1985)

Issuances:

50 FR 38066, September 19, 1985.

Effective Date: November 18, 1985.

Background:

"High-level and Transuranic Radioactive Wastes—Background Information Document for Final Rule," EPA 520/1-85-023 (August 1985); "High-level and Transuranic Radioactive Wastes—Response to Comments for Final Rule," Volumes I, II, EPA 520/1-85-024 (August 1985).

3.1 General Radiation Protection Provisions:

3.1.1 The first part of the EPA standards limits the radiation exposure of members of the public from the management and storage of spent fuel or high-level or transuranic wastes at NRC and DOE facilities.

3.1.2 The second part establishes several different types of requirements for disposal of these materials. They include: long-term containment standards which limit projected releases of radioactivity for 10,000 years after disposal; a set of six qualitative assurance requirements designed to provide adequate confidence that containment requirements will be met; limitations on exposures to individual

members of the public for 1,000 years after disposal; and a set of groundwater protection requirements.

3.1.3 Although disposal of these materials in geological repositories has received the most attention, the regulations apply to disposal by any method, except ocean disposal which is prohibited under the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (P.L. 93-254). (See FACT SHEET 15.)

3.2 Rationale for Detailed Requirements:

3.2.1 "Disposal in compliance with the containment requirements is projected to cause no more than 1,000 premature cancer deaths over the 10,000 year period from disposal of all existing high-level wastes and most of the wastes yet to be produced by currently operating reactors, an average of 0.1 fatality per year. This level of residual risk to future generations would be comparable to the risks that those generations would have faced from the uranium ore used to create the wastes if the ore had never been mined."

3.2.2 EPA felt that the risks of public exposure during management and storage (prior to disposal) were very small, and therefore made the public exposure limits for 40 CFR 191 comparable with other related radiation protection standards. The combined exposure to the public from NRC facilities under 40 CFR 190, and Subpart A of 40 CFR 191, cannot exceed limits equal to those found in Part 190. (This includes all operations prior to final closure at high-level waste disposal facilities.) For DOE management and storage operations, the limits are equivalent to standards found in 40 CFR 61 which were promulgated under the Clean Air Act. (See FACT SHEET 9.)

3.2.3 The groundwater protection standards that apply after disposal are designed to protect individuals in the vicinity of a disposal system and are similar to those established for the output of community water systems in 40 CFR 141. (See FACT SHEET 10.)

3.2.4 The individual protection requirements after disposal of the wastes of 25 millirem/year to the whole body and 75 millirem/year to any organ during the first 1,000 years after disposal are estimated to "cause a 5×10^{-4} chance of incurring a premature fatal cancer." This level of protection was considered sufficiently stringent in this situation, where no more than a few individuals are likely to receive this exposure.

3.3 Description of Detailed Requirements:

40 CFR 191 applies to the management and disposal of spent nuclear fuel, high-level radioactive waste (defined by the NWPA as follows: the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that the NRC determines by rule requires permanent isolation), and transuranic wastes containing more than 100 nanocuries per gram of alpha-emitting

transuranic isotopes, except wastes that either the NRC or EPA determines do not need the degree of isolation required by this rule.

3.3.1 Subpart A - Environmental Standards for Management and Storage

A. Management and storage at facilities regulated by NRC or Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public from all NRC-licensed facilities covered by 40 CFR 190, the EPA uranium fuel cycle standards, will not exceed:

Organ	Dose
Whole body	25 millirem
Thyroid	75 millirem
Any other organ	25 millirem

B. For management and storage at DOE disposal facilities annual doses to members of the public are limited to:

Organ	Dose
Whole body	25 millirem
Any other organ	75 millirem

C. Alternative Standards may be set at DOE facilities if the EPA determines they will prevent any member of the public from receiving a dose exceeding:

Type of Exposure	Dose Equivalent
Continuous	100 millirem/year
Infrequent	500 millirem/year

(from all sources except natural background and medical procedures).

3.3.2 Subpart B - Environmental Standards for Disposal

A. Containment requirements:

Disposal systems shall be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative releases of radionuclides to the environment for 10,000 years after disposal shall:

i. Have a likelihood of less than one chance in ten of exceeding the quantities below; and

ii. Have a likelihood of less than one in 1,000 of exceeding ten times the quantities below:

Cumulative Releases to the Environment for 10,000 Years After Disposal

Radionuclide	Release limit: curies per 1,000 MTHM[1/] or other unit of waste
Americium-241 or -243	100
Carbon-14	100
Cesium-135 or -137	1,000
Iodine-129	100
Neptunium-237	100
Plutonium-238, -239, -240, or -242	100
Radium-226	100
Strontium-90	1,000
Technetium-99	10,000
Thorium-230 or -232	10
Tin-126	1,000
Uranium-233, -234, -235, -236, or -238	100
Any other alpha-emitting radionuclide with a half-life greater than 20 years	100
Any other radionuclide with a half-life greater than 20 years that does not emit alpha particles	1,000

1/ MTHM means metric tons of heavy metal. The above table is found in 40 CFR 191, Appendix A, Table 1. "To develop Release Limits for a particular disposal system, the quantities in Table 1 shall be adjusted for the amount of waste included in the disposal system compared to the various units of waste defined in Note 1" following Table 1, in Appendix A.

B. Individual protection requirements.[1/]

Disposal systems shall be designed to provide a reasonable expectation that for 1,000 years after disposal, undisturbed performance of the system shall not cause the annual dose equivalent to any member of the public in the accessible environment to exceed:

Organ	Dose
Whole body	25 millirem
Any other organ	75 millirem

All potential pathways from the disposal system to people shall be considered, including the assumption that individuals consume 2 liters per day of drinking water from any significant source of groundwater outside the controlled area.

C. Groundwater protection requirements.

i. Disposal systems shall be designed to provide a reasonable expectation that for 1,000 years after disposal, the system shall not cause the radionuclide concentrations averaged over any portion of a special source of groundwater to exceed:

a. 5 picocuries per liter of radium-226 and radium-228;

b. 15 picocuries per liter of alpha-emitting radionuclides (including radium-226 and radium-228, but excluding radon); or

c. The combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem per year (if an individual consumed 2 liters of groundwater per day).

1/ On July 17, 1987, in a suit filed by environmental groups, the U.S. Court of Appeals for the First Circuit nullified EPA's 40 CFR 191 on the basis that it is not consistent with EPA's drinking water standard (Fact Sheet 10). Specifically, the individual dose limit of 25 mrem per year was struck down, since no rationale was provided for departing from the 4 mrem per year limit previously established for drinking water. The court also found that no basis had been provided for establishing a limit of only 1000 years for application of the individual protection criteria. EPA has petitioned the court to reinstate the unaffected sections of 40 CFR 191.

ii. If any of the average annual radionuclide concentrations existing in groundwater before construction of the disposal system already exceed the limits in (C)(i) above, the system shall not increase the existing average concentrations by more than the limits in (C)(i) above.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR Parts 220-229, EPA Regulations and Criteria for Ocean Dumping of Radioactive Materials (1977). (See FACT SHEET 15.)

10 CFR 61, NRC Requirements for Land Disposal of Low-Level Radioactive Waste (1975). (See FACT SHEET 18.)

40 CFR 193, EPA Advance Notice of Proposed Rulemaking for Low-Level Radioactive Waste Disposal, 48 FR 39563, August 31, 1978.

10 CFR 60, NRC Requirements for Disposal of High-Level Radioactive Wastes in Mined Geological Repositories. (See FACT SHEET 17.)

FACT SHEET 14

40 CFR 440, EPA MINING EFFLUENT LIMITS FOR U AND Ra (1982)

COMPLETE TITLE

40 CFR 440, ORE MINING AND DRESSING POINT SOURCE CATEGORY EFFLUENT LIMITATIONS, GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS, 47 FR 54598, December 3, 1982

1. AUTHORIZING STATUTE

Sections 301, 304, 306, 307, 308 and 501 of the Clean Water Act (CWA) [The Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), as amended (P.L. 95-217).]

Effective Date: P.L. 92-500, October 18, 1972; P.L. 95-217, December 27, 1977.

1.1 Statutory Purpose:

The objective of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" through: elimination of the discharge of pollutants into navigable waters; interim goals of water quality; prohibiting the discharge of toxic pollutants in toxic amounts; research and construction grants; and Congressional and Presidential actions to insure to the extent possible that foreign countries shall also take action to improve water quality.

1.2 Radiation Protection Provisions:

Under the CWA, the Environmental Protection Agency (EPA) has established regulations that limit the discharge of pollutants into navigable waters of the United States from existing and new sources in the ore mining and dressing industry. One subcategory of this industry—uranium, radium and vanadium ores—is relevant to radiation protection.

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). Under the CWA, EPA is required to issue effluent limitation guidelines, pretreatment standards, and new-source performance standards for industrial discharges. The regulations will be applied to individual ore mines and mills through National Pollution Discharge Elimination System (NPDES) permits issued by EPA or approved State agencies.

States. The States may administer their own permit programs for discharges into navigable waters within their jurisdictions (or by interstate compact) with approval by the EPA.

3. DESCRIPTION OF 40 CFR 440, EPA MINING EFFLUENT LIMITS FOR U AND Ra (1982)

Issuances:

47 FR 54598, December 3, 1982.

Effective Date: January 17, 1983.

3.1 General Radiation Protection Provisions:

The provisions are applicable to discharges from (a) mines either open-pit or underground, from which uranium, radium and vanadium ores are produced; and (b) mills using the acid leach, alkaline leach, or combined acid and alkaline leach process for the extraction directly from the ground of uranium, radium and vanadium. Only vanadium by-product production from uranium ores is covered under this subpart. The regulations set effluent limitations for existing mines and mills representing best practicable control technology currently available (BPT) and best available technology economically achievable (BAT). The regulations also set effluent limitations for new sources, representing best available demonstrated technology (BADT).

3.2 Rationale for Detailed Requirements:

3.2.1 Best Practicable Control Technology Currently Available (BPT)
"[l]imitations are based on the average of the best existing performance at plants of various sizes, ages and unit processes within the industry or subcategory. In establishing BPT limitations, [EPA] considers the total control of applying the technology in relation to the effluent reduction derived, the age of equipment and facilities involved, the process employed, the engineering aspects of the control technologies, process changes and the nonwater-quality environmental impacts (including energy requirements)."

3.2.2 Best Available Technology Economically Achievable (BAT)
"[l]imitations . . . represent the best existing performance in the industrial category or subcategory. [CWA] establishes BAT as the principal national means of controlling the direct discharge of toxic and nonconventional pollutants to navigable waters. In arriving at BAT, EPA considers the age of the equipment and facilities involved, the process employed, the engineering aspects of the control technologies, process changes, the cost of achieving such effluent reduction and nonwater-quality environmental impacts. [The EPA] retains considerable discretion in assigning weight to these factors."

3.2.3 "EPA established BAT equal to BPT either because BPT already specified zero discharge, . . . or because application of . . . BAT did not reduce the level of toxic or nonconventional pollutants, or because BPT removed a very high percentage of all relevant pollutants."

3.2.4 EPA excluded the mill subpart in the uranium, radium and vanadium subcategory from development of BAT regulations because there is only one discharger.

3.2.5 "New Source Performance Standards (NSPS) are based on the best available demonstrated technology. New plants have the opportunity to install the best and most efficient production processes and wastewater treatment technologies." EPA proposed NSPS equal to BAT limitations for all elements of the ore mining and dressing industry except for the uranium mill subcategory. EPA proposed NSPS requiring "zero discharge for new uranium mills based on data demonstrating 18 of 19 existing mills do not discharge wastewater. The single mill which discharges recycles over 80 percent of the requirement for its intake water. Zero discharge is based on recycle, evaporation, and a combination [of the two.]"

3.3 Description of Detailed Requirements:

The standard establishes limits for non-radiological characteristics (e.g., total suspended solids) as well as radiological characteristics. Only the limits for radionuclides are discussed below. The limits on radioactive effluents are the same for existing point sources and new sources. However, different levels of control technology are required to reach the levels.

3.3.1 "Any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction after application" of BPT:

The concentration of pollutants discharged in mine drainage from either open-pit or underground uranium, radium, and vanadium mines (excluding mines using in-situ leach methods); and from mills using acid leach, alkaline leach, or combined alkaline and acid leach process to extract uranium, radium, and vanadium, including mine-mill facilities using in-situ leach methods, shall not exceed:

Radionuclide	Effluent Limitations	
	Maximum For Any 1 Day	Average of daily values for 30 consecutive days
Ra-226 (dissolved)	10 pCi/l	3 pCi/l
Ra-226 (total)	30 pCi/l	10 pCi/l
U	4 milligrams/liter	2 milligrams/liter

3.3.2. Any existing point source subject to this subpart must achieve the above limitations representing the degree of effluent reduction attainable by application of BAT:

The concentration of pollutants discharged in mine drainage from open-pit or underground mines that produce uranium ore, including mines using in-situ leach methods, shall not exceed the limits in the table above.

3.3.3 Any new source subject to this subpart must achieve the following NSPS representing the degree of effluent reduction attainable by the application of Best Available Demonstrated Technology (BADT):

A. The concentration of pollutants discharged in mine drainage from open-pit or underground mines that produce uranium ore (excluding mines using in-situ leach methods) shall not exceed the limits in the table above.

B. Except as provided in C below, there shall be no discharge of process wastewater to navigable waters from mills using the acid leach, alkaline leach, or combined acid and alkaline leach process for the extraction of uranium or from mines and mills using in-situ leach methods. (EPA recognizes this may result in an increase in discharges of some pollutants in other media.)

C. In the event annual precipitation and surface runoff exceeds annual evaporation at a treatment facility, a volume of water equal to the excess may be discharged subject to the limits in the table, above.

3.3.4 General Provisions

A. Combined Waste Streams: The quantity and concentration of each pollutant or pollutant property in the combined discharge from waste streams from various subparts or segments, shall not exceed the quantity and concentration of each pollutant had each waste stream been treated separately.

B. Storm Exemption: If, as a result of precipitation or snowmelt, a source with an allowable discharge has an overflow or excess discharge of effluent which does not meet the limitations of 40 CFR 440, or a source which is not permitted to discharge has an overflow or discharge that violates the limitations of 40 CFR 440, the facility may qualify for an exemption if:

i. The facility is designed to accommodate a 10-year, 24-hour precipitation event.

ii. The facility takes all reasonable steps to maintain treatment of the wastewater and minimize overflow.

iii. The facility complies with notification requirements.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

FACT SHEET 15

40 CFR Parts 220-229, EPA REGULATIONS AND CRITERIA FOR OCEAN DUMPING OF RADIOACTIVE MATERIALS (1977)

COMPLETE TITLE

40 CFR PARTS 220-229, OCEAN DUMPING; FINAL REVISION OF REGULATIONS AND CRITERIA, 42 FR 2462, January 11, 1977; CONVENTION ON THE PREVENTION OF MARINE POLLUTION BY DUMPING OF WASTES AND OTHER MATTER, London 1972, effective August 30, 1975

1. AUTHORIZING STATUTE

Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), as amended, Public Law 92-532, October 23, 1972; 33 U.S.C. 1401 et seq., 86 Stat. 1052 ("The Ocean Dumping Act").

Effective Date: April 23, 1972.

1.1 Statutory Purpose:

"The [MPRSA] declares that it is the policy of the United States . . . to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."

1.2 Radiation Protection Provisions:

1.2.1 MPRSA empowers the Environmental Protection Agency (EPA) to promulgate regulations and issue permits for the dumping of materials into the territorial waters of the United States, "when the EPA determines that such dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."

1.2.2 Section 102 of the Act prohibits the issuing of a permit for, and therefore bans, the dumping of radiological, chemical, and biological warfare agents, and high-level radioactive waste. High-level radioactive waste is defined as ". . . the aqueous waste resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated waste from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels, or irradiated fuel from nuclear power reactors."

1.2.3 The 1982 amendments to MPRSA (P.L. 97-424, January 6, 1983) added to Section 104, a "Permit Conditions" section which put a two-year moratorium on permits for ocean disposal of all radioactive waste. (The moratorium ran from January 6, 1983 to January 5, 1985.) Thereafter, a permit may not be issued until the applicant

prepares a Radioactive Material Disposal Impact Assessment and Congress authorizes the EPA to grant a permit by a joint resolution.

1.2.4 The MPRSA also requires the EPA to apply the standards and criteria of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), including its Annexes, to the extent that they can do so without relaxing the standards of the MPRSA. The London Convention is an international agreement signed by the United States and 70 other countries on ocean dumping. The U.S. has signed the agreement making it legally binding. Specifically, the definition of high-level radioactive waste unsuitable for sea disposal is binding upon signatories to the Convention. As of October 1986, the definition is both qualitative and quantitative.

2. RESPONSIBLE AGENCIES

The Environmental Protection Agency (EPA). EPA is responsible for issuing permits, promulgating regulations, conducting research, and enforcing the MPRSA.

The Secretary of the Army and Army Corps of Engineers. These agencies can issue permits for dredged material.

The Department of the Coast Guard. The Coast Guard is responsible for enforcement activities and surveillance to prevent unlawful transportation of material for dumping.

The Department of Commerce. This department is responsible for monitoring and research regarding the effects of ocean dumping.

The District Courts of the United States. These courts have jurisdiction over actions arising under the MPRSA.

3. DESCRIPTION OF 40 CFR Parts 220-229, EPA Regulations and Criteria for Ocean Dumping of Radioactive Materials (1977)

Issuances:

42 FR 2462, January 11, 1977; Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters (London, 30 October to 13 November 1972).

Effective Dates:

40 CFR 220-229, February 10, 1977; London Convention, August 30, 1975.

3.1 General Radiation Protection Provisions:

Both 40 CFR 227 and the London Convention ban the dumping of high-level radioactive waste. Other radioactive materials must be containerized for disposal at sea under 40 CFR 227 and are also allowed to be dumped, with special care, under the terms of the London Convention.

3.2 Rationale for Detailed Requirements:

Only a qualitative definition of high-level radioactive waste is given in 40 CFR 220-229. The London Dumping Convention defers to the IAEA to define high-level waste. The IAEA originally developed a quantitative definition. However, in 1985 the IAEA added a qualitative element to their quantitative definition of high-level waste. (A dose of 1 mSv/annum to individuals was used to arrive at the quantitative definition. The Convention went on to state that although the 1 mSv/annum dose was used as a reference, it does not imply an acceptable dose.)

3.3 Description of Detailed Requirements:

3.3.1 40 CFR 227

A. High-level radioactive waste is defined as, "the aqueous waste resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated waste from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels, or irradiated fuel from nuclear power reactors."

B. High-level radioactive wastes cannot be dumped into the ocean under any circumstances.

C. Materials produced or used for radiological warfare cannot be dumped into the ocean under any circumstances.

D. Radioactive materials, other than those described above, must be contained to prevent their direct dispersal or dilution in ocean waters in accordance with the following provisions:

i. The materials to be disposed of decay, decompose, or radiodecay to environmentally innocuous materials within the life expectancy of the containers and/or their inert matrix; and

ii. Materials to be dumped are present in such quantities and are of such nature that only short-term localized adverse effects will occur should the containers rupture at any time; and

iii. Containers are dumped at depths and locations where they will cause no threat to navigation, fishing, shorelines, or beaches.

3.3.2 London Convention

A. High-level radioactive waste or other high-level radioactive matter unsuitable for dumping at sea is defined as follows:

i. Irradiated reactor fuel; liquid wastes from the first solvent extraction cycle of chemical reprocessing of irradiated reactor fuel, or equivalent processes; solidified forms of such waste; and

ii. any other waste or matter of activity concentration exceeding:

a. 5×10^{-5} TBq/Kg (1.35×10^{-3} Ci/Kg) for alpha-emitters;

b. 2×10^{-2} TBq/Kg (0.54 Ci/Kg) for beta/gamma-emitters with half-lives of greater than 1 year (excluding tritium); and

c. 3 TBq/Kg (81 Ci/Kg) for tritium and beta/gamma-emitters with half-lives of 1 year or less.

The above activity concentrations shall be averaged over a gross mass not exceeding 1000 tons.

B. Materials of activity concentration less than those in (ii) above shall not be dumped except under a special permit. The maximum dumping rate into a single ocean basin of volume of at least $10^{17} m^3$ shall not exceed 10^8 Kg per year.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985). (See FACT SHEET 13.)

10 CFR 61, NRC Requirements for Land Disposal of Low-Level Radioactive Waste (1975). (See FACT SHEET 18.)

40 CFR 193, EPA Advance Notice of Proposed Rulemaking for Low-Level Radioactive Waste Disposal, 48 FR 39563, August 31, 1978.

10 CFR 60, NRC Requirements for Disposal of High-Level Radioactive Waste in Geologic Repositories (1981). (See FACT SHEET 17.)

FACT SHEET 16A

10 CFR 20, NRC BASIC STANDARDS FOR RADIATION PROTECTION (1960)

COMPLETE TITLE

10 CFR 20, STANDARDS FOR PROTECTION AGAINST RADIATION, 25 FR 10914, November 17, 1960

1. AUTHORIZING STATUTE

Atomic Energy Act (AEA) of 1954, as amended, and the Energy Reorganization Act (ERA) of 1974, as amended.

Effective Date: Atomic Energy Act, August 30, 1954; Energy Reorganization Act, January 19, 1975 .

1.1 Statutory Purpose:

The policy of the United States under the Atomic Energy Act is:

1.1.1 to develop, use, and control atomic energy so as to maximize its contribution to the general welfare, subject to making the maximum contribution to the common defense and security of the country; and

1.1.2 to develop, use, and control atomic energy so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

1.2 Radiation Protection Provisions:

Section 161 of the Atomic Energy Act of 1954 (The General Authority section) empowered the Atomic Energy Commission (AEC) to establish rules, regulations, and standards to govern the possession or use of nuclear materials as the AEC deemed necessary or desirable to "protect health or minimize danger to life or property." This authority was transferred to the Nuclear Regulatory Commission (NRC) by the Energy Reorganization Act of 1974, as amended.

Section 274(b) of the Atomic Energy Act of 1954 authorizes the Commission "to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission . . . with respect to . . . byproduct materials, . . . source materials, . . . [and] special nuclear materials in quantities not sufficient to form a critical mass." However, §274(c) provides that "[n]o agreement entered into pursuant to subsection b. shall provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of . . . the construction and operation of any production or utilization facility; . . . [and the export, import, and disposal of any nuclear material] as defined in the regulations or orders of the Commission."

2. RESPONSIBLE AGENCIES

The Nuclear Regulatory Commission (NRC). These regulations apply to all persons who receive, possess, use or transfer byproduct, source or special nuclear material pursuant to the regulations in 10 CFR 30 through 35, 40, 60, 61, 70, or 72, including persons licensed to operate a production or utilization facility pursuant to 10 CFR 50, and persons licensed to possess power reactor spent fuel pursuant to 10 CFR 72.

States. As of 1988, 29 States have entered into agreements with NRC under section 274 of the Atomic Energy Act of 1954, as amended, where the States have assumed jurisdiction over many uses of byproduct, source, and small amounts of special nuclear material which are regulated by NRC.

3. DESCRIPTION OF 10 CFR 20, NRC BASIC STANDARDS FOR RADIATION PROTECTION (1960)

Issuances:

22 FR 548, January 29, 1957; and 25 FR 10914, November 17, 1960.

Effective Date: November 17, 1960 (ongoing revisions).

Background:

National Committee on Radiation Protection and Measurement (NCRP) Handbook 52, "Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water" (Revised June 1959, NBS Handbook 69); and FRC Staff Report No. 1, (May 13, 1960) and 25 FR 4402, May 18, 1960.

3.1 General Radiation Protection Provisions:

10 CFR 20 contains standards for the protection of licensees, their employees, and the general public against radiation hazards arising out of the possession or use of special nuclear, source, or byproduct material under a license issued by the NRC. These regulations prescribe limitations which govern: occupational exposure to radiation and concentrations of radioactive material; concentrations of radioactive material which may be discharged into air or water; and limits on levels of radiation to the general population.

3.2 Rationale for Detailed Requirements:

3.2.1 Limits were established at levels for which biological damage or health effects would not be observed. The standards provide what, at that time (1960 and following revisions), was considered to be "a very substantial margin of safety for exposed individuals."

3.2.2 Internal exposure limits were based on the critical organ concept developed by the International Commission on Radiological Protection (ICRP). Tables of "Maximum Permissible Concentrations" (MPC)

were based on the calculated dose to the most irradiated organ using the method published by the ICRP in 1959 (ICRP-2).

3.2.3 In addition to complying with the detailed requirements set forth in 10 CFR 20, licensees should make every reasonable effort to maintain radiation exposures and releases of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable (ALARA).

3.3 Description of Detailed Requirements:

3.3.1 Dose limiting requirements of current 10 CFR 20:

Individuals in Restricted Areas[a] (Occupational)

	Limiting Dose in any Calendar Quarter (Rem/Quarter)
Whole body[b] Head and trunk Active blood forming organs[c] Lens of eyes Gonads	1-1/4[d]
Hands and forearms Feet and ankles	18-3/4
Skin of whole body	7-1/2
Individuals under 18 years of age	10 percent of above limits
Concentrations of radioactive materials in air or water	Not to exceed levels in Table I of Appendix B of 10 CFR 20[e]

Individuals in Unrestricted Areas (General Population)

Whole body	(1) 0.5 rem per calendar year, (2) levels which could exceed 2 millirem in any one hour (for an individual continuously present), or (3) levels which could exceed 100 millirem in any seven consecutive days (for an individual continuously present).
Concentrations of radioactive materials in air or water	Not to exceed levels in Table II of Appendix B of 10 CFR 20[f]

Notes to above detailed requirements:

(a) "Restricted area" means an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

(b) Whole-body exposures in excess of this dose may be permitted provided that (1) the whole-body dose does not exceed 3 rem per calendar quarter, and (2) the dose to the whole body, when added to the accumulated occupational dose to the whole body does not exceed 5(N-18) rem, where "N" equals the individual's age at his last birthday.

(c) The blood-forming organs are generally assumed to include the red bone marrow, lymph nodes, the thymus gland, and the spleen.

(d) For the purposes of computing the 5(N-18) rem calculation in footnote (a) and in lieu of actual exposure data, exposure after January 1, 1961 will be assumed to have been 1.25 rem per quarter. Prior to that, 3.75 rem per quarter should be assumed.

(e) The concentrations in Table I of Appendix B of 10 CFR 20 are based on an exposure period of 40 hours per week and 50 weeks per year.

(f) For effluents released to unrestricted areas, the limiting concentrations given in Table II of Appendix B are based upon continuous exposure for 168 hours per week and 52 weeks per year.

3.3.2 Waste Disposal Requirements of 10 CFR 20:

No licensee shall dispose of licensed material except by:

A. Transfer to an authorized recipient as provided in the regulations in 10 CFR 30, 40, 60, 61, 70, or 72.

B. Obtaining approval by the NRC of disposal procedures not otherwise authorized in 10 CFR.

C. Disposal by release into sanitary sewage systems only if:

i. The material is readily soluble or dispersible in water; and

ii. "The quantity of licensed or other radioactive material released in any one day (1) should not exceed ten times the quantity of such material specified in Appendix C, or (2) if diluted by the average amount of non-radioactive sewerage, will not result in an average concentration exceeding that specified in Appendix B, Table I, Column 2.

"The quantity of licensed or other radioactive material released in any one month, if diluted by the average monthly quantity of water released, will not exceed

the concentrations specified in Appendix B, Table I, Column 2.

"The gross quantity of licensed or other radioactive material released in any one year shall not exceed one curie in total, except for tritium (not to exceed 5 curies) and carbon-14 (not to exceed one curie)."

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Occupational Radiation Exposures (RPGs) (1987). (See FACT SHEET 2.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986). (See FACT SHEET 9.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975). (See FACT SHEET 19.)

29 CFR 1910.96, OSHA Ionizing Radiation Protection Standards (1971). (See FACT SHEET 20.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

10 CFR 35, Human Uses of Byproduct Material, 30 FR 8200, June 26, 1965. (Prescribes NRC regulations governing the licensing of byproduct material for human uses.)

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

NRC Safety Goals for the Operations of Nuclear Power Plants; Policy Statement, August 4, 1986.

FACT SHEET 16B

10 CFR 20, NRC PROPOSED BASIC STANDARDS FOR RADIATION PROTECTION (1986)

COMPLETE TITLE

10 CFR 20, STANDARDS FOR PROTECTION AGAINST RADIATION; PROPOSED RULE, 51 FR 1092, January 9, 1986

1. AUTHORIZING STATUTE

Atomic Energy Act (AEA) of 1954, as amended, and the Energy Reorganization Act (ERA) of 1974, as amended.

Effective Date: Atomic Energy Act, approved August 30, 1954; Energy Reorganization Act, January 19, 1975.

1.1 Statutory Purpose:

The policy of the United States under the Atomic Energy Act is:

1.1.1 to develop, use, and control atomic energy so as to maximize its contribution to the general welfare, subject to making the maximum contribution to the common defense and security of the country; and

1.1.2 to develop, use, and control atomic energy so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

1.2 Radiation Protection Provisions:

Section 161 of the Atomic Energy Act of 1954 (The General Authority section) empowered the Atomic Energy Commission (AEC) to establish rules, regulations, and standards to govern the possession or use of nuclear materials, as the AEC deemed necessary or desirable, to "protect health or minimize danger to life or property." This authority was transferred to the Nuclear Regulatory Commission (NRC) by the Energy Reorganization Act of 1974, as amended.

Section 274(b) of the Atomic Energy Act of 1954 authorizes the Commission "to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission . . . with respect to . . . byproduct materials, . . . source materials, . . . [and] special nuclear materials in quantities not sufficient to form a critical mass." However, §274(c) provides that "[n]o agreement entered into pursuant to subsection b. shall provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of . . . the construction and operation of any production or utilization facility; . . . [and the export, import, and disposal of any nuclear material] as defined in the regulations or orders of the Commission."

2. RESPONSIBLE AGENCIES

The Nuclear Regulatory Commission (NRC). These regulations apply to all persons who receive, possess, use or transfer byproduct, source or special nuclear material pursuant to the regulations in 10 CFR 30 through 35, 40, 60, 61, 70, or 72, including persons licensed to operate a production or utilization facility pursuant to 10 CFR 50, and persons licensed to possess power reactor spent fuel pursuant to 10 CFR 72.

States. As of 1988, 29 States have entered into agreements with NRC under Section 274 of the Atomic Energy Act of 1954, as amended, where the States have assumed jurisdiction over many uses of byproduct, source, and small amounts of special nuclear material which are regulated by NRC.

3. DESCRIPTION OF 10 CFR 20, NRC PROPOSED BASIC STANDARDS FOR RADIATION PROTECTION (1986)

Issuances:

51 FR 1092, January 9, 1986.

Effective Date: The comment period expired October 31, 1986.

Background:

International Commission on Radiological Protection (ICRP) publications: ICRP Publication 26, "Recommendations of the International Commission on Radiation Protection," adopted January 17, 1977; ICRP Publication 30, "Limits for Intake of Radionuclides by Workers," adopted July 1978; ICRP Publication 32, "Limits for Inhalation of Radon Daughters by Workers," adopted March 1981; National Academy of Sciences/National Research Council, Advisory Committee on the Biological Effects of Ionizing Radiations, "The Effects on Populations of Exposures to Low Levels of Ionizing Radiation," (BEIR I), National Academy Press, Washington, D.C. 1972; and National Academy of Sciences/National Research Council, Committee on the Biological Effects of Ionizing Radiations, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980," (BEIR III), National Academy Press, Washington, D.C., 1980.

3.1 General Radiation Protection Provisions:

The proposed regulations constitute a major revision of 10 CFR 20, which provides the requirements for the protection of individuals who are exposed, both within and outside the workplace, to ionizing radiation from routine activities (normal operations) which are licensed by the NRC. This protection is achieved through the setting of occupational and general public dose limits, as well as limits for effluent releases into air, water, or sanitary sewage systems.

3.2 Rationale for Detailed Requirements:

3.2.1 The proposed revision reflects developments in the principles that underlie radiation protection and advances in related sciences that have occurred since the promulgation of 10 CFR 20 in 1960. The

revision would put into practice many of the more recent recommendations of the ICRP.

3.2.2 "In the proposed revision, limits are derived explicitly by quantifying risk, and then by judging the acceptability of the risk through a comparison of risks experienced by workers in industries not involving radiation exposures or a comparison of risks normally encountered by the general public." The "acceptable" risk used as a basis for the limits is 10^{-4} per year for workers, and 10^{-6} to 10^{-5} per year for members of the public, based on estimated radiation-induced fatal cancers and serious hereditary disorders. The upper limits for organs were set to avoid non-stochastic (threshold) effects, such as cataracts.

3.2.3 Each licensee shall ensure that the dose to individuals receiving occupational doses and to members of the public is as low as is reasonably achievable (ALARA) and does not exceed the appropriate limits.

3.3 Description of Detailed Requirements (refer to footnote 1, page II-96):

Dose-Limiting Requirements of Proposed 10 CFR 20:

3.3.1 Occupational Limits

A. External Exposure

Whole body, head, trunk, arm above elbow, and leg above knee	5 rem/year (0.05 Sv/year) includes summation of (external) deep dose equivalent and (internal) committed effective dose equivalent
	3 rem (0.03 Sv) (external) maximum deep dose equivalent in any quarter
Lens of eye	15 rem/year (0.15 Sv/year)
Hand, elbow, arm below elbow, foot, knee, and leg below knee	50 rem/year (0.5 Sv/year)
Skin (10 cm^2)	50 rem/year (0.5 Sv/year)
Minors	1/10 of annual limits for adults
Embryo/fetus	0.5 rem (5mSv) during the entire pregnancy due to occupational exposure of the "declared" pregnant woman

Planned special exposures

Annual limit from all events	1 x annual limits
Lifetime limit from all events	5 x annual limits

B. Internal Exposure

The proposed 10 CFR 20, Appendix B, Table 1, has three columns captioned "Oral Ingestion ALI" (Annual Limit of Intake), "Inhalation ALI," and "DAC" (Derived Air Concentration), which are applicable to occupational exposure to radioactive material and may be used in demonstrating compliance with the occupational dose limits above. The ALIs in this appendix are the annual intakes of given radionuclides by a "Reference Man" which would result in either (1) a committed effective dose equivalent[1/] of 5 rem (stochastic ALI), or (2) a committed dose equivalent of 50 rem to an organ or tissue (non-stochastic ALI). The DAC values are derived limits intended to control chronic exposures. An ALI is equivalent to 2000 derived air concentration (DAC)-hours/year. Note that the values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides, or when the individual is exposed to both external and internal irradiation. In such a case the method of summation in Appendix E of 10 CFR 20 shall apply.

C. Radiation protection program is required, including consideration of ALARA.

3.3.2 Public Limits

A. Explicit limit of 0.5 rem/year (5 mSv/year) for individuals from all sources. Includes summation of external and internal doses and food pathways.

B. A licensee will be in compliance with the 0.5 rem annual limit if he can demonstrate that sources under his control will not result in an individual member of the public receiving

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1/ Definitions:
"Dose Equivalent" means the product of absorbed dose, quality factor, and all other necessary modifying factors at the location of interest in tissue. The units of dose equivalent are the rem and the sievert [1 sievert (Sv) = 100 rem].
"Committed Dose Equivalent" ($H_{c,T}$) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake ($H_{50,T}$).
"Effective Dose Equivalent" (H_E) is the sum of the products of the dose equivalent (H_T) to the organ or tissue (T) and the weighting factors (W_T) applicable to each of the body organs or tissues which are irradiated. ($\sum W_T H_T$).
"Committed Effective Dose Equivalent" ($H_{E,c}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues which are irradiated and the committed dose equivalent.

a dose in excess of the 0.1 rem (1 mSv) annual reference level. A licensee may demonstrate compliance with the annual reference level by:

i. Demonstrating that the sum of the external dose equivalent and internal committed effective dose equivalent to the individual likely to be the highest exposed does not exceed 0.1 rem; or

ii. Demonstrating that the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area are not greater than the values specified in 10 CFR 20, Appendix B, Table 2; and dose rates in unrestricted areas are not greater than 0.002 rem/hour and not more than 0.05 rem/year.

C. Doses less than 0.001 rem/year (0.01 mSv/year) per person need not be included in evaluating collective doses to the general population.

D. A licensee may apply for prior authorization of operations which may result in exposure of individual members of the public in excess of the 0.1 rem annual reference level, but within the 0.5 rem annual limit. The following should be included in the application: demonstration of a clear need to operate in excess of the reference level; an acceptable program to assess and control doses under the 0.5 rem annual limit; and acceptable procedures followed to maintain public exposures ALARA.

E. In addition to the requirements of 10 CFR 20, a licensee engaged in uranium fuel cycle operations must comply with the relevant provisions of 40 CFR 190.

3.3.3. Sanitary Sewerage Disposal

A licensee may discharge licensed material into a sanitary sewerage system if each of the following conditions are satisfied:

A. The material is readily soluble in water;

B. The quantity of licensed or other radioactive material released in one month divided by the average monthly volume of water released does not exceed the concentrations listed in 10 CFR 20, Appendix B, Table 3. [The concentration limits are equivalent to a whole body dose of 0.5 rem/year (5 mSv/year) by potential ingestion.]

C. The gross quantity of licensed and other radioactive material released in a year does not exceed 5 curies of hydrogen-3, 1 curie of carbon-14, and 1 curie of all other radioactive materials.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Occupational Radiation Exposures (RPGs) (1987). (See FACT SHEET 2.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986). (See FACT SHEET 9.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 50, Appendix I, NRC ALARA Design Objectives for Light-Water Reactor Effluents (1975). (See FACT SHEET 19.)

29 CFR 1910.96, OSHA Ionizing Radiation Protection Standards (1971). (See FACT SHEET 20.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

10 CFR 35, Human Uses of Byproduct Material, 30 FR 8200, June 26, 1965. (Prescribes NRC regulations governing the licensing of byproduct material for human uses.)

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

NRC Safety Goals for the Operations of Nuclear Power Plants; Policy Statement, August 4, 1986.

FACT SHEET 17

10 CFR 60, NRC REQUIREMENTS FOR DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE IN GEOLOGIC REPOSITORIES (1981)

COMPLETE TITLE

10 CFR 60, DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES IN GEOLOGIC REPOSITORIES, 46 FR 13971, February 25, 1981 (LICENSING PROCEDURES); 48 FR 28194, June 21, 1983 (TECHNICAL CRITERIA)

1. AUTHORIZING STATUTE

Atomic Energy Act (AEA) of 1954, as amended, and the Energy Reorganization Act (ERA) of 1974, as amended; and the Nuclear Waste Policy Act of 1982.

Effective Date: Atomic Energy Act, approved August 30, 1954; Energy Reorganization Act, January 19, 1975.

1.1 Statutory Purpose:

The policy of the United States under the Atomic Energy Act is:

1.1.1 to develop, use, and control atomic energy so as to maximize its contribution to the general welfare, subject to making the maximum contribution to the common defense and security of the country; and

1.1.2 to develop, use, and control atomic energy so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

1.2 Radiation Protection Provisions:

Section 161 of the Atomic Energy Act of 1954 (The General Authority section) empowered the Atomic Energy Commission (AEC) to establish rules, regulations, and standards to govern the possession or use of nuclear materials as the AEC deemed necessary or desirable to "protect health or minimize danger to life or property." This authority was transferred to the Nuclear Regulatory Commission (NRC) by the Energy Reorganization Act of 1974, as amended.

Section 274(b) of the Atomic Energy Act of 1954 authorizes the Commission "to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission . . . with respect to . . . byproduct materials, . . . source materials, . . . [and] special nuclear materials in quantities not sufficient to form a critical mass." However, §274(c) provides that "[n]o agreement entered into pursuant to subsection b. shall provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of . . . the construction and operation of any production or

utilization facility; . . . [and the export, import and disposal of any nuclear material] as defined in the regulations or orders of the Commission."

2. RESPONSIBLE AGENCIES

The Nuclear Regulatory Commission (NRC). The NRC issues licenses to the Department of Energy (DOE) "to receive and possess source, spent nuclear, and byproduct materials at a geologic repository operations area sited, constructed, or operated in accordance with the Nuclear Waste Policy Act of 1982 (NWPA) (42 U.S.C. 1010 et seq.)."

States and Indian Tribes. A state in which a high-level waste facility is proposed to be located and affected Indian tribes have a legal right to party status in review of license applications for such a facility.

3. DESCRIPTION OF 10 CFR 60, NRC REQUIREMENTS FOR DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE IN GEOLOGIC REPOSITORIES (1981)

Issuances:

46 FR 13971, February 25, 1981; 47 FR 13774, March 31, 1982; 48 FR 28194, June 21, 1983; 50 FR 29641, July 22, 1985; 51 FR 22288, June 19, 1986; 51 FR 27158, July 30, 1986; 52 FR 5992, February 27, 1987.

Effective Date: Procedural Rule, March 27, 1981; Technical Criteria, July 21, 1983.

Background:

The NRC regulations in 10 CFR 60 establish procedures for the licensing of geologic repositories and provide technical criteria (subpart E) to be used in the evaluation of license applications submitted under the procedural rules.

3.1 General Radiation Protection Provisions:

10 CFR 60 "prescribes rules governing the licensing of the U.S. Department of Energy to receive and possess source, spent nuclear, and byproduct materials at a geologic repository operations area sited, constructed, or operated in accordance with the Nuclear Waste Policy Act of 1982." (NWPA) (42 U.S.C. 1010 et seq.)

The regulations do not apply to (1) land disposal of low-level waste as provided for in 10 CFR 61; (2) disposal of uranium or thorium tailings or wastes as provided for in 10 CFR 40; or (3) disposal of licensed material by means provided for in 10 CFR 20.

3.2 Rationale for Detailed Requirements:

3.2.1 Subpart E - Technical Criteria prescribes standards for licensing geologic repositories for disposal of high-level waste.[1/] In particular, it requires "a finding that the issuance of a license will not constitute an unreasonable risk to the health and safety of the public. The purpose of this subpart is to set out performance objectives and set site and design criteria which, if satisfied, will support such a finding of no unreasonable risk."

3.2.2 Because a complete assurance cannot be presented, a reasonable assurance that the objectives and criteria will be met is the general standard that is required.

3.2.3 Where criteria are set for repository performance "over a long time in the future, there will inevitably be greater uncertainties. Proof of future performance . . . over time periods of many hundreds or many thousands of years is not to be had in the ordinary sense of the word. . . . [W]hat is required is reasonable assurance, making allowance for the time period, hazards, and uncertainties involved."

3.3 Description of Detailed Requirements:

3.3.1 Performance Objectives:

A. Performance objective for the geologic repository area through permanent closure.

"The geologic repository operations area shall be designed so that until permanent closure has been completed, radiation exposures and radiation levels, and release of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in [10 CFR 20] and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency."

"Repository operations must be conducted so as to make it possible to retrieve the wastes throughout the period during which they are being emplaced." Also, waste must be retrievable on a reasonable schedule "starting at any time up to 50 years after waste emplacement operations are initiated." A "reasonable schedule" for retrieval "would permit retrieval in about the same time as that devoted to constructions of the geologic repository area and the emplacement of wastes."

1/ " 'High-level radioactive waste' or 'HLW' means: (1) Irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such wastes have been converted."

B. Performance objective for the geologic repository area after permanent closure.

The geologic setting must be chosen, and shafts designed, to assure that "release of radioactive materials to the accessible environment following permanent closure conforms to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events."

C. Performance of particular barriers after permanent closure.

Engineered barriers must be designed to effect substantially complete containment while "radiation and thermal conditions in the engineered barrier system are dominated by fission product decay." Also, any release of radionuclides must be small, and occur over long periods of time.

i. Containment of HLW within the waste packages must be substantially complete for a period to be determined by the Commission of "not less than 300 years nor more than 1,000 years after permanent closure of the facility."

ii. Release rate of any radionuclides following the containment period must not exceed one part in 100,000 of "the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure," or such other fraction approved by the Commission. "[T]his requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release limit." The calculated release limit is one part in 100,000 per year of the radionuclide that remains after 1,000 years of radioactive decay. The geologic setting must be such that radionuclides will not be transported by groundwater, along the fastest path likely, to the accessible environment in less than 1,000 years.

iii. The Commission may approve other radionuclide release rates on a case-by-case basis provided that the overall system performance objective is met. The Commission may take into account such factors as: any generally applicable environmental standard for radioactivity established by the Environmental Protection Agency; the age and nature of the waste; the geochemical characteristics of the host rock; particular sources of uncertainty in predicting performance; and any additional requirements made necessary by unanticipated factors.

3.3.2 Design criteria for the geologic repository operations area:

"The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive materials in air in restricted areas within the limits specified in [10 CFR 20]." Design must include:

A. Means to limit concentrations of radioactive material in air;

B. Means to limit time required to perform work in the vicinity of radioactive materials;

C. Suitable shielding;

D. Means to control access to high radiation areas or airborne radioactivity areas.

3.3.3 Additional design criteria for surface facilities:

The surface facilities must be designed to control the release of radioactive materials in effluents within the limits specified in 10 CFR 20 and such generally applicable environmental standards for radioactivity as may have been set by the Environmental Protection Agency (EPA).

3.3.4 Design criteria for the waste packages for High-Level Waste:

Waste packages for HLW must be designed so that the chemical, physical and nuclear properties of the waste package and its interaction with the site environment do not compromise the performance of the waste package or the underground facility or geologic setting.

3.3.5 Siting Criteria:

A geologic setting must exhibit an appropriate combination of favorable conditions to reasonably assure that the performance objectives relating to isolation of the waste will be met. Favorable conditions are enumerated in 10 CFR 60.122(b).

4. RELATED STANDARDS

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985). (See FACT SHEET 13.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 61, NRC Requirements for Land Disposal of Low-Level Radioactive Waste (1975). (See FACT SHEET 18.)

10 CFR 40, NRC Regulations for Domestic Licensing of Source Material (1961).

FACT SHEET 18

10 CFR 61, NRC REQUIREMENTS FOR LAND DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTE (1975)

COMPLETE TITLE

10 CFR 61, LICENSING REQUIREMENTS FOR LAND DISPOSAL OF RADIOACTIVE WASTE, 47 FR 57446, December 27, 1982

1. AUTHORIZING STATUTE

Atomic Energy Act (AEA) of 1954, as amended, and the Energy Reorganization Act (ERA) of 1974, as amended.

Effective Date: Atomic Energy Act, approved August 30, 1954; Energy Reorganization Act, January 19, 1975.

1.1 Statutory Purpose:

The policy of the United States under the Atomic Energy Act is:

1.1.1 to develop, use, and control atomic energy so as to maximize its contribution to the general welfare, subject to making the maximum contribution to the common defense and security of the country; and

1.1.2 to develop, use, and control atomic energy so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

1.2 Radiation Protection Provisions:

Section 161 of the Atomic Energy Act of 1954 (The General Authority section) empowered the Atomic Energy Commission (AEC) to establish rules, regulations, and standards to govern the possession or use of nuclear materials as the AEC deemed necessary or desirable to "protect health or minimize danger to life or property." This authority was transferred to the Nuclear Regulatory Commission (NRC) by the Energy Reorganization Act of 1974, as amended.

Section 274(b) of the Atomic Energy Act of 1954 authorizes the Commission "to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission . . . with respect to . . . byproduct materials . . . source materials . . . [and] special nuclear materials in quantities not sufficient to form a critical mass." However, §274(c) provides that "[n]o agreement entered into pursuant to subsection b. shall provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of . . . the construction and operation of any production or

utilization facility; . . . [and the export, import, and disposal of any nuclear material] as defined in the regulations or orders of the Commission."

2. RESPONSIBLE AGENCIES

The Nuclear Regulatory Commission (NRC). The NRC issues licenses for land disposal facilities and promulgates, implements, and enforces regulations for the siting, constructing, and operating of these facilities.

States. Under §274 of AEA, states can, under Agreement State status, license a low-level waste disposal facility. Upon formal request, a state or tribal government may participate in the review of a license application for a land disposal facility.

3. DESCRIPTION OF 10 CFR 61, NRC REQUIREMENTS FOR LAND DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTE (1975)

Issuances:

47 FR 57446, December 27, 1982.

Effective Date: January 26, 1983.

3.1 General Radiation Protection Provisions:

10 CFR 61 provides specific requirements for the near-surface disposal of low-level radioactive wastes (LLW) containing source, special nuclear, or byproduct material. The regulations establish performance objectives for land disposal of waste and technical requirements for the siting, design, operation, closure and long-term control for a near-surface disposal facility. Waste classification is defined in the regulations. Institutional control of access to the site is required for up to 100 years.

The regulations do not apply to (1) disposal of high-level waste as provided for in 10 CFR 60; (2) disposal of uranium or thorium tailings or wastes as provided for in 10 CFR 40; or (3) disposal of licensed material by means provided for in 10 CFR 20.

3.2 Rationale for Detailed Requirements:

3.2.1 "Disposal of [LLW] in near-surface disposal facilities has [these] objectives: protection of the general population from releases of radioactivity, protection of individuals from inadvertent intrusion, and protection of individuals during operation. A fourth objective is to ensure stability of the site after closure."

3.2.2 Presently there are no Environmental Protection Agency (EPA) standards that set limits for releases of radioactivity from (LLW) disposal facilities to the environment. "In the absence of such a standard, the [NRC] examined a range of limits which bound that expected for the EPA standard and selected a proposed performance

objective that establishes a release limit for the site boundary. . . ." The EPA "stated that the range of 1 to 25 mrem/year analyzed by the [NRC] was a reasonable range and should encompass any standard which EPA might derive. . . ."

3.2.3 Every reasonable effort should be made to limit releases of radioactivity in effluents, and radiation exposure during operations as low as is reasonably achievable (ALARA).

3.3 Description of Detailed Requirements:

3.3.1 Performance Objectives:

A. General requirement: Land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives below. Free-standing liquids in waste delivered to the site are limited to one percent (0.01) by volume.

B. Protection of the general population: Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals must not result in an annual dose to any member of the public exceeding:

Organ	Annual Dose
Whole body	25 millirem
Thyroid	75 millirem
Any other organ	25 millirem

Also, every reasonable effort should be made to limit releases of radioactivity in effluents to the general environment as low as is reasonably achievable.

C. Protection to individuals from inadvertent intrusion: Design, operation, and closure of facilities must ensure protection of individuals inadvertently intruding onto disposal sites after active institutional controls are removed.

D. Protection of individuals during operations: Operations must be conducted in compliance with radiation protection standards in 10 CFR 20, except for releases of radioactivity in effluents, which are governed by the standards in B above.

Also, every reasonable effort should be made to maintain radiation exposure as low as is reasonably achievable.

E. Stability of the disposal site after closure: The facility must be sited, designed, used, operated, and closed to achieve long-term stability of the site and to eliminate to the extent practicable the need for ongoing active maintenance of the

site following closure so that only surveillance, monitoring, or minor custodial care are required.

3.3.2 Waste Classification:

Waste is classified on two considerations: (1) the concentration of long-lived radionuclides, whose potential hazard will persist beyond the effective life of institutional controls, and (2) the concentration of shorter-lived radionuclides. Classifications from Class A to Class C are set out in 10 CFR 61.55.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 192, EPA, and 10 CFR 40, NRC, Environmental Standards for U and Th Mill Tailings (1983, 1985). (See FACT SHEET 12.)

40 CFR 191, EPA Environmental Standards for Management and Disposal of High-Level and Transuranic Radioactive Waste (1985). (See FACT SHEET 13.)

40 CFR 220-229, EPA Regulations and Criteria for Ocean Dumping of Radioactive Materials (1977). (See FACT SHEET 15.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

40 CFR 193, EPA Advance Notice of Proposed Rulemaking for Low-Level Radioactive Waste Disposal, 48 FR 39563, August 31, 1978.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

FACT SHEET 19

10 CFR 50, APPENDIX I, NRC ALARA DESIGN OBJECTIVES FOR LIGHT-WATER REACTOR EFFLUENTS (1975)

COMPLETE TITLE

10 CFR 50, APPENDIX I, NUMERICAL GUIDES FOR DESIGN OBJECTIVES AND LIMITING CONDITIONS FOR OPERATION TO MEET THE CRITERION "AS LOW AS IS REASONABLY ACHIEVABLE" FOR RADIOACTIVE MATERIAL IN LIGHT-WATER-COOLED NUCLEAR POWER REACTOR EFFLUENTS, 40 FR 19442, May 5, 1975

1. AUTHORIZING STATUTE

Atomic Energy Act (AEA) of 1954, as amended; Energy Reorganization Act (ERA) of 1974, as amended.

Effective Date: Atomic Energy Act, approved August 30, 1954; Energy Reorganization Act, January 19, 1975.

1.1 Statutory Purpose:

The policy of the United States under the Atomic Energy Act is:

1.1.1 to develop, use, and control atomic energy so as to maximize its contribution to the general welfare and to make the maximum contribution to the common defense and security of the country; and

1.1.2 to develop, use, and control atomic energy so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

1.2 Radiation Protection Provisions:

Section 161 of the Atomic Energy Act of 1954 (The General Authority section) empowered the Atomic Energy Commission (AEC) to establish rules, regulations, and standards to govern the possession or use of nuclear materials as the AEC deemed necessary or desirable to "protect health or minimize danger to life or property." This authority was transferred to the Nuclear Regulatory Commission (NRC) by the Energy Reorganization Act of 1974, as amended.

2. RESPONSIBLE AGENCY

The Nuclear Regulatory Commission (NRC). The NRC issues licenses for nuclear power plants and promulgates, implements, and enforces safety regulations for their siting, construction and operation.

3. DESCRIPTION OF 10 CFR 50, APPENDIX I, NRC ALARA DESIGN OBJECTIVES FOR LIGHT-WATER REACTOR EFFLUENTS (1975)

Issuances:

40 FR 19442, May 5, 1975.

Effective Dates:

June 4, 1975, for permit applications filed after January 2, 1971. Applications filed prior to January 2, 1971 must file additional material with NRC within 12 months of June 4, 1975.

Background:

Effective Rule Published, 40 FR 19439, May 5, 1975; amended 40 FR 40516, September 4, 1975; 40 FR 33029, December 19, 1975.

Proposed Rule Published for Public Comment; 36 FR 11113, June 9, 1971. AEC published new sections of 10 CFR 50.34a and 50.36a; 35 FR 18385, December 3, 1970, which specified the qualitative requirement for keeping radioactive material effluents "as low as possible" [now "as low as is reasonably achievable" (ALARA).]

3.1 General Radiation Protection Provisions:

10 CFR 50, Appendix I, provides quantitative design objectives for radioactive material in light-water-cooled (LWR) reactor effluents. Guidelines are promulgated for liquid and gaseous effluents, and for radioactive iodine and radioactive material in particulate form. Conforming to the guidelines is deemed a conclusive showing of compliance with the "as low as is reasonably achievable" (ALARA) requirement of 10 CFR 50.34a and 50.36a.

3.2 Rationale for Detailed Requirements:

ALARA is defined in 10 CFR 50.34a(a) as: "as low as is reasonably achievable" taking into account the state of technology, and the economics of improvements in relation to the benefits to public health and safety and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest. The guidelines quantify the qualitative ALARA criterion.

3.3 Description of Detailed Requirements:

3.3.1 Guides on design objectives for LWRs licensed under 10 CFR 50:

The following numerical guides are based on estimated annual dose or dose commitments for any individual in an unrestricted area from all pathways of exposure from each LWR reactor.

Liquid effluents

- 3 mrem total body or
- 10 mrem any organ

Gaseous effluents

- 10 mrad from gamma radiation or
- 20 mrad from beta radiation

Notwithstanding these air doses, the following apply:

- 5 mrem total body or
- 15 mrem skin

Radioactive iodine/radioactive material in particulate form

- 15 mrem any organ

3.3.2 In addition to the provisions in 3.3.1 above, the licensee must include in the radwaste system all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. The values of $1000 per total body man-rem and $1000 per man-thyroid-rem shall be used on an interim basis in this cost-benefit analysis (lesser values may be determined on a case-by-case basis).

3.3.3 Guides on technical specifications for limiting conditions for operation for LWRs licensed under 10 CFR 50:

A. The quantity of radioactive material released in effluents to unrestricted areas during any calendar quarter shall be such that the calculated resultant radiation exposure does not exceed one-half the design objective annual exposure.

B. Establish a monitoring program of radionuclide releases in effluents and measurable levels of radiation and radioactive materials in the environment to evaluate doses to individuals from principal exposure pathways.

C. If data developed in monitoring shows that the relationship between material released and individual doses in the unrestricted area is significantly different from that assumed in calculating design objectives, the Commission may modify the quantities in the technical specifications defining the limiting conditions for operating a light-water-cooled nuclear power reactor.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Limiting Certain Internal Radiation Exposures (RPGs) (1961). (See FACT SHEET 4.)

40 CFR 61, EPA Air Emission Standards for Radionuclides (1985, 1986). (See FACT SHEET 9.)

40 CFR 141, EPA Interim Drinking Water Standards for Radionuclides (1976). (See FACT SHEET 10.)

40 CFR 190, EPA Environmental Standards for Uranium Fuel Cycle (1977). (See FACT SHEET 11.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

40 CFR 141, EPA Advance Notice of Proposed Rulemaking Dealing with Radionuclides Under Safe Drinking Water Act, 51 FR 34836, September 30, 1986. (This will be a revision of the standard described in FACT SHEET 10.)

DOE Manual Chapter XI, DOE Limits on Occupational and General Population Exposure to Radiation, April 29, 1981.

Great Lakes Water Quality Agreement: Specific Water Quality Objectives; Radiological. April 15, 1972; renewed November 22, 1978.

NRC Safety Goals for the Operations of Nuclear Power Plants; Policy Statement, August 4, 1986.

FACT SHEET 20

29 CFR 1910.96, OSHA IONIZING RADIATION PROTECTION STANDARDS (1971)

COMPLETE TITLE

29 CFR 1910.96, IONIZING RADIATION: OSHA RADIATION PROTECTION STANDARDS, 36 FR 10466, May 29, 1971 (and later amendments)

1. AUTHORIZING STATUTE

Occupational Safety and Health Act of 1970, 29 U.S.C. 651 et seq., P.L. 91-596, 84 Stat. 1590, December 29, 1970.

Effective Date: April 27, 1971.

1.1 Statutory Purpose:

To assure insofar as is possible that every worker in the Nation has safe and healthy working conditions and to preserve human resources.

1.2 Radiation Protection Provisions:

Regulations concerning radiation protection of workers were established under Sections 6(a) and 8(g) of the Act, which broadly empower the Secretary of Labor to promulgate occupational safety and health standards.

2. RESPONSIBLE AGENCIES

U.S. Department of Labor, Occupational Health and Safety Administration (OSHA). The Secretary of Labor sets mandatory occupational health and safety standards. The Secretary is authorized to set standards regarding labels showing exposure limits, protective equipment, medical examinations, recordkeeping, and reporting and is empowered to conduct inspections and investigations.

Occupational Health Review Commission. A 3-member board, appointed by the President carries out adjudicatory functions under the Act.

The Secretary, U.S. Department of Health and Human Services (HHS) (formerly Health, Education and Welfare). The Secretary of HHS conducts research, experiments, and studies of exposure levels; recommends regulations regarding records, medical examinations, and toxic substances; conducts annual studies and inspections and has contracting authority, all of which are delegated to the Director of the National Institute for Occupational Safety and Health.

3. DESCRIPTION OF 29 CFR 1910.96, OSHA IONIZING RADIATION PROTECTION STANDARDS (1971)

Issuances:

36 FR 10466, May 29, 1971; 39 FR 23502, June 27, 1974, as amended at 43 FR 49746, October 24, 1978; 43 FR 51759, November 7, 1978; and 49 FR 18295, April 30, 1984.

Effective Date: August 27, 1971, or February 15, 1972, in situations where time was necessary to adjust to the standards.

3.1 General Radiation Protection Provisions:

Radiation protection standards promulgated under OSHA are designed to protect workers from exposure to radiation in programs other than those regulated by MSHA, those specifically covered by the Atomic Energy Act of 1954, as amended, and those in specific situations covered by other Federal regulatory agencies. Also excluded from direct OSHA jurisdiction are States which maintain NRC agreements or which have OSHA State plans. OSHA sets exposure limits; requires the monitoring of individual exposure; requires evacuation warning signals; sets standards for posting, storage, notification, and reporting of incidents; establishes requirements for recordkeeping and surveying; and requires education of employees on exposure hazards and safety procedures.

3.2 Rationale for Detailed Requirements:

No specific rationale was provided in the regulations.

3.3 Description of Detailed Requirements:

3.3.1 The requirements are almost identical to those found in 10 CFR 20.

3.3.2 The regulations define: radiation, radioactive material, restricted area, unrestricted area, dose, rad, rem, radiation area, high radiation area, airborne radiation area, and neutron flux dose equivalents.

3.3.3 Exposure to individuals in restricted areas may not exceed the following doses:

		rem/calendar quarter
A.	Whole body	1-1/4
	Hands and forearms Feet and ankles	18-3/4
	Skin of whole body	7-1/2

B. The above doses may be exceeded if: the dose to the whole body does not exceed 3 rem in any calendar quarter and the dose to the whole body does not exceed 5 times (age at last birthday minus 18) rem when added to the accumulated

occupational dose, and employer maintains past and current exposure records to show the addition of such a dose will not exceed the limits set above.

C. No employers shall permit employees under 18 to receive in any period of a calendar quarter a dose in excess of 10% of the above limits.

3.3.4 Exposure to Airborne Radioactive Materials:

No employer shall possess, use or transport radioactive material in such manner as to cause any employee to be exposed to airborne radioactive material in an average concentration in excess of limits specified in:

A. Table I of Appendix B to 10 CFR 20 if an individual is over 18 years old, and

B. Table II of Appendix B to 10 CFR 20 if an individual is under 18 years old.

NOTE: Exposure means an individual is present. No allowance is made for protective clothing or equipment or particle size.

3.3.5 Instruction of Personnel:

All employers, except employers regulated by the Atomic Energy Commission (Nuclear Regulatory Commission), governed by 10 CFR 20 standards, or employers regulated under AEC(NRC)-State agreements, are regulated by the following:

A. Individuals working or frequenting any portion of a radiation area must be informed of the occurrence of radioactive materials and be instructed in the safety problems associated with exposure, and be instructed in precautions and devices to minimize exposure; and

B. Employers shall conspicuously post current regulations and operating procedures or keep these documents for examination on request.

3.3.6 Waste Disposal:

No employer shall dispose of radioactive materials except by transfer to an authorized recipient or in a manner approved by the Atomic Energy Commission (Nuclear Regulatory Commission) or Agreement State programs under the Atomic Energy Act.

3.3.7 Records:

A. Employers shall maintain records for employees under Paragraph 3.3.5.A above that are exposed to radiation at levels in excess of 25 percent of the applicable value in 3.3.3 above for adults, and in excess of 5 percent of the limits in 3.3.3 for minors. Employers shall also advise employees of their individual exposure on at least an annual basis.

above for adults, and in excess of 5 percent of the limits in 3.3.3 for minors. Employers shall also advise employees of their individual exposure on at least an annual basis.

B. Employers shall maintain records in the same units used in Paragraph 3.3.3 above, and Appendix B to 10 CFR 20.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Occupational Exposures (RPGs) (1987). (See FACT SHEET 2.)

Guidance on Radon Exposures in Uranium Mines (1969). (See FACT SHEET 3.)

10 CFR 20, NRC Basic Standards for Radiation Protection (1960). (See FACT SHEET 16A.)

10 CFR 20, NRC Proposed Basic Standards for Radiation Protection (1986). (See FACT SHEET 16B.)

Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, September 1975, Revised June 1980, EPA-520/1-75-001. (Provides action levels and guidance for their use by state and local agencies in developing radiological emergency plans.)

FACT SHEET 21

21 CFR 1020, FDA PERFORMANCE STANDARDS FOR IONIZING RADIATION EMITTING PRODUCTS (1973)

COMPLETE TITLE

21 CFR 1020, PERFORMANCE STANDARDS FOR IONIZING RADIATION EMITTING PRODUCTS, 38 FR 28632, October 15, 1973

1. AUTHORIZING STATUTE

Section 358 of the Radiation Control for Health and Safety Act of 1968 (RCHSA), 42 U.S.C. 263f, P.L. 90-602.

Effective Date: October 18, 1968.

1.1 Statutory Purpose:

The purpose of the RCHSA is "to provide . . . an electronic product radiation control program which shall include the development and administration of performance standards to control the emission of electronic product radiation . . . and the undertaking . . . of research and investigation into the effects and control of such radiation emissions." Electronic product radiation means:

(1) Any ionizing or non-ionizing electromagnetic or particulate radiation; or

(2) Any sonic, infrasonic, or ultrasonic wave, which is emitted from an electronic product as the result of an electronic circuit in such product.

1.2 Radiation Protection Provisions:

Under Section 358 of the RCHSA, the Assistant Secretary for Health in the Department of Health and Human Services (HHS) shall prescribe regulations for performance standards for radiation emitting products to control electronic product radiation.

2. RESPONSIBLE AGENCIES

Department of Health and Human Services (HHS). This department has authority under RCHSA to prescribe performance standards for radiation emitting products. HHS has delegated this responsibility to the:

Food and Drug Administration (FDA). The FDA has set performance standards for electronic products.

States. Whenever a performance standard is prescribed under Section 358, no State shall have any authority to either establish, or to continue in effect, any standard which is applicable to the same aspect of performance which is not identical to the Federal standard. States may impose a more restrictive standard than the Federal standard for electronic products procured for their own use.

Technical Electronic Products Radiation Safety Standards Committee (TEPRSSC). The Secretary of HHS must consult the Committee before prescribing a standard. The 15 member Committee is appointed by the Secretary and is made up of experts on electronic product radiation safety as follows:

—five members from governmental agencies (State and Federal);

—five members selected from affected industries; and

—five members selected from the general public (at least one from organized labor).

The Committee may propose standards to the Secretary for his consideration.

3. DESCRIPTION OF 21 CFR 1020, FDA PERFORMANCE STANDARDS FOR IONIZING RADIATION EMITTING PRODUCTS (1973)

Issuances:

38 FR 28624, October 15, 1973.

Effective Date: October 15, 1973.

3.1 General Radiation Protection Provisions:

Performance standards have been established for ionizing radiation emitting products: television receivers, cold-cathode gas discharge tubes, diagnostic x-ray systems (radiographic equipment, fluoroscopic equipment, and CT x-ray systems), and cabinet x-ray systems (including airport security).

3.2 Rationale for Detailed Requirements:

No specific rationale was provided in the regulations.

3.3 Description of Detailed Requirements:

NOTE: The Standards below are ionizing radiation emission limits found in the regulations. Standards for implementation have been omitted.

3.3.1 Radiation exposure rates produced by a television receiver shall not exceed 0.5 milliroentgens per hour at a distance of 5 centimeters from any external surface of the receiver, measurement averaged over 10 square centimeters with no linear dimension greater than 5 centimeters.

3.3.2 Radiation exposure rates produced by cold-cathode gas discharge tubes shall not exceed 10 milliroentgens per hour at a distance of 30 centimeters from any point on the external surface of the tube.

3.3.3 The leakage of radiation from the diagnostic source assembly of an x-ray diagnostic system shall not exceed 100 milliroentgens in one hour, measured at a distance of 1 meter in any direction from the source; measurements shall be averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters.

3.3.4 The radiation emitted by a component other than the diagnostic source assembly of an x-ray diagnostic system shall not exceed 2 milliroentgens in one hour at 5 centimeters from any accessible surface of the component.

3.3.5 Radiation emitted from a cabinet x-ray system, such as those used in airports for security, shall not exceed an exposure of 0.5 milliroentgens in one hour at any point 5 centimeters outside the external surface, measurement averaged over 10 square centimeters with no linear dimension greater than 5 centimeters.

4. RELATED STANDARDS

Federal Guidance on Occupational and Population Radiation Exposures (RPGs) (1960). (See FACT SHEET 1.)

Federal Guidance on Occupational Radiation Exposures (RPGs) (1987). (See FACT SHEET 2.)

29 CFR 1910.96, OSHA Ionizing Radiation Protection Standards (1971). (See FACT SHEET 20.)

FACT SHEET 22

ADVISORY FDA PROTECTIVE ACTION GUIDES (PAGs) FOR RADIOACTIVE CONTAMINATION IN FOOD (1982)

COMPLETE TITLE

ACCIDENTAL RADIOACTIVE CONTAMINATION OF HUMAN FOOD AND ANIMAL FEEDS; RECOMMENDATIONS FOR STATE AND LOCAL AGENCIES, 47 FR 47073, October 22, 1982

1. AUTHORIZING STATUTE

Public Health Service Act of 1944, as amended, 42 U.S.C. 241, 242, and 243, and authority delegated to the Commissioner of Food and Drugs (21 CFR 5.10).

Effective Date: March 11, 1982.

1.1 Interagency Assignment:

44 CFR 351 sets out Federal agency roles and assigns tasks regarding Federal assistance to State and local governments in radiological emergency planning activities. Federal Emergency Management Agency (FEMA) assigned the task of issuing Protective Action Guides for human food and animal feeds to the Department of Health and Human Services with the cooperation of the Environmental Protection Agency.

1.2 Applicability:

The FDA Protective Action Guides are applicable to radiological accidents at fixed nuclear facilities and transportation accidents involving radioactive material.

2. RESPONSIBLE AGENCIES

The Department of Health and Human Services (HHS). HHS has the responsibility to develop and specify to State and local governments protective actions and associated guidance for human food and animal feed. This responsibility was delegated to the Food and Drug Administration (FDA).

State and Local Governments. The FDA Protective Action Guides are recommendations for when State and local agencies should take voluntary action to protect the public from food contaminated with radiation.

3. DESCRIPTION OF ADVISORY FDA PROTECTIVE ACTION GUIDES (PAGs) FOR RADIOACTIVE CONTAMINATION IN FOOD (1982)

Issuances:

47 FR 47073, October 22, 1982; and 43 FR 58790, December 15, 1978.

Effective Date: October 22, 1982.

3.1 General Radiation Protection Provisions:

FDA recommendations, Protective Action Guides (PAGs), establish the level of radioactive contamination in human or animal feeds at which actions should be taken to protect the public health and assure the safety of food. The PAGs are recommendations only, which State and local agencies should, but are not required, to follow.

3.2 Rationale for Detailed Requirements:

3.2.1 "The PAGs represent FDA's judgment as to that level of food contamination resulting from radiation incidents at which action should be taken to protect public health. This is based on the agency's recognition that safety includes the degree to which risks are judged acceptable. The risk from natural disasters (approximately one in a million annual individual risk of death) and the risk from variations in natural background radiation have provided perspective in selecting PAG values. The recommendations are based on the assumption that . . . contamination requiring protective actions . . . is an unlikely event, that most individuals will never be so exposed, and that any individual is not likely to be exposed at the PAG level more than once in his or her lifetime."

3.2.2 The basis for the Preventive PAG involves consideration of the risk from natural disasters, the variation in the population-weighted natural background radiation dose to the total population, and the variation in dose due to ingestion of food.

3.2.3 "The basis for the Emergency PAG involves consideration of (1) the ratio between average and maximum individual radiation doses (taken as 1 to 10), (2) the cost of low- and high-impact protective actions, (3) the relative risks from natural disasters, (4) health impact, (5) the upper range of the PAGs proposed by EPA (5 rem projected radiation dose to the whole body and 25 rem projected dose to the thyroid), and (6) radiation doses from multiple pathways."

3.2.4 The PAGs issued by the Federal Radiation Council for I-131 in 1964 (see FACT SHEET 7) and for Sr-89, Sr-90, Cs-137 in 1965 (see FACT SHEET 8) were considered in developing these PAGs.

3.3 Description of Detailed Requirements:

These recommendations are for use by appropriate State or local agencies in response planning and radiation protection activities in the event of an incident resulting in the release of radioactivity to the environment. FDA

recommends that the guidance be used on a case-by-case basis. If, in a particular situation, effective action with low total impact is available, initiation of such action at a projected dose lower than the PAG may be justifiable. If only high impact action would be effective, initiation at a projected dose higher than the PAG may be justifiable.

NOTE: PAGs are not intended to authorize deliberate releases expected to result in doses of these magnitudes.

3.3.1 Definitions:

Protective Action is an action or measure taken to avoid most of the radiation dose "that would occur from future ingestion of foods contaminated with radioactive materials."

Preventive PAG "is the projected dose commitment value at which . . . officials should take protective actions having minimal impact. . . ."

Emergency PAG "is the projected dose commitment value at which officials should isolate food containing radioactivity. . . ."

Response Level "means the activity of a specific radionuclide (1) initially deposited on pasture; or (2) per unit weight or volume of food or animal feed; or (3) in the total dietary intake which corresponds to a particular PAG." (Specific radionuclide concentrations upon which to initiate protective actions.)

3.3.2 The following Preventive and Emergency PAGs for an exposed individual in the population are adopted:

A. Preventive PAG: ". . . 1.5 rem projected dose commitment to the thyroid; or 0.5 rem projected dose commitment to the whole body, bone marrow or any other organ."

B. Emergency PAG: ". . . 15 rem projected dose commitment to the thyroid; or 5 rem projected dose commitment to the whole body, bone marrow, or any other organ."

C. Response Levels for Preventive and Emergency PAGs: (see chart on following page).

Response Levels for Preventive PAG: Infant[1/]

	I-131[3/]	Cs-134[5/]	Cs-137[5/]	Sr-90	Sr-89
Initial Activity Area Deposition (microcuries/sq. meter)	0.130	2.00	3.00	0.500	8.00
Forage Concentration[4/] (microcuries/kilogram)	0.050	0.80	1.30	0.180	3.00
Peak Milk Activity (microcuries/liter)	0.015	0.15	0.24	0.009	0.14
Total Intake (microcuries)	0.090	4.00	7.00	0.200	2.60

Response Levels for Emergency PAG

	I-131[3/]		Cs-134[5/]		Cs-137[5/]		Sr-90		Sr-89	
	Infant[1/]	Adult	Infant[2/]	Adult	Infant[2/]	Adult	Infant[2/]	Adult	Infant[2/]	Adult
Initial Activity Area Deposition (microcuries/sq. meter)	1.3	18	20.0	40	30.0	50	5.00	20.0	80.0	1,600
Forage Concentration (microcuries/kilogram)	0.5	7	8.0	17	13.0	19	1.80	8.0	30.0	700
Peak Milk Activity (microcuries/liter)	0.15	2	1.5	3	2.4	4	0.09	0.4	1.4	30
Total Intake (microcuries)	0.9	10	40.0	70	70.0	80	2.00	7.0	26.0	400

1/ Newborn Infant as critical segment of population, includes fetus (pregnant women) as critical segment for I-131.
2/ Infant refers to child less than 1 year of age.
3/ From fallout, iodine-131 is the only radioiodine of significance with respect to milk contamination beyond the first day. In case of a reactor accident, the cumulative intake of iodine-133 via milk is about 2 percent of iodine-131 assuming equivalent deposition.
4/ Fresh Weight.
5/ Intake of cesium via the meat/person pathway for adults may exceed that of the milk pathway; therefore, such levels in milk should cause surveillance and protective actions for meat as appropriate. If both cesium-134 and cesium-137 are equally present, as might be expected for reactor accidents, the response levels should be reduced by a factor of 2.

D. To obtain the Response Level (microcuries/kilogram) equivalent to the Protective Action Guide for other specific foods:

$$\text{Response Level} = \frac{\text{Total Intake (microcuries)}}{\text{Consumption (kilograms)}}$$

where: Total intake for the appropriate PAG and radionuclide is given in the chart above, and consumption is the product of the average daily consumption and the days of intake of contaminated food.

4. RELATED STANDARDS

Federal Protective Action Guide (PAG) for I-131 (1964). (See FACT SHEET 7.)

Federal Protective Action Guides (PAGs) for Sr-89, Sr-90 and Cs-137 (1965). (See FACT SHEET 8.)

Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, September 1975, Revised June 1980, EPA-520/1-75-001. (Provides action levels and guidance for their use by state and local agencies in developing radiological emergency plans.)

FACT SHEET 23A

30 CFR 57, MSHA SAFETY AND HEALTH RADIATION STANDARDS FOR UNDERGROUND METAL AND NONMETAL MINES (1977)

COMPLETE TITLE

30 CFR 57.5037-5047, SAFETY AND HEALTH STANDARDS -UNDERGROUND METAL AND NONMETAL MINES-RADIATION-UNDERGROUND ONLY

1. AUTHORIZING STATUTES

Federal Metal and Nonmetallic Mine Safety Act, 30 U.S.C. 721, P.L. 89-577 § 6, 80 Stat. 774. Repealed by P.L. 95-164, Title III, §306(a), November 9, 1977. Replaced by 30 U.S.C. 801, pursuant to P.L. 95-164.
Federal Mine Safety and Health Act of 1977 (P.L. 91-173) as amended by P.L. 95-164, 30 U.S.C. 957, 83 Stat. 803.

Effective Date: Repeal and replacement effective March 9, 1978.

1.1 Statutory Purpose:

1.1.1 To establish interim mandatory health and safety standards and to direct the Secretary of Health, Education and Welfare [later Health and Human Services (HHS)] and the Secretary of Labor to develop improved mandatory health or safety standards to protect the nation's miners.

1.1.2 To require mine operators and miners to comply with such standards.

1.1.3 To cooperate with the States in development of effective mine safety programs.

1.1.4 To improve and expand training programs aimed at preventing accidents and occupationally-caused diseases in the mining industry.

1.2 Radiation Protection Provisions:

Under the Federal Metal and Nonmetallic Mine Safety Act, the Department of the Interior, through the Mining Enforcement Safety Administration (MESA), established regulations governing health and safety standards. One set of regulations, governing exposure to ionizing radiation (radon daughters and gamma rays) is relevant to radiation protection.

When the original §§721-740 of the Federal Metal and Nonmetallic Mine Safety Act were repealed and replaced by §§801 et seq., the Department of Labor received the Department of the Interior's rulemaking authority, and delegated it to the Mine Safety and Health Administration (MSHA).

2. RESPONSIBLE AGENCIES

The Department of the Interior. Under 30 U.S.C. 721, the Secretary of the Interior was authorized to promulgate mandatory mine health and safety standards. Authority was delegated to the Mining Enforcement and Safety Administration.

The Department of Labor. Under 30 U.S.C. 801, authority over mine safety standards was transferred to the Secretary of Labor. This brought operation of all mines under a single legislative canopy. The Secretary delegated the rule-making authority to the Mine Safety and Health Administration created by 30 CFR I, under the authority of the Federal Mine Safety and Health Act of 1977.

The Secretary, U.S. Department of Health and Human Services (HHS) (formerly Health, Education and Welfare). The Secretary of HHS conducts research, experiments, and studies of exposure levels; recommends regulations regarding records, medical examinations, and toxic substances; conducts annual studies and inspections and has contracting authority, all of which are delegated to the Director of the National Institute for Occupational Safety and Health.

The States. One purpose of 30 U.S.C. 801 was to promote cooperation by Federal agencies with the states in developing health and safety standards.

3. DESCRIPTION OF 30 CFR 57, MSHA SAFETY AND HEALTH RADIATION STANDARDS FOR UNDERGROUND METAL AND NONMETAL MINES (1977)

Issuances:

42 FR 5546, January 28, 1977; 42 FR 29418, June 8, 1977.

Effective Date: July 18, 1977 (revisions currently proposed).

3.1 General Radiation Protection Provisions:

30 CFR 57 prescribes limitations which govern radon daughter exposure monitoring, annual exposure limits, maximum permissible concentration, exposure records, smoking prohibition, revised exposure levels, posting of inactive workings, protection against radon gas, and gamma radiation surveys and exposure limit.

3.2 Rationale for Detailed Requirements:

3.2.1 The existing mining standard for gamma radiation was set at 5 rem in 1977 (42 FR 29418). This level was based on the recommendations first made by the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) in the mid-1950s.

3.2.2 In 1970, the Bureau of Mines (predecessor to MESA and MHSA) had established 12 working level months (WLM) as the Federal exposure limit to radon daughters in underground mines. In 1971, the Environmental Protection Agency (EPA) issued a Federal Radiation Protection Guidance for radon daughters, which specified a limit of

4 WLM per year. (See FACT SHEET 3.) That annual limit applied to underground mines as a mandatory standard through 30 CFR 57.5042, which incorporates EPA radon daughter recommendations approved by the President. The 4 WLM limit was later explicitly adopted.[1/]

3.3 Description of Detailed Requirements:

3.3.1 Radon Daughter Exposure Monitoring: In all mines at least one sample must be taken of mine exhaust air.

A. Uranium mines: If the concentration in the initial sample is less than 0.1 WL, mines must be sampled monthly thereafter. If the concentration is more than 0.1 WL, samples must be taken every two weeks thereafter. If a concentration in excess of 0.3 WL is found, monitoring must be done weekly until the concentration is less than 0.3 WL for five consecutive weeks.

B. All other mines: If the concentration in the initial sample is less than 0.1 WL, no further samples need be taken. If the concentration is more than 0.1 WL, samples must then be taken at least every three months. If the concentration in the initial sample is greater than 0.3 WL, sampling must be done at least every week until the concentration is less than 0.3 WL for five consecutive weeks.

3.3.2 Annual Exposure Limits: No person shall be permitted to receive an exposure in excess of 4 WLM in any calendar year.

3.3.3 Maximum Permissible Concentration: No one may be exposed to air containing concentrations of radon daughters exceeding 1.0 WL in active workings, except as provided by standard 30 CFR 57.5005: ". . . [W]here accepted engineering control measures have not been developed or when necessary by the nature of work involved (for example, while establishing controls or occasional entry into hazardous atmospheres to perform maintenance or investigation), employees may work for reasonable periods of time in concentrations of airborne contaminants exceeding permissible levels if they are protected by appropriate respiratory protective equipment."

3.3.4 Radon daughter exposure monitoring and records are required. A higher level of scrutiny is required where uranium is mined.

3.3.5 Smoking is prohibited in all areas of a mine where exposure records are required to be kept.

1/ To calculate an individual's exposure to WLM under this standard, multiply the total exposure time (hours to the nearest half-hour) by the average concentration of airborne radon daughters for the applicable active working area (average working level calculated to the nearest hundredth working level) and divide the product by the constant 173 hours per month. (This 173 hours per month standard differs from the NRC and international standard of 170 hours per month.)

3.3.6 Revised Exposure Levels: If maximum exposure levels to concentrations of radon daughters are recommended by the EPA and approved by the President, no employee shall be permitted to receive exposures in excess of those levels after the effective dates established by the Agency.

3.3.7 Respirators are required in compliance with §57.5005 in environments exceeding 1.0 WL.

3.3.8 Inactive Workings in which radon daughter concentrations are above 1.0 WL shall be posted against unauthorized entry, and identified by signs as an area in which respirators are required.

3.3.9 Protection Against Radon Gas: Where radon daughter concentrations exceed 10 WL, respirator protection against radon gas must be provided in addition to protection against radon daughters.

3.3.10 Gamma Radiation

A. Gamma radiation surveys must be conducted annually in all underground mines where radioactive ores are mined.

B. Surveys must be in accordance with American National Standards (ANSI) Standard N13.8-1973 ("Radiation Protection in Uranium Mines"), section 14.1, page 12, which is incorporated in this standard by reference.

C. Where average gamma radiation measurements are in excess of 2.0 milliroentgens per hour in the working place, gamma radiation dosimeters must be provided for all persons affected, and records of cumulative gamma radiation exposure must be kept.

D. Annual individual gamma radiation exposure must not exceed 5 rem.

4. RELATED STANDARDS

Federal Guidance on Occupational Radiation Exposures (RPGs) (1987). (See FACT SHEET 2.)

Federal Guidance on Radon Exposure in Uranium Mines (1969). (See FACT SHEET 3.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

30 CFR 57, MSHA Proposed Ionizing Radiation Standards for Underground Metal and Nonmetal Mines (1986). (See FACT SHEET 23B.)

FACT SHEET 23B

30 CFR 57, MSHA PROPOSED IONIZING RADIATION STANDARDS FOR UNDERGROUND METAL AND NONMETAL MINES (1986)

COMPLETE TITLE

30 CFR 57, IONIZING RADIATION STANDARDS FOR UNDERGROUND METAL AND NONMETAL MINES; PROPOSED RULES, 41 FR 45678, DECEMBER 19, 1986.

1. AUTHORIZING STATUTES

Federal Metal and Nonmetallic Mine Safety Act, 30 U.S.C. 721, P.L. 89-577 §6, 80 Stat. 774. Repealed by P.L. 95-164, Title III, §306(a), November 9, 1977. Replaced by 30 U.S.C. 801, pursuant to P.L. 95-164.
Federal Mine Safety and Health Act of 1977, P.L. 91-173 as amended by P.L. 95-164, 30 U.S.C. 957, 83 Stat. 803.

Effective Date: Repeal and replacement effective March 9, 1978.

1.1 Statutory Purpose:

1.1.1 To establish interim mandatory health and safety standards and to direct the Secretary of Health, Education and Welfare [later Health and Human Services (HHS)] and the Secretary of Labor to develop improved mandatory health or safety standards to protect the nation's miners.

1.1.2 To require mine operators and miners to comply with such standards.

1.1.3 To cooperate with the States in development of effective mine safety programs.

1.1.4 To improve and expand training programs aimed at preventing accidents and occupationally-caused diseases in the mining industry.

1.2 Radiation Protection Provisions:

Under the Federal Metal and Nonmetallic Mine Safety Act, the Department of the Interior, through the Mining Enforcement Safety Administration (MESA), established regulations governing health and safety standards. One set of regulations, governing exposure to ionizing radiation (radon daughters and gamma rays) is relevant to radiation protection.

When the original §§721-740 of the Federal Metal and Nonmetallic Mine Safety Act were repealed and replaced by §§801 et seq., the Department of Labor received the Department of the Interior's rulemaking authority, and delegated it to the Mine Safety and Health Administration (MSHA).

2. RESPONSIBLE AGENCIES

The Department of the Interior. Under 30 U.S.C. 721, the Secretary of the Interior was authorized to promulgate mandatory mine health and safety standards. Authority was delegated to the Mining Enforcement and Safety Administration.

The Department of Labor. Under 30 U.S.C. 801, authority over mine safety standards was transferred to the Secretary of Labor. This brought operation of all mines under a single legislative canopy. The Secretary delegated the rule-making authority to the Mine Safety and Health Administration created by 30 CFR I, under the authority of the Federal Mine Safety and Health Act of 1977.

The Secretary, U.S. Department of Health and Human Services (HHS) (formerly Health, Education and Welfare). The Secretary of HHS conducts research, experiments, and studies of exposure levels; recommends regulations regarding records, medical examinations, and toxic substances; conducts annual studies and inspections and has contracting authority, all of which are delegated to the Director of the National Institute for Occupational Safety and Health.

The States. One purpose of 30 U.S.C. 801 was to promote cooperation by Federal agencies with the states in developing health and safety standards.

3. DESCRIPTION OF 30 CFR 57, MSHA PROPOSED IONIZING RADIATION STANDARDS FOR UNDERGROUND METAL AND NONMETAL MINES (1986)

Issuances:

50 FR 4144, January 29, 1985, 50 FR 47700, November 19, 1985, 51 FR 45678, December 10, 1986.

Effective Date: The comment period expired February 14, 1987.

Background

Sum rule: ICRP Publication 2, "Report of Committee II on Permissible Dose from Internal Radiation" (1959); Nuclear Regulatory Commission, proposed revision to Part 20 of Code of Federal Regulations (50 FR 1092, January 9, 1986); ICRP Publication 32, "Limits for Inhalation of Radon Daughters" (1982); ICRP Publication 47, "Radiation Protection of Workers in Mines" (1985).

Monitoring: Schiager et al., "Radiation Monitoring for Uranium Mines: Evaluation and Optimization" (1981).

3.1 General Radiation Protection Provisions:

The proposed standards would revise large portions of 30 CFR 5037-5047, which set standards for limits on annual exposure to, and recording standards for, occupational exposure to ionizing radiation in underground mines.

3.2 Rationale for Detailed Requirements:

3.2.1 Scope. MSHA continues to limit the scope of the rule to underground mines because "MSHA found no significant radiation hazard at surface operations which was not already adequately addressed by other

State or Federal agencies." Nor does the rule cover use of x-radiation equipment, because such exposure is low, isolated to specific parts of the body, and adequately regulated by State and local governmental agencies.

3.2.2 Control of exposure to radiation-Sum rule: "The most significant departure from the Agency's existing ionizing radiation standards in this proposed rule is the establishment of a combined exposure limit or sum rule for radon daughters, thoron daughters, and gamma radiation. . . .

"The guiding principle is that the total risk of radiation-induced fatal cancers for an individual should be limited."

3.2.3 Monitoring for radon daughters and thoron daughters: The proposed rule would reduce the action level for radon daughters for weekly sampling from 0.3 WL to 0.2 WL, and would institute an action level for thoron daughters of 0.6 WL. This reflects the concern for the effects of combined radiation resulting in increased fatal cancer risk.

3.2.4 Gamma ray dosimetry: The threshold level for required gamma ray dosimetry would also be changed, from an average of 2.0 milliroentgens per hour to an average of 0.75 millirem per hour. This was intended to prevent any miner from exceeding 30% (1.5 rem) of the annual allowed exposure (5 rem) without his exposure being recorded.

3.2.5 Records: Two levels of record-keeping are proposed for radon daughters, based on the level of gamma radiation present. This reflects the same whole-risk concern as does the recommendation of the sum rule.

3.2.6 Calculation of exposure to individuals: This section "clarifies the methodology for calculating individual radon daughter exposure in existing 30 CFR 57.5040, and contains provisions for calculating exposure to thoron daughters." Although no thoron daughter concentrations approaching the action level have been recorded in any working mine in the United States, such levels have been found in some inactive mines.

3.2.7 Smoking prohibition: The smoking prohibition has been maintained because removing it "would be a step back from sound health protection." There is no evidence of the exact relationship between smoking and radiation-induced lung cancer.

3.2.8 ALARA: "A widely-held, basic tenet for minimizing harm from radiation is that exposures should be kept as low as reasonably achievable (ALARA). Effective implementation of the principle involves: education of workers, . . . training in regulatory requirements, . . . establishment of appropriate exposure limits, . . . monitoring, . . . and implementation of radiation control measures. [To this end] the mining act contains specific provisions for training miners in health and safety. This proposal would put into effect

other facets of ALARA by setting requirements for monitoring and record-keeping."

3.3 Description of Detailed Requirements:

3.3.1 Control of exposure to radiation.

A. Ceiling limits. The proposed regulation requires that no person be exposed to air containing concentrations of radon daughters exceeding 1.0 WL or thoron daughters exceeding 3.0 WL unless the person is wearing approved respiratory protection. Areas where concentrations exceed these limits must be barricaded or posted. If radon-daughter concentration exceeds 10 WL, supplied-air type respirators must be used.[1/]

B. Combined limit. Combined radiation exposure for any person during any calendar year may not exceed 1.0 as determined by the following formula:

$$\text{Combined radiation exposure} = \frac{R}{4\ \text{WLM}} + \frac{T}{14\ \text{WLM}} + \frac{G}{5\ \text{rem}}$$

Where:
R = the recorded calendar-year radon-daughter exposure in WLM.[2/]

T = the recorded calendar-year thoron-daughter exposure in WLM.

G = the recorded calendar-year whole-body gamma dose in rem.

C. Declared pregnancy. The occupational whole-body dose of gamma radiation of a declared pregnant woman (one who has been diagnosed as pregnant and has informed the mine-operator) shall not exceed 0.50 rem during the entire pregnancy.

1/ WL, WLM, and rem are the traditional measures in the mining industry. Conversion to the International System of Units (SI), involving joules and sieverts, can be accomplished with the following conversion factors:
1.0 WL=2.08 x 10^{-5}J/m^3
1.0 WLM=3.6 x 10^{-3}J per m^3
1.0 rem=10 mSv.

2/ To calculate an individual's exposure to WLM under this standard, multiply the total exposure time (hours to the nearest half-hour) by the average concentration of airborne radon daughters for the applicable active working area (average working level calculated to the nearest hundredth working level) and divide the product by the constant 173 hours per month. (This 173 hours per month standard differs from the NRC and international standard of 170 hours per month).

3.3.2 Monitoring for airborne radiation.

A. Action level. Monitoring standards apply to any mine identified as having radon daughter concentrations above 0.20 WL or thoron daughter concentrations above 0.60 WL, unless levels can be promptly reduced and maintained, or the areas are barricaded or posted.

B. Frequency. Areas with concentration levels above the action level must be sampled weekly. Where areas have concentrations below the action level, but are entered by persons whose exposures are monitored because of their exposures in other areas of the mine, these areas shall be sampled on a monthly basis. Sampling frequency may be lowered either for weekly or monthly areas, subject to guidelines concerning the consistency of the levels in the last four regular samples.

3.3.3 Gamma ray dosimetry.
The mine operator must provide gamma-ray dosimeters for all persons with an average whole-body gamma-ray dose rate of more than 0.75 millirem per hour during any shift, and for the term of the pregnancy if the whole-body dose rate from gamma radiation of a declared pregnant woman exceeds an average of 0.33 millirem/hour during any shift.

3.3.4 Records. Two levels for recordkeeping of individual exposure to radon daughters are proposed. Where gamma ray dosimetry is required, calendar-year radon exposure levels are required where radon daughter concentrations exceed 0.2 WL. Where gamma dosimetry is not required, yearly records are only required where radon-daughter exposure exceeds 0.3 WL.

3.3.5 Calculation of exposure to individuals.

A. The average radon or thoron daughter concentration for an area is determined by averaging two consecutive samples.

B. For each person the exposure time (to the nearest half-hour) is multiplied by the average concentration (WL) to arrive at the person's exposure in working level hours (WLH) to the nearest hundredth.

The quarterly WLH are added together and divided by 173 to calculate the person's quarterly exposure in working level months (WLM). The quarterly exposure in WLM are added together to calculate the calendar-year exposure.

C. Where respiratory protective equipment is used for short-term entry for inspection, maintenance, or installation of controls, or to supplement feasible controls as required by 30 CFR 57.5701(d), the following adjustments may be made in calculating exposure:

i. For approved respirators that remove airborne nuclides, the wearer's exposure may be considered to be 10% of the last radon daughter and thoron daughter concentration in the area prior to the respirator use.

ii. For approved supplied-air respirators, exposure may be calculated on the basis of radon daughter and thoron daughter concentrations present in the supplied air for the time the respirator is worn.

3.3.6 Smoking prohibition. Smoking would be prohibited underground in mines where airborne radiation exposure records are required.

3.3.7 30 CFR 57.5042, which incorporated any standard for radon daughter exposure proposed by the Environmental Protection Agency (EPA) and approved by the President, has been removed.

4. RELATED STANDARDS

Federal Guidance on Occupational Radiation Exposures (RPGs) (1987). (See FACT SHEET 2.)

Federal Guidance on Radon Exposure in Uranium Mines (1969). (See FACT SHEET 3.)

40 CFR 440, EPA Mining Effluent Limits for U and Ra (1982). (See FACT SHEET 14.)

30 CFR 57, MSHA Safety and Health Radiation Standards for Underground Metal and Nonmetal Mines (1977). (See FACT SHEET 23A.)

USER'S GUIDE

1. ACTS.

2. AGENCIES.

3. RADIONUCLIDES.	FACT SHEET
Cesium	8, 10, 13, 22
Iodine	4, 7, 10, 11, 13, 19, 22
Krypton	11
Plutonium	11, 13
Polonium	3, 9
Radium	1, 4, 10, 12-14
Radon	2, 3, 9, 12, 23A and B
Strontium	4, 8, 10, 13, 22
Thorium	12, 13
Thoron	23B
Transuranics	6, 11, 13
Tritium	10, 15, 16A
Uranium	3, 9, 11-14, 23A and B

4. MAJOR RADIATION SOURCE CATEGORIES.	
Consumer Products	1, 10, 21
Medical	5, 16, 21
Miscellaneous Environment	1, 4, 6-9, 14-16, 22
Nuclear Fuel Cycle	1, 4, 7-9, 11-13, 16-19
Occupational	2, 3, 16, 20, 23

5. SPECIFIC ORGANS OR TISSUES.	
Active Blood-Forming Organs	1, 16A
Ankle	1, 16A, 20
Arm	1, 16A and B, 20
Bone	1, 2, 4, 6
Bone Marrow	2, 4, 8, 10, 22
Breast	2
Elbow	16B
Extremity	2
Eye, Lens	1, 2, 16A and B
Foot	1, 16A and B, 20
Gonads	1, 2, 6, 16A
Hand	1, 16A and B, 20
Head	1, 16A and B
Knee	16B
Leg	16B
Liver	6
Lung	2, 3, 6, 9, 12
Skin	1, 2, 5, 16A and B, 19, 20
Thyroid	1, 2, 4, 7, 11-13, 18, 22
Trunk	1, 16A and B
Whole Body	1, 2, 8-13, 16A and B, 18-20, 22

6. TERMS.

7. TOPICS.

7. TOPICS (CONTINUED).	FACT SHEET
Effluents	
gaseous	16A and B, 19
light-water reactor	19
limits for uranium fuel cycle	11
liquid	16A and B, 19
mining limits for U and Ra	14
Electronic product	5, 21
Environmental	
radionuclides	4, 6-9, 12, 13, 17
standards for uranium fuel cycle	11
transuranics	6
Embryo/fetus	2, 16B, 22, 23B
Exposure	
internal	2, 4, 6, 16A and B
radon	3, 23A and B
thoron	23B
Gamma	
limits for LWR gaseous effluents	19
ocean dumping	15
radiation in underground mines	23A and B
radioactivity in drinking water	10
radionuclides in groundwater	13
Genetic damage	2, 6
Medical	
diagnostic x-ray	5, 21
Mines	
metal and nonmetal	23A and B
uranium (see Uranium, mines)	
Minors	2, 16A and B, 20, 22
Occupational	
limits	1, 2, 16A and B, 20
miners	3, 23A and B
Ocean Dumping	15
Photons (see Gamma)	
Population	
general limits	1, 16A and B
internal exposure limits	4, 16A and B
limits from air emissions	9
limits from mill tailings	12
limits from waste disposal	13, 17, 18
limits from nuclear fuel cycle	11, 19
Pregnant female (see Embryo/Fetus)	
Radionuclides	
air emission standards	9
drinking water standards	10
mining effluent limits for U and Ra	14
ocean dumping	15
Sewage systems	
disposal of NRC-licensed material	16A and B
Smoking	3, 23A and B
Thorium	
mill tailings	12

7. TOPICS (CONTINUED).	FACT SHEET
Uranium	
mill tailings	9, 12
mills	9, 12, 14
mines	3, 9, 14, 23A and B
Waste	
disposal into sewage systems	16A and B
geologic repository	17
high-level	13, 15, 17
land disposal	18
low-level	18
ocean dumping	15
spent nuclear fuel	13, 17
transuranic	13
Water	
drinking	10
groundwater	12, 13, 17