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FEDERAL ENVIRONMENTAL STANDARDS OF POTENTIAL IMPORTANCE TO OPERATIONS AND ACTIVITIES AT U.S. DEPARTMENT OF ENERGY SITES

DRAFT

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TABLES

ABBREVIATIONS

ACL	alternate concentration limit
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate
BAT	best available technology (DOE Orders)
BCT	best conventional pollutant control technology
BDAT	best demonstrated available technology
BOD_5	five-day biochemical oxygen demand
BPT	best practicable control technology currently available
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COD	chemical oxygen demand
CWA	Clean Water Act
DAC	derived air concentration
DCG	derived concentration guide
DOE	U.S. Department of Energy
dose e.	dose equivalent
DOT	U.S. Department of Transportation
dpm	disintegrations per minute
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
EP Toxicity	extraction procedure toxicity

ER	Environment Reporter
ERS	Environmental Restoration Sites
EH	Environmental Safety and Health
ERDA	U.S. Energy Research and Development Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
HCS	Hazard Communication Standard
Hg	mercury
HHS	Department of Human and Health Services
HOC	halogenated organic compound
HSWA	Hazardous and Solid Waste Amendments
ICRP	International Commission on Radiological Protection
IOCs	inorganic chemicals
ISFSI	Independent Spent Fuel Storage Installation
keV	kiloelectron-volt
LDR	land disposal restriction
LOEL	lowest observed effect level
MACT	maximum achievable control technology
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MeV	megaelectron-volt
μCi/mL	microcurie per milliliter
μg/L	microgram per liter
$\mu g/m^3$	microgram per cubic meter
μR/L	microrems per hour
mg/L	milligram per liter

mg/m^3	milligram per cubic meter
mm	millimeter
mrem	millirem
MTHM	metric tons of heavy metal
NCP	National Air and Hazardous Substances Pollution Control Plan
NESHAP	National Emission Standard for Hazardous Air Pollutants
NACOSH	National Advisory Committee on Occupational Safety and Health
NIOSH	National Institute of Occupational Safety Health and Health
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NSDWR	National Secondary Drinking Water Regulations
NSPS	New Source Performance Standards
NWPA	Nuclear Waste Policy Act
OSHA	Occupational Safety and Health Act
PCB	polychlorinated biphenyl
pCi	picocurie
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/m^2-5	picocurie per meter squared-second
PNL	Pacific Northwest Laboratory
ppm	part per million
PPE	personal protective equipment
PSES	Pretreatment Standards for Existing Sources
PSNS	Pretreatment Standards for New Sources
RCRA	Resource Conservation and Recovery Act

RMERC	retorting or roasting in a thermal processing unit capable of volatilizing mercury and subsequently condensing the volatilized mercury for recovery
SCBA	self-contained breathing apparatus
SMCL	secondary maximum contaminant level
SDWA	Safe Drinking Water Act
SOCs	synthetic organic chemicals
Sv	sievert
TC	toxicity characteristic
TRU	transuranic
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSS	total suspended solids
UST	underground storage tank
VHAP	volatile hazardous air pollutant
VOC	volatile organic compound
wb	welfare-based as defined by the Safe Drinking Water Act, secondary standards based on aesthetic qualities of drinking water
WL	working level

EXECUTIVE SUMMARY

When conducting environmental restoration, waste management, and decontamination and decommissioning activities, the U.S. Department of Energy (DOE) must consider potentially applicable federal standards. Potentially applicable standards are found in the following statutes and regulations promulgated pursuant to those statutes: the Clean Air Act; the Clean Water Act; the Comprehensive Environmental Response, Compensation, and Liability Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the Atomic Energy Act and Nuclear Waste Policy Act; the Resource Conservation and Recovery Act; the Safe Drinking Water Act; Toxic Substances Control Act; and the Occupational Safety and Health Act. Some DOE Orders and federal Executive Orders also contain potentially applicable standards.

A variety of qualitative and quantitative standards exist in the regulations. In general, quantitative standards are risk-based, technology-based, welfare-based, or a combination thereof. Risk-based standards are typically defined in terms of human health or safety. Risk is often measured as the maximum acceptable probability of unacceptable health effects. Technology-based standards can be defined in a variety of ways. However, all technology-based standards set pollutant discharge limits for categories of discharges based on available pollution control technologies. The environmental and health effects of the discharged pollutants are not considered. The type of technology-based standard may differ with the type of substance being regulated.

Welfare-based standards are defined differently among the various regulations. The Clean Air Act defines public welfare to include factors such as effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, climate, damage to and deterioration of property, hazards to transportation, as well as effects on economic values, personal comfort, and well-being. Under the Safe Drinking Water Act, welfare is defined very generally as factors that may affect the aesthetic qualities of drinking water.

Some standards are based on a combination of these basic types of standards. A typical example is a technology-based standard founded on a risk-based goal. The acceptable level of risk is determined based on purely health factors. An ample margin of safety for that risk value is based on a combination of health, economic, technological, and other relevant factors. In all standards that are cited in this report and that have a combination of bases, risk is the underlying factor. After risk has been considered, other factors are included in the evaluation.

In some cases the bases for standards are not specified in the regulations. Such standards may be questioned by the public. As it continues its cleanup and remediation activities, DOE must consider all of these standards, regardless of their technical bases.

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) is now engaged in a program of environmental restoration nationwide across its 45 sites. It is also bringing its facilities into compliance with environmental regulations, decontaminating and decommissioning unwanted facilities, and constructing new waste management facilities.

One of the most difficult questions that DOE must face in successfully remediating its inactive waste sites, decontaminating and decommissioning its inactive facilities, and operating its waste management facilities is: "What criteria and standards should be met?" Before a specific cleanup action begins, and as a continuing activity during the operation of its waste management facilities, DOE must determine acceptable levels of "cleanliness." This determination must be based on federal, state, and local laws and regulations. However, within the framework of those laws and regulations, considerable latitude exists for setting quantitative cleanup standards (OTA 1989). Hence, in cooperation with the responsible federal, state, and local regulatory agencies, DOE will need acceptable quantitative standards and criteria that apply to its environmental restoration, waste management, and decontamination and decommissioning (D&D) activities or acceptable procedures for determining such standards and criteria at each of its sites. Acceptable standards or procedures for determining standards will assist DOE in its conduct of ongoing waste management and pending cleanup activities by helping to ensure that those activities are conducted in compliance with applicable laws and regulations and are accepted by the regulatory community and the public.

1.1 PURPOSE AND SCOPE

This document reports on the second of three baseline activities that are being conducted as prerequisites to either the development of quantitative standards that could be used by DOE, or consistent procedures for developing such standards. The first and third baseline activities are also briefly discussed in conjuction with the second of the three activities.

The first baseline activity for determining quantitative standards that are applicable to DOE's environmental restoration, waste management, and D&D activities is to identify substances that are important to DOE and for which standards and criteria are needed. The second baseline activity for determining applicable standards is addressed in this report: to identify existing quantitative standards that are potentially applicable to DOE's activities. The standards identified in this document were compiled from relevant federal regulations and DOE Orders that are presently in effect. Draft regulations were not considered. State and local regulations are also not considered, although they may be at a later date.

Although the primary purpose of this report is to compile quantitative standards that are or could be applicable to DOE, qualitative standards are noted where appropriate. The potentially applicable quantitative standards compiled herein are typically risk-based or technology-based. However, other bases (e.g., welfare-based) for standards were encountered and are defined as appropriate below. This report was prepared by the Pacific Northwest Laboratory (PNL)[(a)] for DOE's Office of Environmental Guidance.

In the third baseline activity, the potentially applicable quantitative standards identified in this report will be matched with the substances identified in the first baseline activity to identify quantitative standards that are applicable to DOE's waste management, decontamination and decommissioning, and environmental restoration activities. When the applicable standards and criteria have been identified, areas in which quantitative standards and criteria need to be developed and technical and procedural issues that are related to the development of needed standards and criteria will be apparent.

1.2 BACKGROUND

DOE owns 45 sites in 26 different states where it operates facilities that support national security interests, energy research, environmental restoration, etc. The first site was established in 1942 to support World War

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(a) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RLO 1830.

II efforts and has operated since 1944. Additional sites were added as the nation's security needs increased. These facilities generated, treated, stored, and disposed of hazardous, radioactive, and mixed wastes.

During four decades of operations at its facilities, DOE facilities released chemicals and radioactive substances into the environment via trenches, landfills, pipes and stacks. As a result, cubic miles of soils and groundwater at these sites became contaminated with hazardous, radioactive, and mixed wastes. These contaminated media will require remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, or the corrective action requirements of the Resource Conservation and Recovery Act (RCRA) of 1984 (as amended). DOE's sites also contain numerous old production reactors and other facilities that are no longer operable. These facilities must be decontaminated and decommissioned in accordance with RCRA and other statutes.

All operating facilities must also have, and be in compliance with, RCRA operating permits from the U.S. Environmental Protection Agency (EPA) or from the state regulatory agency to which RCRA permitting responsibility has been delegated. Most of DOE's facilities were not constructed to be in compliance with today's environmental requirements. DOE is presently modernizing its facilities by bringing them into compliance with environmental requirements and by decontaminating and decommissioning unwanted facilities.

As stated publicly on numerous occasions, DOE views the minimization, management, and cleanup of waste materials generated from its operations to be one of its most challenging problems. Before DOE can effectively act to minimize, manage, and clean up waste materials, it must understand the present status of its sites, the standards that now apply to those sites, and the operations that are conducted on them. This report compiles the existing risk-based and technology-based standards that may be applicable to DOE's activities and goals. By comparing the inventory of waste materials that are important to DOE operations and activities and this compilation of standards, it will be possible to assess which standards are relevant to DOE's environmental restoration, waste management, and decontamination and decommissioning activities; where multiple standards exist; and where no standards exist. The

regulatory agency can then plan and execute actions to ensure that standards needed for its environmental restoration, D&D, and waste management activities are developed. The regulatory agency can also ensure that unique problems (e.g., radioactive mixed waste) are considered and appropriate actions are taken to develop standards that address these specific problems.

2.0 APPROACH

Standards are generally published in regulations promulgated pursuant to statutes. Hence, the results section, Chapter 3.0, of this report is divided into subsections that correspond to the applicable statutes. The intent of each statute is discussed briefly, followed by a compilation of potentially applicable standards listed in the numerical order of the Code of Federal Regulations (CFR) sections in which they are found. Potentially applicable standards in DOE Orders are also listed according to the numerical order of the relevant DOE Orders.

Most potentially applicable standards and criteria are risk-based or technology-based. However, welfare-based standards and standards having combinations of different bases also exist. The bases for all standards are defined, as appropriate, in this document. These definitions are critical to understanding the bases of the standards because different CFR sections may define the same term (e.g., welfare-based standard) differently. In most cases, the bases for the standards and criteria are explained in the preambles of the Federal Register (FR) notices at the time the regulations were proposed and finalized, or in the preambles to amended regulations. Hence, in most cases, the FR notices must be consulted if more detailed information on the bases for the standards and criteria is desired.

Understanding and documenting the bases for the existing standards is important for determining the appropriate actions that DOE should take in its environmental restoration, decontamination and decommissioning, and waste management activities. Compliance with technology-based standards reduces emissions of, and exposures to, hazardous and radioactive substances. The 1990 Clean Air Act Amendments are an example of technology-based standards. However, the degree to which public health and the environment are protected is often not estimated. For this reason, the EPA moved toward the development of risk-based standards. Similarly, the National Academy of Sciences (NAS, 1989) has recommended that DOE adopt risk-based standards in its environmental restoration, decontamination and decommissioning, and waste management activities to ensure that public health and the environment are protected

adequately. Hence, for some substances, DOE may find that existing technology-based standards are not adequate and that risk-based standards need to be developed.

Quantitative and qualitative standards were encountered during the preparation of this report. All potentially applicable quantitative standards and all potentially applicable qualitative standards upon which quantitative standards could be based are compiled herein. Vaguely defined qualitative standards (i.e., "shall not degrade...") are not compiled herein because they are too broadly defined to be used alone as a basis for setting quantitative standards. Operational and procedural requirements also were compiled only if they specified target levels for cleanup or remediation activities. All standards compiled below were updated through July 24, 1992.

2.1 DETERMINATION OF INFORMATION SOURCES

DOE Orders were the primary means by which relevant regulations and requirements specific to DOE facilities were identified. Order DOE 5480.4 lists all parts of the CFR that apply to DOE under federal law. All CFR sections listed in Order DOE 5480.4 were examined to determine whether they contain standards or criteria that could be applicable to environmental restoration, waste management, and decontamination and decommissioning activities. Because the agency specifies additional requirements that all DOE facilities must meet, relevant DOE Orders were also a major source of information on potentially applicable standards. DOE Orders were an especially important source of standards on exposure to radiation.

2.2 INFORMATION SOURCES

The primary sources of information used to compile potentially applicable standards and criteria were the CFR and relevant DOE Orders (as identified in Section 4.8 of this report). Secondary sources of information included the relevant statutes, the FR, the Environment Reporter, Executive Orders, and Publication No. 26 of the International Commission on Radiological Protection (ICRP).

The CFR is a compilation of Executive Orders and the rules and requirements published by agencies of the federal government. It includes 50 titles, most of which are promulgated to implement federal statutes. Title 10 contains the regulations that affect energy, and Title 40 contains the regulations that affect the environment. Titles are divided into chapters, which are further subdivided into parts dedicated to specific regulatory areas.

DOE Orders are internal department documents that set policy and specify procedures for implementing that policy. They may apply to specific sites and facilities or to all areas of DOE operations. In lieu of creating new policies and regulations, DOE Orders may mandate compliance with existing federal, state, and local regulations. Directives contained in DOE Orders may be very specific. During the preparation of this report, DOE Orders were a major source of information on radiation standards for the protection of human health.

The FR is the federal government's newspaper through which draft and final regulations are published, meetings are announced, and legal notices are posted. Regulations published in the FR are typically accompanied by background information and explanatory material that does not become incorporated into the CFR. Information in the FR often explains the intent of the regulation (or specific parts thereof) and the technical basis of the regulations. The FR was a key source of information on the technical bases of various numerical standards.

Executive Orders are the means by which the executive branch assigns responsibilities for implementing policies, statutes, and regulations. The Presidential Guidance entitled "Radiation Protection Guidance to Federal Agencies for Occupational Exposure" (52 FR 2822) contains standards that are potentially applicable to DOE activities.

Publication No. 26 of the ICRP explains the types of risk and sets risk levels for occupational exposure to radioactive contamination. It also defines the process used to set exposure limits and weighing factors for exposure of specific organs and tissues. This process has been adopted in Executive Orders, DOE Orders, and federal regulations for occupational exposure.

3.0 RESULTS

This section covers the standards and regulations mandated by major Federal environmental statutes and orders. The statutes and orders included in this investigation were the Clean Air Act (CAA); the Clean Water Act (CWA); the Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA); the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); the Atomic Energy Act (AEA); the Nuclear Waste Policy Act (NWPA); the Resource Conservation and Recovery Act (RCRA); the Safe Drinking Water Act (SDWA); the Toxic Substances Control Act (TSCA); the Occupational Safety and Health Act (OSHA); Orders DOE; and Executive Orders. The statutes are presented below in alphabetical order, followed by Orders DOE and Executive Orders.

Within each statute, more than one part of the CFR typically pertains to DOE. For easy reference, CFR parts are arranged in this chapter numerically by statute. To maintain some consistency within the sections, a very general format was set up, beginning with definitions. In cases where it was possible to do so, standards and criteria were summarized in tables, followed by more detailed descriptions of the standards, their bases, and the conditions for their applicability. In general, quantitative standards are listed first, followed by qualitative standards and industry-specific standards. The bases of the standards are included in the discussions.

Because of the variety of formats within the regulations, the format within the descriptions varies substantially in some cases. The summary attempts to clarify the critical details for each standard or criterion. For industry-specific standards that do not apply to DOE at this time, the industry and the appropriate CFR part are listed for future reference. In the event that DOE constructs new facilities, these standards may be pertinent.

3.1 STANDARDS UNDER THE CLEAN AIR ACT

The Clean Air Act was enacted in 1970 and was extended and amended in 1977. The Act was also amended in 1990 and those amendments will be a major focus in 1992. Its intent is to "protect and enhance the quality of the nation's air resources in order to promote the public health and welfare and

the productive capacity of its population." Standards under the Clean Air Act control air quality by two different mechanisms. National ambient air quality standards establish the concentrations of pollutants that are allowed in the surrounding air. Emission standards limit the quantities of specific air pollutants at the source regardless of the ambient air concentrations of those pollutants.

The Clean Air Act is based on the premise that State and local governments bear primary responsibility for preventing and controlling air pollution. Each state is to develop an implementation plan that establishes the regulatory framework and control strategy to attain or maintain the national ambient air quality standards established by EPA. Once approved by EPA, the State implementation plan has the effect and force of Federal law and may be enforced by EPA in Federal courts. If a state fails to submit a plan, or submits one that is not acceptable to EPA, EPA must promulgate a plan for the State. The approved State implementation plan must have provisions not only for ambient air quality, but also for emission limitations for new sources and for EPA-specified hazardous air pollutants. State or local governments may enforce emission standards or limitations that are more stringent than those in effect under Federal new source performance standards or hazardous air pollutant standards.

Of the new rules and proposals under the 1990 Clean Air Act Amendments, industrial emission permits are the most critical. Other major rule-makings include air toxics emissions trading, acid rain controls on emissions of sulfur dioxide and nitrogen oxides, and controlling emissions from motor vehicle fueling. The Act lists 189 hazardous chemicals commonly emitted from industrial sources that must be regulated. The act requires EPA to regulate emissions by "source" rather than chemical-by-chemical. For each source category, the agency must develop "maximum achievable control technology" (MACT) standards. The first 40 are to be finalized by November 15, 1992 and the remainder are to be issued within 10 years on a phased schedule. In summary, EPA establishes the levels of air quality standards to be adopted nationwide, but the State dictates the methods for achieving those standards

through State implementation plans. About 30 states already require various levels of air permits (ER 1992, 22 (39): 2192).

Ambient air quality is regulated by primary and secondary standards (Table 3.1) for the purpose of protecting public health and welfare as defined in 40 CFR part 50. Standards of performance for new stationary sources are industry-specific and are listed under 40 CFR part 60. National emission standards for hazardous air pollutants (NESHAPs) are specific for pollutants and are listed under 40 CFR part 61.

TABLE 3.1. Summary of Ambient Air Quality Standards

	Primary Standard (risk-based)		Secondary Standard
Constituent	Annual Mean[a]	Hourly Maximum	(welfare-based)
Sulfur Oxides	80 $\mu g/m^3$ (0.03 ppm)	365 $\mu g/m^3$[b] (0.14 ppm)	1300 $\mu g/m^3$[c] (0.5 ppm)
Particulates	50 $\mu g/m^3$	150 $\mu g/m^3$[d]	same as primary
Carbon Monoxide		10 mg/m^3 (9 ppm)[e] 40 mg/m^3 (35 ppm)[f]	
Ozone		235 $\mu g/m^3$ (0.12 ppm)[g]	same as primary
Nitrogen Dioxide	100 $\mu g/m^3$ (0.053 ppm)		same as primary
Lead	1.5 $\mu g/m^3$[h]		same as primary

(a) Annual arithmetic mean concentration.
(b) Maximum 24-hour concentration not to be exceeded more than once per year.
(c) Maximum 3-hour concentration not to be exceeded more than once per year.
(d) 24-hour average concentration not expected to exceed limit more than once per year.
(e) 8-hour average concentration not to be exceeded more than once per year.
(f) 1-hour average concentration not to be exceeded more then once per year.
(g) Maximum hourly average concentrations not expected to exceed limit more than one day per calendar year.
(h) Maximum arithmetic mean averaged over a calendar quarter.

3.1.1 40 CFR part 50 - National Primary and Secondary Ambient Air Quality Standards Pursuant to the Clean Air Act

Reference Conditions

Temperature = 25°C
Pressure = 760 mm Hg

Definitions

Ambient Air. That portion of the atmosphere, external to buildings, to which the general public has access.

Primary Standards. The levels of air quality that are necessary to protect the public health. These are risk-based standards.

Secondary Standards. The levels of air quality that are necessary to protect the public welfare. These welfare-based standards include factors such as soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, climate, damage to and deterioration of property, hazards to transportation, and effects on economic values and on personal comfort and well-being [40 CFR part 302(h)].

40 CFR part 50.4 - National Primary Ambient Air Quality Standards for Sulfur Oxides

- 80 $\mu g/m^3$ (0.03 ppm) annual arithmetic mean
- 365 $\mu g/m^3$ (0.14 ppm) maximum 24-hour concentration not to be exceeded more than once per year

40 CFR part 50.5 - National Secondary Ambient Air Quality Standards for Sulfur Oxides

- 1300 $\mu g/m^3$ (0.5 ppm) maximum 3-hour concentration not to be exceeded more than once per year

40 CFR part 50.6 - National Primary and Secondary Ambient Air Quality Standards for Particulate Matter

- 50 $\mu g/m^3$ annual arithmetic mean concentration
- 150 $\mu g/m^3$ 24-hour average concentration not to be exceeded more than once per calendar year

40 CFR part 50.8 - National Primary Ambient Air Quality Standards for Carbon Monoxide

- 10 mg/m^3 (9 ppm) for an 8-hour average concentration not to be exceeded more than once per year
- 40 mg/m^3 (35 ppm) for a 1-hour average concentration not to be exceeded more than once per year

40 CFR part 50.9 - National Primary and Secondary Ambient Air Quality Standards for Ozone

- 235 $\mu g/m^3$ (0.12 ppm) maximum hourly average concentration not to be exceeded more than once a year

40 CFR part 50.11 - National Primary and Secondary Ambient Air Quality Standards for Nitrogen Dioxide

- primary standard = 100 $\mu g/m^3$ (0.053 ppm) annual arithmetic mean concentration
- secondary standard = 100 $\mu g/m^3$ (0.053 ppm) annual arithmetic mean concentration

40 CFR part 50.12 - National Primary and Secondary Ambient Air Quality Standards for Lead

- 1.5 $\mu g/m^3$ maximum arithmetic mean averaged over a calendar quarter

3.1.2 40 CFR part 60 - Regulations on Standards of Performance for New Stationary Sources

The regulations listed below in Subparts A through VVV set performance standards for emissions from new stationary sources. Performance standards vary based on the type of source and the design of the facility. Typically, the substances regulated by these performance standards are particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, and volatile organic compounds (VOCs). Because these regulations would only apply to new DOE facilities, the standards promulgated therein are not listed in this document. The titles of the subparts are listed, however, to facilitate retrieval of standards that could be applicable to a new DOE facility.

Subpart A	General Provisions
Subpart B	Adoption and Submittal of State Plans for Designated Facilities
Subpart C	Emission Guidelines and Compliance Times
Subpart Ca	Emission Guidelines and Compliance Times for Municipal Waste Combustors
Subpart Cb	Emission Guidelines and Compliance Times for Sulfuric Acid Production Units
Subpart D	Standards of Performance for Fossil-Fuel Fired Steam Generators for Which Construction is Commenced After August 17, 1971
Subpart Da	Standards of Performance for Electric Utility Steam Generating Units for Which Construction is Commenced After September 18, 1978
Subpart Db	Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units
Subpart Dc	Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units
Subpart E	Standards of Performance for Incinerators
Subpart Ea	Standards of Performance for Municipal Waste Combustors
Subpart F	Standards of Performance for Portland Cement Plants
Subpart G	Standards of Performance for Nitric Acid Plants
Subpart H	Standards of Performance for Sulfuric Acid Plants
Subpart I	Standards of Performance for Asphalt Concrete Plants
Subpart J	Standards of Performance for Petroleum Refineries
Subpart K	Standards of Performance for Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After June 11, 1973, and Prior to May 19, 1978
Subpart Ka	Standards of Performance for Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After May 18, 1978, and Prior to July 23, 1984

Subpart Kb	Standards of Performance for Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984
Subpart L	Standards of Performance for Secondary Lead Smelters
Subpart M	Standards of Performance for Secondary Brass and Bronze Production Plants
Subpart N	Standards of Performance for Primary Emissions from Basic Oxygen Process Furnaces for Which Construction is Commenced After June 11, 1973
Subpart Na	Standards of Performance for Secondary Emissions from Basic Oxygen Process Steelmaking Facilities for Which Construction is Commenced After January 20, 1983
Subpart O	Standards of Performance for Sewage Treatment Plants
Subpart P	Standards of Performance for Primary Copper Smelters
Subpart Q	Standards of Performance for Primary Zinc Smelters
Subpart R	Standards of Performance for Primary Lead Smelters
Subpart S	Standards of Performance for Primary Aluminum Reduction Plants
Subpart T	Standards of Performance for the Phosphate Fertilizer Industry: Wet-Process Phosphoric Acid Plants
Subpart U	Standards of Performance for the Phosphate Fertilizer Industry: Superphosphoric Acid Plants
Subpart V	Standards of Performance for the Phosphate Fertilizer Industry: Diammonium Phosphate Plants
Subpart W	Standards of Performance for the Phosphate Fertilizer Industry: Triple Superphosphate Plants
Subpart X	Standards of Performance for the Phosphate Fertilizer Industry: Granular Triple Superphosphate Storage Facilities
Subpart Y	Standards of Performance for Coal Preparation Plants
Subpart Z	Standards of Performance for Ferroalloy Production Facilities

Subpart AA	Standards of Performance for Steel Plants: Electric Arc Furnaces
Subpart AAa	Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed After August 7, 1983
Subpart BB	Standards of Performance for Kraft Pulp Mills
Subpart CC	Standards of Performance for Glass Manufacturing Plants
Subpart DD	Standards of Performance for Grain Elevators
Subpart EE	Standards of Performance for Surface Coating of Metal Furniture
Subpart FF	Reserved
Subpart GG	Standards of Performance for Stationary Gas Turbines
Subpart HH	Standards of Performance for Lime Manufacturing Plants
Subpart KK	Standards of Performance for Lead-Acid Battery Manufacturing Plants
Subpart LL	Standards of Performance for Metallic Mineral Processing Plants
Subpart MM	Standards of Performance for Automobile and Light-Duty Truck Surface Coating Operations
Subpart NN	Standards of Performance for Phosphate Rock Plants
Subpart PP	Standards of Performance for Ammonium Sulfate Manufacture
Subpart QQ	Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing
Subpart RR	Standards of Performance for Pressure Sensitive Tape and Label Surface Coating Operations
Subpart SS	Standards of Performance for Industrial Surface Coating: Large Appliances
Subpart TT	Standards of Performance for Metal Coil Surface Coating
Subpart UU	Standards of Performance for Asphalt Processing and Asphalt Roofing Manufacture
Subpart VV	Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry

Subpart WW	Standards of Performance for the Beverage Can Surface Coating Industry
Subpart XX	Standards of Performance for Bulk Gasoline Terminals
Subpart AAA	Standards of Performance for New Residential Wood Heaters
Subpart BBB	Standards of Performance for the Rubber Tire Manufacturing Industry
Subpart CCC	Reserved
Subpart DDD	Standards of Performance for Volatile Organic Compound (VOC) Emissions from the Polymer Manufacturing Industry
Subpart EEE	Reserved
Subpart FFF	Standards of Performance for Flexible Vinyl and Urethane Coating and Printing
Subpart GGG	Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries
Subpart HHH	Standards of Performance for Synthetic Fiber Production Facilities
Subpart III	Standards of Performance for Volatile Organic Compound Emissions from the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes
Subpart JJJ	Standards of Performance for Petroleum Dry Cleaners
Subpart KKK	Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants
Subpart LLL	Standards of Performance for Onshore Natural Gas Processing: SO_2 Emissions
Subpart MMM	Reserved
Subpart NNN	Standards of Performance for Volatile Organic Compound Emissions from Synthetic Organic Chemical Manufacturing Industry Distillation Operations
Subpart OOO	Standards of Performance for Nonmetallic Mineral Processing Plants
Subpart PPP	Standards of Performance for Wool Fiberglass Insulation Manufacturing Plants

Subpart QQQ	Standards of Performance for VOC Emissions from Petroleum Refinery Wastewater Systems
Subpart RRR	Reserved
Subpart SSS	Standards of Performance for Magnetic Tape Coating Facilities
Subpart TTT	Standards of Performance for Industrial Surface Coating: Surface Coating of Plastic Parts for Business Machines
Subpart UUU	Reserved
Subpart VVV	Standards of Performance for Polymetric Coating of Supporting Substrates Facilities

3.1.3 40 CFR part 61 - Regulations on National Emission Standards for Hazardous Air Pollutants Pursuant to the Clean Air Act

National emission standards (Table 3.2) regulate emissions of air pollutants classified as hazardous by EPA. These limits are regulated independently of ambient air concentrations of the hazardous substances. For some hazardous substances, emission limits are established based on the type of generating facility as well as the substance itself. 40 CFR part 61 should be consulted for standards applicable to newly constructed facilities of the following types: underground uranium mines, beryllium rocket motors, firing test sites, elemental phosphorus plants, glass manufacturing plants, primary copper smelters, arsenic production facilities, phosphogypsum plants, mill tailings, and facilities that emit vinyl chloride.

Specific Standards within 40 CFR part 61

The subparts listed below give further details regarding the NESHAPs. All subparts are listed, though some are not applicable to facilities presently operated by DOE.

Subpart A	General Provisions
Subpart B	National Emission Standards for Radon Emissions from Underground Uranium Mines *These are risk-based, construction-specific standards.*

TABLE 3.2. Summary of National Emission Standards

Contaminant	Facility Type	Sampling Time Period	Maximum Emission	Standard Type
Beryllium	Stationary source	24-hr period	10 g	ns[a]
	Stationary source	30-day period	0.01 $\mu g/m^3$	ns
Mercury	Ore processing facility, Hg cell chlor-alkali plants	24 hours	2300 g	ns
	Sludge incineration plants, drying plants, etc.	24 hours	3200 g	ns
Radionuclides	DOE facilities	1 year	10 mrem/yr	rt[b]
Radon-222	DOE facilities		20 pCi/m^2s	rt
Benzene	Operational standards			rt
Benzene	Coke by-product Recovery plants		0	rt
Benzene	Benzene storage vessels		0	rt
Equip. Leaks	Operational standards			ns
Asbestos	Operational standards			ns

(a) ns = not specified.
(b) rt = "acceptable risk" based on health factors, "ample margin of safety" for that risk level includes evaluation of health, economic, technological, and other relevant factors. This is called the multifactor approach. 54 Federal Register 51656 states that the multifactor approach has already been adopted for the determination of the benzene NESHAP and will become the policy for future NESHAP decisions. The approach will not apply to other EPA programs or to other sections of the CAA.

Subpart C — National Emission Standard for Beryllium

Emissions from stationary sources to the atmosphere shall not exceed 10 g of beryllium over any 24-hour period, except as provided here. Upon approval from the administrator of the EPA, the ambient concentration limit of beryllium in the vicinity of the stationary source shall be 0.01 $\mu g/m^3$, averaged over a 30-day period. The basis for this standard is not specified.

Subpart D — National Emission Standard for Beryllium Rocket Motor Firing

Not presently applicable to DOE.

Subpart E — National Emission Standard for Mercury
Emissions from mercury ore processing facilities and mercury cell chlor-alkali plants shall not exceed 2300 g of Hg per 24-hour period. Emissions from sludge incineration plants, sludge drying plants, or plants that process wastewater treatment plant sludges shall not exceed 3200 g of Hg per 24-hour period. The basis for this standard is not specified.

Subpart F — National Emission Standard for Vinyl Chloride
These standards vary based on the type of vinyl chloride produced and the type of generating plant. Risk/technology-based standards exist under this subpart for ethylene dichloride plants, vinyl chloride plants, and polyvinyl chloride plants.

Subpart G — Reserved

Subpart H — National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities
Emissions to ambient air are not to exceed those amounts that would cause any member of the public to receive in any year an EDE of 10 mrem per year. Doses due to radon-220 or radon-222 or decay products are excluded. This is a risk/technology-based standard.

Subpart I — National Emission Standards for Radionuclide Emissions from Facilities Licensed by the Nuclear Regulatory Commission and Federal Facilities Not Covered By Subpart H
Not presently applicable to DOE.

Subpart J — National Emission Standard for Equipment Leaks (Fugitive Emission Sources) of Benzene
These are risk/technology-based operational standards based on the type of equipment. The standards are listed under Subpart V.

Subpart K — National Emission Standards for Radionuclide Emissions from Elemental Phosphorus Plants
Not presently applicable to DOE.

Subpart L — National Emission Standard for Benzene Emissions from Coke By-Product Recovery Plants
No detectable emissions of benzene are allowed from process vessels, storage tanks, tar-intercepting sumps, light-oil sumps, naphthalene processing, final coolers, and final-cooler cooling towers. By definition, a leak is detected if an instrument reads an organic chemical concentration of more than 500 ppm above a background concentration, or 10,000 ppm or greater total concentration. These are risk/technology-based standards.

Subpart M	National Emission Standard for Asbestos *These operation-specific standards vary with respect to type of generator or source. Standards exist for:* *asbestos mills* *roadways* *manufacturing* *demolition and renovation* *spraying* *fabricating* *insulating materials* *waste disposal for asbestos mills* *waste disposal for manufacturing, demolition, renovation, spraying, and fabricating* *inactive waste disposal for asbestos mills and manufacturing and fabricating* *air cleaning* *reporting* *active waste disposal sites* *operations that convert asbestos-containing waste material into non-asbestos (asbestos-free) material* *cross-reference to other asbestos regulations*
Subpart N	National Emission Standard for Inorganic Arsenic Emissions from Glass Manufacturing Plants *Not presently applicable to DOE.*
Subpart O	National Emission Standard for Inorganic Arsenic Emissions from Primary Copper Smelters *Not presently applicable to DOE.*
Subpart P	National Emission Standard for Inorganic Arsenic Emissions from Arsenic Trioxide and Metallic Arsenic Production Facilities *Not presently applicable to DOE.*
Subpart Q	National Emission Standards for Radon Emissions from Department of Energy Facilities *No source shall emit more than 20 pCi/m^{2}s of radon-222 as an average for the entire source into the air. This requirement will be part of any Federal Facilities Agreement reached between Environmental Protection Agency and Department of Energy. This is a risk/ technology-based standard.*
Subpart R	National Emission Standards for Radon Emissions from Phosphogypsum Stacks *Not presently applicable to DOE.*
Subpart S	Reserved

Subpart T — National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings

Radon-222 emissions to the ambient air from uranium mill tailings pile that are no longer operational shall not exceed 20 pCi/m^{2}s of Radon-222. Compliance must be achieved within 2 years of operations cessation. This is a risk/technology-based standard.

Subpart U — Reserved

Subpart V — National Emission Standards for Equipment Leaks (Fugitive Emission Sources)

These are operational standards based on very specific mechanical sources. Monitoring and equipment standards exist for:

- *pumps*
- *compressors*
- *pressure relief devices in gas/vapor service*
- *sampling connection systems*
- *open-ended valves or lines*
- *valves*
- *pressure relief devices in liquid service and*
- *flanges and other connectors*
- *product accumulator vessels*
- *delay of repair*
- *closed-vent systems and control device*

and include alternative standards for:

valves in VHAP service - allowable percentage of valves leaking

valves in VHAP service - skip period leak detection and repair

Subpart W — National Emission Standards for Radon Emissions from Operating Mill Tailings

Not presently applicable to DOE.

Subpart X — Reserved

Subpart Y — National Emission Standard for Benzene Emissions from Benzene Storage Vessels

No emissions are allowed from storage vessels with a design capacity greater than or equal to 38 cubic meters (10,000 gallons). An emission can be detected visually and is inferred if an instrument reads 500 ppm or more above background levels. This is a risk/technology-based standard.

Subparts Z-AA Reserved

Subpart BB National Emission Standard for Benzene Emissions from Benzene Transfer Operations
These operating standards apply to facilities which load liquid containing more than 70%-weight benzene. Monitoring and equipment standards exist for:
- *loading racks*
- *vent streams*
- *flares*
- *vapor-tight vehicles*
- *marine vessels*
- *collections systems*

Subparts CC-EE Reserved

Subpart FF National Emission Standard for Benzene Waste Operations
These operational standards apply to owners and operators of chemical manufacturing plants, coke by-product recovery plants, and petroleum refineries and to those facilities which treat, store, or dispose of such waste. Monitoring and equipment standards exist for:
- *tanks*
- *surface impoundments*
- *containers*
- *individual drain systems*
- *oil-water separators*
- *treatment processes*
- *closed-vent systems and control devices*
- *delay of repair*

and include alternative standards for:
- *tanks*
- *oil-water separators*

3.2 STANDARDS UNDER THE CLEAN WATER ACT

The legislation commonly referred to as the Clean Water Act was originally enacted in 1972 as the Federal Water Pollution Control Act. It was amended with major revisions in 1977 (i.e., the Clean Water Act), 1981, and 1987. The 1987 amendments are entitled the Water Quality Act of 1987. This legislation was enacted to protect surface waters from point and non-point sources of pollutants. Under this act, all discharges of pollutants must be in compliance with a National Pollutant Discharge Elimination System (NPDES) permit that is issued by the EPA or the State, if the EPA has delegated the authority to issue NPDES permits to the State. Under the Federal Water Pollution Control Act and its amendments, states are required to enforce water

quality standards that are at least as stringent as those required by the EPA. To date, implementation of the act has emphasized the control or elimination of point source discharges of pollutants. In recent years, the EPA has become increasingly active in attempting to control pollutants from non-point source discharges. The most recent amendment was the Great Lakes Critical Programs Act of 1990 which amended the Federal Water Pollution Control Act with respect to water quality in the Great Lakes. This amendment extends the authorization of the EPA's Great Lakes National Program Office through 1997. This amendment also requires all states to develop remedial action plans for "areas of concern" as specified in the amended Great Lakes Agreement of 1978.

Clean Water Act regulations cited for completion in 1992 include a rule that would establish Federal water quality standards for toxic pollutants. The rule, which was proposed in November 1991, would cover pollutants listed under section 307(a) of the act. Congress will set a high priority on the reauthorization of the CWA in 1992 and on the controversial debate of defining wetlands. Some revisions have been made in the wetlands manual, but the manual may not be completed before the end of 1992 (ER 1991, 22 (39): 2194 - 2195).

Two general sets of standards have been promulgated under the CWA that may be applicable to DOE activities: categorical standards and water quality criteria. Categorical standards are applicable to various categories of industrial discharges. Standards for the various categories of industrial discharges are each promulgated in a different part of the CFR. Water quality criteria are not promulgated in the CFR, but are published as a separate document that is updated periodically. The most recent water quality criteria were published in 1986 as "Quality Criteria for Water" (EPA 1986).

3.2.1 Categorical Standards

Categorical standards are technology-based standards that are applicable to various categories of industrial discharges. Categorical standards are promulgated in 40 CFR parts 405-471. Each CFR part contains a set of standards that is specific to a particular category of industries (e.g., Dairy Products Processing; Battery Manufacturing). Industries regulated under a specific set of categorical standards may be subject to compliance with one of

up to six categories of standards, depending on the types of pollutants discharged, the age of the facility, the type of manufacturing process, or other characteristics. These six categories are Best Available Technology Economically Achievable (BAT), Best Conventional Pollutant Control Technology (BCT), Best Practicable Control Technology Currently Available (BPT), New Source Performance Standards (NSPS), Pretreatment Standards for Existing Sources (PSES), and Pretreatment Standards for New Sources (PSNS).

The types of pollutants regulated vary greatly among the industries and may include conventional (e.g., dissolved oxygen, suspended solids) and nonconventional pollutants (e.g., toxic substances). The units of measurement upon which compliance is determined also vary greatly. Many standards measure performance as a function of product produced (e.g., kg of pollutant discharged per 1000 kg of product produced), and hence, are very industry-specific. Other standards measure performance as the concentration of a pollutant in the waste stream (e.g., mg of pollutant per L of effluent) of the specific industry being considered. The categorical standards for each industry may be further subdivided into one or more of six categories of dischargers within the type of industry.

Most of the categorical standards are highly industry-specific and cannot be applied directly to present or future DOE activities. Hence, compilation of those standards is not warranted in this document. Four sets of categorical standards are specifically referenced in Orders DOE, however, and can be applied to present and future DOE activities. The four sets of applicable categorical standards and the pollutants that are regulated therein are identified below.

Applicable Categorical Standards

Categorical standards that are cited in Orders DOE include standards for the Electroplating Point Source Category, the Steam Electric Power Generating Point Source Category, the Explosives Manufacturing Point Source Category, and the Photographic Point Source Category. The categories of standards, units of measurement for the standards, and pollutants for which standards are promulgated are listed below for each of these four industrial categories. Within each CFR part, multiple standards exist for individual pollutants. The

applicability of the standards is determined largely by the type of facility and its discharge characteristics. Because multiple standards exist, and because the characteristics of the facility under consideration must be known before the appropriate standards can be determined, numerical standards are not compiled herein. The appropriate CFR part should be consulted to determine which standards are appropriate for each specific facility.

40 CFR part 413 - Effluent Guidelines and Standards for Electroplating

Types of Standards: PSES

Units of Standards: mg/L

Pollutants Regulated:

cadmium
copper
cyanide
chromium
lead
nickel
pH
silver
zinc
total metal
Total Suspended Solids

Total Toxic Organics:

acenaphthene
acrolein
acrylonitrile
benzene
benzidine
carbon tetrachloride (tetrachloromethane)
chlorobenzene
1,2,4-trichlorobenzene
hexachlorobenzene
1,2-dichloroethane
1,1,1-trichloroethane
hexachloroethane
1,1,-dichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane
chloroethane

Total Toxic Organics (contd):

bis (2-chloroethyl) ether
2-chloroethyl vinyl ether (mixed)
2-chloronaphthalene
2,4,6-trichlorophenol
parachlorometa cresol
chloroform (trichloromethane)
2-chlorophenol
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3-dichlorobenzidine
1,1-dichloroethylene
1,2-trans-dichloroethylene
2,4-dichlorophenol
1,2-dichloropropane
1,3-dichloropropylene (1,3-dichloropropene)
2,4-dimethylphenol
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
ethylbenzene
fluoranthene
4-chlorophenyl phenyl ether
4-bromophenyl phenyl ether
bis (2-chloroisopropyl) ether
bis (2-chloroethoxy) methane
methylene chloride (dichloromethane)
methyl chloride (chloromethane)
methyl bromide (bromomethane)
bromoform (tribromomethane)
dichlorobromomethane
chlorodibromomethane
hexachlorobutadiene
hexachlorocyclopentadiene
isophorone
naphthalene
nitrobenzene
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-o-cresol
n-nitrosodimethylamine
n-nitrosodiphenylamine
n-nitrosodi-n-propylamine
pentachlorophenol
phenol
bis (2-ethylhexyl) phthalate
butyl benzyl phthalate
di-n-butyl phthalate

Total Toxic Organics (contd):

- di-n-octyl phthalate
- diethyl phthalate
- dimethyl phthalate
- 1,2-benzanthracene (benzo(a)anthracene)
- benzo(a)pyrene (3,4-benzopyrene)
- 3,4-benzofluoranthene (benzo(b)fluoranthene)
- 11,12-benzofluoranthene (benzo(k)fluoranthene)
- chrysene
- acenaphthylene
- anthracene
- 1,12-benzoperylene (benzo(ghi)perylene)
- fluorene
- phenanthrene
- 1,2,5,6-dibenzanthracene (dibenzo(a,h)anthracene)
- indeno (1,2,3-cd) pyrene (2,3-o-phenylene pyrene)
- pyrene
- tetrachloroethylene
- toluene
- trichloroethylene
- vinyl chloride (chloroethylene)
- aldrin
- dieldrin
- chlordane (technical mixture and metabolites)
- 4,4-DDT
- 4,4-DDE (p,p-DDX)
- 4,4-DDD (p,p-TDE)
- alpha-endosulfan
- beta-endosulfan
- endosulfan sulfate
- endrin
- endrin aldehyde
- heptachlor
- heptachlor epoxide
- BHC-hexachlorocyclohexane
  - alpha-BHC
  - beta-BHC
  - gamma-BHC
  - delta-BHC
- PCBs-polychlorinated biphenyls
  - PCB-1242 (aroclor 1242)
  - PCB-1254 (aroclor 1254)
  - PCB-1221 (aroclor 1221)
  - PCB-1232 (aroclor 1232)
  - PCB-1248 (aroclor 1248)
  - PCB-1260 (aroclor 1260)
  - PCB-1016 (aroclor 1016)
- toxaphene
- 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

40 CFR part 423 - Effluent Guidelines and Standards for Steam Electric Power Generating

Types of Standards: BAT; BCT; BPT; NSPS; PSES; PSNS

Units of Standards: mg/L

Pollutants Regulated:

oil and grease
Total Suspended Solids
chlorine (free available)
chlorine (total residual)
copper (total)
iron (total)
chromium (total)
zinc (total)

Priority Pollutants (by number):

001 acenaphthene
002 acrolein
003 acrylonitrile
004 benzene
005 benzidine
006 carbon tetrachloride (tetrachloromethane)
007 chlorobenzene
008 1,2,4-trichlorobenzene
009 hexachlorobenzene
010 1,2-dichloroethane
011 1,1,1-trichloroethane
012 hexachloroethane
013 1,1,-dichloroethane
014 1,1,2-trichloroethane
015 1,1,2,2-tetrachloroethane
016 chloroethane
018 bis (2-chloroethyl) ether
019 2-chloroethyl vinyl ether (mixed)
020 2-chloronaphthalene
021 2,4,6-trichlorophenol
022 parachlorometa cresol
023 chloroform (trichloromethane)
024 2-chlorophenol
025 1,2-dichlorobenzene
026 1,3-dichlorobenzene
027 1,4-dichlorobenzene
028 3,3-dichlorobenzidine
029 1,1-dichloroethylene
030 1,2-trans-dichloroethylene
031 2,4-dichlorophenol
032 1,2-dichloropropane

Priority Pollutants (by number) (contd):

033 1,3-dichloropropylene (1,3-dichloropropene)
034 2,4-dimethylphenol
035 2,4-dinitrotoluene
036 2,6-dinitrotoluene
037 1,2-diphenylhydrazine
038 ethylbenzene
039 fluoranthene
040 4-chlorophenyl phenyl ether
041 4-bromophenyl phenyl ether
042 bis (2-chloroisopropyl) ether
043 bis (2-chloroethoxy) methane
044 methylene chloride (dichloromethane)
045 methyl chloride (chloromethane)
046 methyl bromide (bromomethane)
047 bromoform (tribromomethane)
048 dichlorobromomethane
051 chlorodibromomethane
052 hexachlorobutadiene
053 hexachlorocyclopentadiene
054 isophorone
055 naphthalene
056 nitrobenzene
057 2-nitrophenol
058 4-nitrophenol
059 2,4-dinitrophenol
060 4,6-dinitro-o-cresol
061 n-nitrosodimethylamine
062 n-nitrosodiphenylamine
063 n-nitrosodi-n-propylamine
064 pentachlorophenol
065 phenol
066 bis (2-ethylhexyl) phthalate
067 butyl benzyl phthalate
068 di-n-butyl phthalate
069 di-n-octyl phthalate
070 diethyl phthalate
071 dimethyl phthalate
072 1,2-benzanthracene (benzo(a)anthracene)
073 benzo(a)pyrene (3,4-benzopyrene)
074 3,4-benzofluoranthene (benzo(b)fluoranthene)
075 11,12-benzofluoranthene (benzo(b)fluoranthene)
076 chrysene
077 acenaphthylene
078 anthracene
079 1,12-benzoperylene (benzo(ghi)perylene)
080 fluorene
081 phenanthrene
082 1,2,5,6-dibenzanthracene (dibenzo(a,h)anthracene)
083 indeno (1,2,3-cd) pyrene (2,3-o-phenylene pyrene)

Priority Pollutants (by number) (contd):

084 pyrene
085 tetrachloroethylene
086 toluene
087 trichloroethylene
088 vinyl chloride (chloroethylene)
089 aldrin
090 dieldrin
091 chlordane (technical mixture and metabolites)
092 4,4-DDT
093 4,4-DDE (p,p-DDX)
094 4,4-DDD (p,p-TDE)
095 alpha-endosulfan
096 beta-endosulfan
097 endosulfan sulfate
098 endrin
099 endrin aldehyde
100 heptachlor
101 heptachlor epoxide (BHC-hexachlorocyclohexane)
102 alpha-BHC
103 beta-BHC
104 gamma-BHC (lindane)
105 delta-BHC (PCB-polychlorinated biphenyls)
106 PCB-1242 (aroclor 1242)
107 PCB-1254 (aroclor 1254)
108 PCB-1221 (aroclor 1221)
109 PCB-1232 (aroclor 1232)
110 PCB-1248 (aroclor 1248)
111 PCB-1260 (aroclor 1260)
112 PCB-1016 (aroclor 1016)
113 toxaphene
114 antimony
115 arsenic
116 asbestos
117 beryllium
118 cadmium
119 chromium
120 copper
121 cyanide, total
122 lead
123 mercury
124 nickel
125 selenium
126 silver
127 thallium
128 zinc
129 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD)

40 CFR part 457 - Effluent Guidelines and Standards for Explosives Manufacturing

Types of Standards: BPT

Units of Standards: kg/1000 kg of product; lb/1000 lb of product; pH units

Pollutants Regulated:
pH
chemical oxygen demand (COD)
five day biochemical oxygen demand (BOD_5)
Total Suspended Solids
oil and grease

40 CFR part 459 - Effluent Guidelines and Standards for Photographic Processing

Types of Standards: BPT

Units of Standards: kg/1000 m^2 of product; lb/1000 ft^2 of product; pH units

Pollutants Regulated:

pH
silver
cyanide

3.2.2 Water Quality Criteria

Water quality criteria (Table 3.3) are risk-based standards that are intended to protect aquatic life and human health. They are applicable to all permitted discharges of effluent to surface waters. The present set of standards was published by the EPA (1986) to be used by its regional offices and by states for the purpose of setting effluent limitations in NPDES permits. The Water Quality Act of 1987 elevated the water quality criteria from guideline to criterion status, thereby making their use mandatory for setting permit limitations. States may develop and implement water quality standards that are stricter than those listed below, but may not allow compliance with standards that are less strict.

TABLE 3.3. Summary of Water Quality Criteria

	Aquatic Life				Human Health	
	Fresh Water		Marine			
	Acute	Chronic	Acute	Chronic	Water and Fish Ingestion	Fish Consumption Only
Acenaphthene	1,700 μg/L[a]	(b)	970 μg/L[a]	710 μg/L[a]	(b)	(b)
Acrolein	68 μg/L[a]	21 μg/L[a]	55 μg/L[a]	(b)	320 μg/L	780 μg/L
Acrylonitrile	7,550 μg/L[a]	(b)	(b)	(b)	0.058 μg/L[c]	0.65 μg/L[c]
Aldrin	3.0 μg/L[d]	(b)	1.3 μg/L[d]	(b)	0.000074 μg/L	0.000079 μg/L
Ammonia	(k)					
Antimony	9,000 μg/L[a]	1,600 μg/L[a]	(b)	(b)	146 μg/L	45,000 μg/L
Arsenic	(b)	(b)	(b)	(b)	0.0022 μg/L[c]	0.0175 μg/L[c]
Arsenic (Pentavalent)	850 μg/L[a]	48 μg/L[a]	2,319 μg/L[a]	(b)	(b)	(b)
Arsenic (Trivalent)	360 μg/L[e]	190 μg/L[f]	69 μg/L[e]	36 μg/L[f]	(b)	(b)
Asbestos	(b)	(b)	(b)	(b)	30,000 fibers/L	(b)
Barium	(b)	(b)	(b)	(b)	1000 μg/L	(b)
Benzene	5,300 μg/L[a]	(b)	5,100 μg/L[a]	700 μg/L[a]	0.66 μg/L[c]	40.0 μg/L[c]
Benzidine	2,500 μg/L[a]	(b)	(b)	(b)	0.00012 μg/L[c]	0.00053 μg/L[c]
Beryllium	130 μg/L[a]	5.3 μg/L[a]	(b)	(b)	0.0068 μg/L[c]	0.117 μg/L[c]
Cadmium	3.9 μg/L[e]	1.1 μg/L[f]	43 μg/L[e]	9.3 μg/L[f]	10 μg/L	(b)
Carbon Tetrachloride	35,200 μg/L[a]	(b)	50,000 μg/L[a]	(b)	0.40 μg/L[c]	6.94 μg/L[c]
Chlordane	2.4 μg/L[d]	0.0043 μg/L[g]	0.09 μg/L[d]	0.0040 μg/L[g]	0.00046 μg/L[c]	0.00048 μg/L[c]
Chlorinated Benzenes	250 μg/L[a]	50 μg/L[a]	160 μg/L[a]	129 μg/L[a]	(b)	(b)
Hexachlorobenzene	(b)	(b)	(b)	(b)	0.00072 μg/L[c]	0.00074 μg/L[c]
Monochlorobenzene	(b)	(b)	(b)	(b)	488 μg/L	(b)
Pentachlorobenzene	(b)	(b)	(b)	(b)	74 μg/L	85 μg/L

TABLE 3.3. (contd)

	Aquatic Life				Human Health	
	Fresh Water		Marine			
	Acute	Chronic	Acute	Chronic	Water and Fish Ingestion	Fish Consumption Only
Tetrachlorobenzene 1,2,4,5	(b)	(b)	(b)	(b)	38 µg/L	48 µg/L
Chlorinated Ethanes						
Dichloroethane 1,2	118,000 µg/L[a]	20,000 µg/L[a]	113,000 µg/L[a]	(b)	0.94 µg/L[c]	243 µg/L[c]
Hexachloroethane	980 µg/L[a]	540 µg/L[a]	940 µg/L[a]	(b)	1.9 µg/L[c]	8.74 µg/L[c]
Pentachloroethane	7,240 µg/L[a]	1,100 µg/L[a]	390 µg/L[a]	281 µg/L[a]	(b)	(b)
Tetrachlorinated Ethanes	9,320 µg/L[a]	(b)	(b)	(b)	(b)	(b)
Tetrachloroethane 1,1,2,2	(b)	2,400 µg/L[a]	9,020 µg/L[a]	(b)	0.17 µg/L[c]	10.7 µg/L[c]
Trichlorinated Ethanes	18,000 µg/L[a]	(b)	(b)	(b)	(b)	(b)
Trichloroethane 1,1,1	(b)	(b)	31,200 µg/L[a]	(b)	18,400 µg/L	1.03 µg/L
Trichloroethane 1,1,2	(b)	9,400 µg/L[a]	(b)	(b)	0.6 µg/L[c]	41.8 µg/L[c]
Chlorinated Ethylenes						
Dichloroethylenes	11,600 µg/L[a]	(b)	224,000 µg/L[a]	(b)	0.033 µg/L[c]	1.85 µg/L[c]
Tetrachloroethylene	5,280 µg/L[a]	840 µg/L[a]	10,200 µg/L[a]	450 µg/L[a]	0.8 µg/L[c]	8.85 µg/L[c]
Trichloroethylene	45,000 µg/L[a]	21,900 µg/L[a]	2,000 µg/L[a]	(b)	2.7 µg/L[c]	80.7 µg/L[c]
Chlorinated Naphthalenes	1,600 µg/L[a]	(b)	7.5 µg/L[a]	(b)	(b)	(b)
Chlorinated Phenols						
Chloro-4 Methyl-3 Phenol	30 µg/L[a]	(b)	(b)	(b)	(b)	(b)
Chlorophenol 2	4,380 µg/L[a]	2,000 µg/L[a]	(b)	(b)	(b)	(b)
Chlorophenol 4	(b)	(b)	29,700 µg/L[a]	(b)	(b)	(b)
Dichlorophenol 2,4	2,020 µg/L[a]	365 µg/L[a]	(b)	(b)	3,090 µg/L	(b)
Pentachlorophenol (penta)	20 µg/L[e,h]	13 µg/L[f,h]	13 µg/L[h]	7.9 µg/L[h]	1,010 µg/L	(b)

TABLE 3.3. (contd)

	Aquatic Life				Human Health	
	Fresh Water		Marine			
	Acute	Chronic	Acute	Chronic	Water and Fish Ingestion	Fish Consumption Only
Tetrachlorophenol 2,3,5,6	(b)	(b)	440 µg/L[a]	(b)	(b)	(b)
Trichlorophenol 2,4,5	(b)	(b)	(b)	(b)	2,600 µg/L	(b)
Trichlorophenol 2,4,6	(b)	970 µg/L[a]	(b)	(b)	1.2 µg/L[c]	3.6 µg/L[c]
Chlorine	19 µg/L[e]	11 µg/L[f]	13 µg/L[e]	7.5 µg/L[f]	(b)	(b)
Chloroalkyl Ethers	238,000 µg/L[a]	(b)	(b)	(b)	(b)	(b)
Chloroethyl Ether (bis-2)	(b)	(b)	(b)	(b)	0.03 µg/L[c]	1.36 µg/L[c]
Chloroform	28,900 µg/L[a]	1,240 µg/L[a]	(b)	(b)	0.19 µg/L[c]	15.7 µg/L[c]
Chloroisopropyl Ether(bis-2)	(b)	(b)	(b)	(b)	34.7 µg/L	4,360 µg/L
Chloromethyl Ether (bis)	(b)	(b)	(b)	(b)	0.00000376 µg/L[c]	0.00184 µg/L[c]
Chlorophenoxy Herbicides (2,4,5-TP)	(b)	(b)	(b)	(b)	10 µg/L	(b)
Chlorophenoxy Herbicides (2,4-D)	(b)	(b)	(b)	(b)	100 µg/L	(b)
Chlorpyrifos	0.083 µg/L[e]	0.041 µg/L[f]	0.011 µg/L[e]	0.0056 µg/L[f]	(b)	(b)
Chromium (hexavalent)	16 µg/L[e]	11 µg/L[f]	1,100 µg/L[e]	50 µg/L[f]	50 µg/L	(b)
Chromium (trivalent)	1,700 µg/L[e,i]	210 µg/L[f,i]	10,300 µg/L[a]	(b)	170,000 µg/L	3,433,000 µg/L
Copper	18 µg/L[e,i]	12 µg/L[f,i]	2.9 µg/L[e]	(b)	(b)	(b)
Cyanide	22 µg/L[e]	5.2 µg/L[f]	1 µg/L[e]	(b)	200 µg/L	(b)
DDT	1.1 µg/L[d]	0.0010 µg/L[g]	0.13 µg/L[d]	0.001 µg/L[g]	0.000024 µg/L[c]	0.000024 µg/L[c]
TDE (DDT Metabolite)	0.06 µg/L[a]	(b)	3.6 µg/L[a]	(b)	(b)	(b)
DDE (DDT Metabolite)	1,050 µg/L[a]	(b)	14 µg/L[a]	(b)	(b)	(b)
Demeton	(b)	0.1 µg/L	(b)	0.1 µg/L	(b)	(b)

TABLE 3.3. (contd)

	Aquatic Life				Human Health	
	Fresh Water		Marine			
	Acute	Chronic	Acute	Chronic	Water and Fish Ingestion	Fish Consumption Only
Dichlorobenzenes	1,120 µg/L[a]	763 µg/L[a]	1,970 µg/L[a]	(b)	400 µg/L	2,600.0 µg/L
Dichlorobenzidine	(b)	(b)	(b)	(b)	0.01 µg/L[c]	0.02 µg/L[c]
Dichloropropanes	23,000 µg/L[a]	5,700 µg/L[a]	10,300 µg/L[a]	3,040 µg/L[a]	(b)	(b)
Dichloropropenes	6,060 µg/L[a]	244 µg/L[a]	790 µg/L[a]	(b)	87 µg/L	14,100 µg/L
Dieldrin	2.5 µg/L[d]	0.0019 µg/L[g]	0.71 µg/L[d]	0.0019 µg/L[g]	0.000071 µg/L[c]	0.000076 µg/L[c]
Dimethylphenol 2,4	2,120 µg/L[a]	(b)	(b)	(b)	(b)	(b)
Dinitrotoluenes	330 µg/L[a]	230 µg/L[a]	590 µg/L[a]	370 µg/L[a]	(b)	(b)
Dinitrotoluene 2,4	(b)	(b)	(b)	(b)	0.11 µg/L[c]	9.1 µg/L[c]
Dioxin (2,3,7,8-TCDD)	<0.01 µg/L[a]	<0.00001 µg/L[a]	(b)	<0.00001 µg/L[a]	1.3×10^{-8} µg/L[c]	1.4×10^{-8} µg/L[c]
Diphenylhydrazine	(b)	(b)	(b)	(b)	0.042 µg/L[c]	0.56 µg/L[c]
Diphenylhydrazine 1,2	270 µg/L[a]	(b)	(b)	(b)	(b)	(b)
Endosulfan	0.22 µg/L[d]	0.056 µg/L[g]	0.034 µg/L[d]	0.0087 µg/L[g]	74 µg/L	159 µg/L
Endrin	0.18 µg/L[d]	0.0023 µg/L[g]	0.037 µg/L[d]	0.0023 µg/L[g]	1.0 µg/L	(b)
Ethylbenzene	32,000 µg/L[a]	(b)	430 µg/L[a]	(b)	1,400 µg/L	3,280 µg/L
Fluoranthene	3,980 µg/L[a]	(b)	40 µg/L[a]	16 µg/L[a]	42 µg/L	54 µg/L
Guthion	(b)	0.01 µg/L	(b)	0.01 µg/L	(b)	(b)
Haloethers	360 µg/L[a]	122 µg/L[a]	(b)	(b)	(b)	(b)
Halomethanes	11,000 µg/L[a]	(b)	12,000 µg/L[a]	6,400 µg/L[a]	0.19 µg/L[c]	15.7 µg/L[c]
Heptachlor	0.52 µg/L[d]	0.0038 µg/L[g]	0.053 µg/L[d]	0.0036 µg/L[g]	0.00028 µg/L[c]	0.00029 µg/L[c]
Hexachlorobutadiene	90 µg/L[a]	9.3 µg/L[a]	32 µg/L[a]	(b)	45 µg/L[c]	50 µg/L[c]
Hexachlorocyclohexane (HCH)						

TABLE 3.3. (contd)

	Aquatic Life				Human Health	
	Fresh Water		Marine			
	Acute	Chronic	Acute	Chronic	Water and Fish Ingestion	Fish Consumption Only
HCH-Alpha	(b)	(b)	(b)	(b)	0.0092 µg/L[c]	0.031 µg/L[c]
HCH-Beta	(b)	(b)	(b)	(b)	0.0163 µg/L[c]	0.0547 µg/L[c]
Lindane (HCH-gamma)	2.0 µg/L[d]	0.08 µg/L[g]	0.16 µg/L[d]	(b)	0.0186 µg/L[c]	0.0625 µg/L[c]
HCH (mixture of isomers)	100 µg/L[a]	(b)	0.34 µg/L[a]	(b)	0.0123 µg/L[c]	0.0414 µg/L[c]
Hexachlorocyclopentadiene	7.0 µg/L[a]	5.2 µg/L[a]	7.0 µg/L[a]	(b)	206 µg/L	(b)
Iron	(b)	1,000 µg/L[a]	(b)	(b)	300 µg/L[j]	(b)
Isophorone	117,000 µg/L[a]	(b)	12,900 µg/L[a]	(b)	5,200 µg/L	520,000 µg/L
Lead	82 µg/L[e]	3.2 µg/L[f]	140 µg/L[e]	5.6 µg/L[f]	50 µg/L	(b)
Malathion	(b)	0.1 µg/L	(b)	0.1 µg/L	(b)	(b)
Manganese	(b)	(b)	(b)	(b)	50 µg/L[j]	100 µg/L
Mercury	2.4 µg/L[e]	0.012 µg/L[f]	2.1 µg/L[e]	0.025 µg/L[f]	0.144 µg/L	0.146 µg/L
Methoxychlor	(b)	0.03 µg/L	(b)	0.03 µg/L	100 µg/L	(b)
Mirex	(b)	0.001 µg/L	(b)	0.001 µg/L	(b)	(b)
Naphthalene	2,300 µg/L[a]	620 µg/L[a]	2,350 µg/L[a]	(b)	(b)	(b)
Nickel	1,400 µg/L[d,i]	160 µg/L[g,i]	75 µg/L[d]	8.3 µg/L[g]	13.4 µg/L	100 µg/L
Nitrates	(b)	(b)	(b)	(b)	10,000 µg/L	(b)
Nitrobenzene	27,000 µg/L[a]	(b)	6,680 µg/L[a]	(b)	19,800 µg/L	(b)
Nitrophenols	230 µg/L[a]	150 µg/L[a]	4,850 µg/L[a]	(b)	(b)	(b)
Dinitrophenols	(b)	(b)	(b)	(b)	70 µg/L	14,300 µg/L
Dinitro-o-cresol 2,4	(b)	(b)	(b)	(b)	13.4 µg/L	765 µg/L
Nitrosamines	5,850 µg/L[a]	(b)	3,300,000 µg/L[a]	(b)	(b)	(b)
Nitrosodibutylamine	(b)	(b)	(b)	(b)	0.0064 µg/L[c]	0.587 µg/L[c]

TABLE 3.3. (contd)

	Aquatic Life				Human Health	
	Fresh Water		Marine			
	Acute	Chronic	Acute	Chronic	Water and Fish Ingestion	Fish Consumption Only
Nitrosodiethylamine	(b)	(b)	(b)	(b)	0.0008 μg/L[c]	1.24 μg/L[c]
Nitrosodimethylamine	(b)	(b)	(b)	(b)	0.0014 μg/L[c]	16 μg/L[c]
Nitrosodiphenylamine	(b)	(b)	(b)	(b)	4.9 μg/L[c]	16.1 μg/L[c]
Nitrosopyrrolidine	(b)	(b)	(b)	(b)	0.016 μg/L[c]	91.9 μg/L[c]
Parathion	0.065 μg/L[e]	0.013 μg/L[f]	(b)	(b)	(b)	(b)
Phenol	10,200 μg/L[a]	2,560 μg/L[a]	5,800 μg/L[a]	(b)	3,500 μg/L	(b)
Phosphorus (elemental)	(b)	(b)	(b)	0.1 μg/L	(b)	(b)
Phthalate esters	940 μg/L[a]	3 μg/L[a]	2,944 μg/L[a]	(b)	(b)	(b)
Dibutyl phthalate	(b)	(b)	(b)	(b)	34,000 μg/L	154,000 μg/L
Diethyl phthalate	(b)	(b)	(b)	(b)	350,000 μg/L	1,800,000 μg/L
Dimethyl phthalate	(b)	(b)	(b)	(b)	313,000 μg/L	2,900,000 μg/L
Di-2-ethylhexyl phthalate	(b)	(b)	(b)	(b)	15,000 μg/L	50,000 μg/L
Polychlorinated biphenyls	2 μg/L[a]	0.014 μg/L[g]	10 μg/L[a]	0.03 μg/L[g]	0.000079 μg/L[c]	0.000079 μg/L[c]
Polynuclear aromatic hydrocarbons	(b)	(b)	300 μg/L[a]	(b)	0.0028 μg/L[c]	0.0311 μg/L[c]
Selenium inorganic selenite	260 μg/L[d]	35 μg/L[g]	410 μg/L[d]	54 μg/L[g]	10 μg/L	(b)
inorganic selenate	760 μg/L	(b)	(b)	(b)	(b)	(b)
Silver	4.1 μg/L[d,i]	0.12 μg/L	2.3 μg/L[d]	(b)	50 μg/L	(b)
Solids (dissolved) and salinity	(b)	(b)	(b)	(b)	250,000 μg/L[j]	(b)
Sulfide (hydrogen sulfide, H2S)	(b)	2 μg/L[g]	(b)	2 μg/L[g]	(b)	(b)

TABLE 3.3. (contd)

	Aquatic Life				Human Health	
	Fresh Water		Marine			
	Acute	Chronic	Acute	Chronic	Water and Fish Ingestion	Fish Consumption Only
Thallium	1,400 µg/L[a]	40 µg/L[a]	2,130 µg/L[a]	(b)	13 µg/L	48 µg/L
Toluene	17,500 µg/L[a]	(b)	6,300 µg/L[a]	5,000 µg/L[a]	14,300 µg/L	424,000 µg/L
Toxaphene	0.73 µg/L[e]	0.0002 µg/L[f]	0.21 µg/L[e]	0.0002 µg/L[f]	0.00071 µg/L	0.00073 µg/L
Vinyl chloride	(b)	(b)	(b)	(b)	2 µg/L[c]	525 µg/L[c]
Zinc	120 µg/L[e,i]	110 µg/L[f,i]	95 µg/L[e]	86 µg/L[f]	(b)	(b)

(a) Data insufficient to derive criteria. Value stated is the lowest observed effect level (LOEL). These concentrations represent apparent threshold levels for acute and/or chronic toxic effects, and are intended to convey information about the degree of toxicity of a pollutant in the absence of established criteria.
(b) Criterion has not been established.
(c) Human health criteria for carcinogens at the 10^{-6} risk level, assuming a lifetime consumption of 6.5 g/day average of contaminated fish and/or shellfish for a 70-kg male.
(d) Not to be exceeded at any time.
(e) Maximum 1-hour average. Not to be exceeded more than an average of once every three years.
(f) Maximum 96-hour (four-day) average. Not to be exceeded more than once every three years.
(g) Maximum 24-hour average. Not to be exceeded more than once every three years.
(h) At 7.8 pH.
(i) At 100 mg/L Ca CO_3.
(j) Welfare-based.

Aquatic life is protected by setting standards below which acute or chronic effects of the subject pollutant do not occur in test species. Acute and chronic criteria are determined separately for freshwater and marine biota. Criteria for the protection of human health are set for the ingestion of water and fish tissue and for the ingestion of fish tissue only. For non-carcinogens, the objective of the standards is to prevent adverse health effects in humans. For carcinogens, the objective of the standards is to represent incremental levels of cancer risk that range from 10^{-7} to 10^{-5}. All water quality criteria are for individual pollutants; the effects of mixtures of pollutants are not considered. A detailed explanation of the technical bases for water quality criteria is found in 45 FR 79318-79357.

3.3 STANDARDS UNDER THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

CERCLA and its related regulations do not promulgate specific standards for environmental restoration. Instead, they mandate that during the feasibility study, the lead agency and support agency identify requirements that are "applicable or relevant and appropriate requirements" (ARARs) to each site (55 FR 8666-8865). Hence, the agencies are given the authority to determine which Federal and State standards should be used at each site during environmental restoration activities.

However, in addition to ARARs, the lead and supporting agencies must also consider generic standards for toxicants and carcinogens (55 FR 8848):

- "For systematic toxicants, acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety"

- "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure"

Hence, although the regulations pursuant to CERCLA do not set specific numerical standards for environmental restoration, they do set minimum generic standards for systemic toxic substances and carcinogenic substances.

In October of 1991, the EPA announced its goals for expediting Superfund cleanups, with a target of 650 completed cleanups by the year 2000 (ER 1992, 22 (39): 2178). By the end of 1992, construction would be complete at 130 sites under the accelerated schedule and at 200 sites by the end of 1993. The EPA has now completed construction at 65 sites. Of those sites, 25 are listed in the construction completion category, and 40 sites have been deleted from the National Priorities List (NPL). The 1990 revisions to the Superfund National Contingency Plan allow EPA to re-categorize certain "completed" sites into a construction completion category. This category includes sites awaiting deletion from the NPL and sites undergoing long-term remedial actions. In the construction phase of the actions, the National Contingency Plan also permits another category, sites awaiting a five-year review after completion of the remedial action, but EPA removed the five-year requirement in December 1991 (ER 1992 22 (39): 2178). The sites listed in this category are now considered awaiting deletion. As a part of the regulatory agenda (ORNL/M-1929/R1, ORNL 1992) EPA proposed to add 30 sites including 6 Federal facility sites, to the NPL. No DOE sites were proposed, but a final ruling will be made in December of 1992. CERCLA will be the topic of interest in a series of congressional hearings in 1992, which will bring about debate over the reauthorization of the statute. CERCLA's current authorization expires at the end of 1994.

3.4 STANDARDS UNDER THE FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

The Federal Insecticide, Fungicide, and Rodenticide Act has undergone several amendments and name changes, although it is still commonly referred to as FIFRA. FIFRA was amended most recently in 1972 and 1978.

The original act of 1947 marked the beginning of major Federal regulation of the production, storage, distribution, sale, use, and disposal of pesticides and was primarily a pesticide labeling statute. The 1972 amendments added a requirement for the registration of all pesticides, which was

essentially a means of instituting a premarket clearance system for the sale of pesticides. Registration of pesticides continues to be the primary part of FIFRA, since EPA must determine that the pesticide will not adversely affect people or the environment before approving its registration. The registration of a pesticide can be cancelled by EPA at any time that the pesticide is determined to present a hazard to human health or the environment.

A state can be given primary responsibility for the enforcement of regulations under FIFRA if a cooperative agreement is reached with EPA. EPA restricts the extent to which a state can regulate pesticides, and retains the authority to rescind State responsibility if the State does not comply with statutory requirements or does not adequately enforce the regulations (Wolf 1988).

Standards under FIFRA potentially affect DOE facilities in two ways: through storage and disposal regulations for pesticides, and through worker protection standards.

3.4.1 40 CFR part 165 - Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticides Containers

The EPA has the authority to establish regulations and procedures for the disposal and storage of pesticides, pesticide containers, and pesticide-related wastes to adequately protect public health and the environment. EPA is required by FIFRA to accept for safe disposal any pesticide or related wastes for which registration under FIFRA has been canceled, if the owner of the pesticide so requests.

3.4.2 40 CFR part 170 - Worker Protection Standards for Agricultural Pesticides

Unless they are wearing protective clothing, workers may not enter a treated field until sprays have dried or dusts have settled, unless the owner has been specifically exempted from this requirement, or a specific reentry time (see Table 3.4) has been assigned to the pesticide. The owner of the field is responsible for seeing that the restriction is enforced.

TABLE 3.4. Reentry Time

Active Ingredient	Hours
Ethyl parathion	48
Methyl parathion	48
Guthion	24
Demeton	48
Azodrin	48
Phosalone	24
Carbophenothion	48
Metasystox-R	48
EPN	24
Bidrin	48
Endrin	48
Ethion	24

3.5 REGULATIONS FOR RADIATION PROTECTION

Standards for radiation protection stem from two laws: the Nuclear Waste Policy Act (NWPA) and the Atomic Energy Act (AEA). The AEA was first promulgated in 1946 to ensure that nuclear energy was developed in a manner consistent with the security of the United States. The AEA mandated the creation of the Atomic Energy Commission (AEC), which was given control of regulations for the production and use of fissionable material. The AEA subsequently underwent several major revisions to reflect changes in nuclear energy research and development in other countries. The first major revision in 1954 opened the development and use of nuclear energy for peaceful purposes to private enterprise. Amendments in 1959 provided for some AEA regulatory responsibilities to be transferred to State governments under federally-approved programs. In 1964, amendments allowed AEC licensees private ownership of special nuclear material. The Uranium Mill Tailings Radiation Control Act of 1978 amended AEA by expanding the definition of by-product material to include tailings and waste produced from uranium or thorium ore. The 1983 amendments implemented procedures to improve quality assurance and quality control and mandated quarterly reports to the Secretary of Energy. The AEA has continued to be revised and supplemented by additional statutes.

The NWPA, enacted in 1982, was developed to "provide for the development of repositories for the disposal of high-level radioactive waste and spent

nuclear fuel, to establish a program of research, development, and demonstration regarding the disposal of high-level radioactive waste and spent nuclear fuel" (42 USC 10101 et. seq.). This Act was the first to establish Federal responsibility for the development of repositories. Under the Act, DOE must evaluate potential sites for a permanent high-level waste repository. Once the NRC approves the proposed site, DOE may begin construction of a monitored retrievable storage facility to provide interim storage for high-level radioactive waste.

The Energy Reorganization Act of 1974 separated licensing and related functions from energy development functions by establishing the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC). The Act also abolished the AEC and gave the NRC some regulatory authority over ERDA (which later became the U.S. Department of Energy). Unlike the AEA and the NWPA, the Energy Reorganization Act of 1974 did not promulgate regulations containing standards that might be applicable to DOE.

3.5.1 10 CFR part 60 - Disposal of High-Level Radioactive Wastes in Geologic Repositories Pursuant to the Nuclear Waste Policy Act

These performance objectives are based on human health considerations. The specific health factors and the methodology used are not defined in the regulations.

Performance Objectives Before Permanent Closure

- Geologic repository operations areas must be designed so that any releases or exposures before permanent closure are within the limits specified in any applicable environmental standards (especially 10 CFR part 20).

- Geologic repository operations areas must be designed so that any of the waste could be retrieved at any time, with retrieval operations beginning up to 50 years after waste emplacement began.

Performance Objectives After Permanent Closure

- Engineered barrier systems must be designed so that containment of high-level waste will be assured during the period when radiation and thermal conditions are dominated by fission product decay.

This period, determined by the NRC, must be at least 300 years and less than 1,000 years after permanent closure.

- Any release of radionuclides must be a gradual process which results in small fractional releases over long periods of time. The release rate must be less than one part per 100,000 per year of the quantity of that radionuclide calculated to be present 1,000 years after permanent closure.

3.5.2 10 CFR part 72 - Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste Pursuant to the Atomic Energy Act

The design of an Independent Spent Fuel Storage Installation (ISFSI) should be based on public health and safety criteria, but specific health factors and the methodology for determining the standards are not defined in this CFR part.

Annual Dose Equivalent Outside a Controlled Area

The annual dose equivalent to any individual outside a controlled area must not exceed:

25 mrem to whole body
75 mrem to the thyroid
25 mrem to any other organ

as a result of planned discharges of radioactive materials (except radon and its daughters), direct radiation from ISFSI operations, or any other radiation from uranium fuel cycle operations. Radioactive materials in effluents and direct radiation levels associated with ISFSI operations must have as low as reasonably achievable (ALARA) operational restrictions established.

Doses Outside a Controlled Area Due to Design Accidents

Any individual at or outside the nearest boundary of the controlled area of an ISFSI site must not receive a dose greater than 5 rem to the whole body or any organ as a result of any design-basis accident. The minimum distance of the nearest boundary of a controlled area to the spent fuel handling and storage facilities must be at least 100 meters.

3.5.3 40 CFR part 191 - Radiation Protection Standards for Managing and Disposing of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste Pursuant to the Atomic Energy Act

The objective of long-term containment follows a non-degradation ideal. Containment should limit the projected releases of radionuclides to the environment so as to "insure that risks to future generations from disposal of these wastes will be no greater than the risks which would have existed if the uranium ore used to create the wastes had not been mined to begin with." (50 FR 38066).

The actual standards set forth in this rule were developed by balancing several considerations. The first was the expected capabilities of waste management and disposal technologies to reduce risks to the public health and environment. Long-term and short-term risks should be factors. A second consideration was consistency with any applicable or related environmental standards for radiation exposure. Third, to assess the acceptability of residual risks that might be allowed by the rule, various benchmarks were evaluated. Finally, a major consideration was public concerns expressed during various phases of the rule-making process, particularly concerns about the uncertainties inherent in the unprecedented time periods involved. The final rule is a combination of all of these factors. EPA states that no one factor predominated in creating the rule. These standards are reasonably achievable and limit risks to levels that are acceptably small (50 FR 38069-38070).

Management and Storage

- The combined annual dose equivalent to any member of the public from 1) discharges of radioactive material and direct radiation resulting from management and storage of the materials and 2) all operations covered by Part 190, at facilities regulated by the NRC, or Agreement States, must not exceed

  25 mrem to the whole body
  75 mrem to the thyroid
  25 mrem to any other critical organ.

- Any discharges from facilities operated by the DOE must not exceed

  25 mrem to the whole body
  75 mrem to any critical organ.

(These limits were equivalent to the standards promulgated under the Clean Air Act in 40 CFR part 61 until these limits were reduced.)

Disposal - Containment

Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes are to be designed so as to provide reasonable assurance that for 10,000 years after disposal the system will

- have a likelihood of less than one chance in 10 of exceeding the quantities calculated according to Table 3.5.
- have a likelihood of less than one chance in 1,000 of exceeding ten times the quantities calculated according to Table 3.5.

TABLE 3.5. Release Limits for Containment Requirements (cumulative releases to the accessible environment for 10,000 years after disposal)

Radionuclide	Release Limit per 1,000 MTHM[a] or Other Unit of Waste (Curies)
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

(a) metric tons of heavy metal

Disposal - Individual Protection

The system must be designed so that the annual dose equivalent to any member of the public for 1,000 years after disposal does not exceed

25 mrem to the whole body
75 mrem to any critical organ.

(These doses are calculated by considering all potential pathways and assuming that individuals consume 2 L/day of drinking water from any significant source of groundwater outside of the controlled area.)

Disposal - Groundwater Protection

For 1,000 years after disposal, the radionuclide concentrations averaged over any portion of a special source of groundwater must not exceed

- 5 pCi/L of radium-226 and radium-228
- 15 pCi/L of alpha-emitting radionuclides (including radium-226 and radium-228 but excluding radon)
- a combined concentration of radionuclides that emit either beta or gamma radiation producing an annual dose equivalent to the total body or any internal organ greater than 4 mrems per year if an individual consumed 2 L/day of drinking water.

3.5.4 40 CFR part 192 - Standards for Protection Against Uranium Mill Tailings Pursuant to the Atomic Energy Act

The basis for these standards was changed from non-degradation to optimized cost-benefit. The small increase in benefit for health protection under the non-degradation basis was judged to be insufficient to justify the associated large increase in cost. An optimized cost-benefit approach gives longer-term health protection at somewhat higher costs without a reliance on institutional controls. Because health risks cannot be quantified totally, risk models are used. The extent to which health impacts might be avoided under any realistic alternative standards are estimated, and the alternatives that offer the most cost-effective reduction of these impacts are selected (48 FR 596).

Residual Radioactive Material

Residual radioactive material must be contained for up to 1,000 years to the extent that is reasonably achievable, or for at least 200 years. The containment structures must provide reasonable assurance that releases of radon-222 from residual radioactive material will not

- exceed an average release rate (averaged over the entire surface of the disposal site over at least a one-year period) of 20 pCi/m^2/s or
- increase the annual average concentration of radon-222 in air outside the disposal site by more than one-half pCi/L.

For land and buildings contaminated with post-cleanup residual radioactive materials, the concentration of radium-226 in land averaged over any area of 100 m^2 must not exceed the background level by more than

- 5 pCi/g, averaged over the upper 15 cm of soil
- 15 pCi/g, averaged over 15 cm-thick layers of soil more than 15 cm below the surface.

In any occupied or habitable building, the objective of remedial action is to achieve an annual average radon decay product concentration that does not exceed 0.002 WL (WL = working level = any combination of short-lived radon decay products in one liter of air that will result in the ultimate emission of alpha particles with a total energy of 130 billion electron volts). In any case, the concentration must not exceed 0.03 WL, and the level of gamma radiation must not exceed the background level by more than 20 microroentgens per hour.

Management of Uranium By-Products

Molybdenum and uranium are listed as hazardous under 40 CFR part 26493. They are limited to quantities for emissions not exceeding the following:

- combined radium-226 and radium-228 5 pCi
- gross alpha-particle activity (excluding radon and uranium) 15 pCi.

Disposal areas must be designed to provide reasonable assurance that radiological hazards will be controlled for 1,000 years to the extent

reasonably achievable, and for at least 200 years; and that releases of radon-222 do not exceed an average release rate of 20 $pCi/m^2/s$.

These requirements do not apply to a site that contains a concentration of radium-226 in land, averaged over areas of 100 m^2, that does not exceed the background level by more than

- 5 pCi/g, averaged over the upper 15 cm below the surface
- 15 pCi/g, averaged over 15 cm-thick layers of soil more than 15 cm below the surface.

Management of Thorium By-Products

The above standards for management of uranium by-products apply also to thorium by-products. In addition, provisions applicable to radon-222 also apply to radon-220, and provisions applicable to radium-226 also apply to radium-228.

Operations must be conducted in such a way as to provide reasonable assurance that the annual dose equivalent as a result of exposures to the planned discharge of radioactive materials, radon-220 and its daughters excepted, does not exceed

25 mrem to the whole body
75 mrem to the thyroid
25 mrem to any other organ.

3.6 STANDARDS UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT

The Resource Conservation and Recovery Act (RCRA) of 1976 governs the management of solid waste. The purposes of RCRA are 1) to ensure the safe and environmentally sound management of hazardous and nonhazardous solid waste, and 2) to promote resource recovery techniques to provide fuel and minimize waste volume. Substantive requirements that are applicable to the management of solid waste are found in Subtitle C, "Hazardous Waste Management"; Subtitle D, "State and Regional Solid Waste Plans;" and Subtitle I, "Regulation of Underground Storage Tanks." In 1984, RCRA's scope and level of detail were expanded by the Hazardous and Solid Waste Amendments (HSWA). Under RCRA, states may develop and enforce their own hazardous waste programs

in lieu of the Federal program administered by the EPA, provided that the State program is at least as stringent as the Federal program.

The chemical-specific regulatory standards that have been promulgated pursuant to RCRA and that are of interest to DOE are found in 40 CFR part 261 (Regulations for Identifying Hazardous Waste); 40 CFR part 264/265 (Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities); and 40 CFR part 268 (Land Disposal Restrictions). The standards in 40 CFR part 261 identify wastes that are subject to regulatory control under the hazardous waste management program of RCRA Subtitle C.

RCRA provides quantitative, chemical specific standards for many hazardous constituents in groundwater, and other media. Chemical-specific standards for the monitoring and protection of groundwater are found in 40 CFR part 257 (Appendix I), 40 CFR part 258 Subpart D, 49 CFR part 264 Subpart F. Air emission standards for waste management unit process vents and equipment leaks are found at 40 CFR part 264 Subparts AA and BB, and 40 CFR part 265 Subparts AA and BB. Air emission and related technical standards for industrial boilers and furnaces that burn hazardous waste are found in 40 CFR part 266 Appendix I through VIII. Chemical specific and technology-based treatment standards for hazardous waste subject to land disposal restrictions are found in 40 CFR part 268.

In addition to RCRA's currently promulgated standards, changes to add new standards and modify existing standards have also been proposed by EPA and may be of concern to DOE. The proposed changes include:

- 40 CFR parts 260 through 270 - EPA is going to propose exemption from regulation for any currently listed wastes that are not hazardous because the concentrations of hazardous constituents are lower than limits established by the proposed by rule.
- 40 CFR part 261 - Seven additional waste streams generated during the production, recovery, and refining of coke are proposed for listing as hazardous waste.
- 40 CFR part 264 Subpart S - "Action" levels, for clean up of soils, water and air, were proposed for the RCRA Subpart S corrective action program.

- 40 CFR parts 264 and 265 - Air emission standards are proposed for emissions of volatile organic constituents from tanks, impoundments, containers, and miscellaneous units.
- 40 CFR part 268 - Treatment standards are proposed for contaminated debris and other newly listed wastes.
- 40 CFR part 268 - EPA will propose standards that mush be met before contaminated soil or toxicity characteristic waste may be disposed of on land.

Additional information about technical standards, definition, and other provisions in RCRA 40 CFR parts 261, 264, 265, and 268 are discussed in the following sections.

3.6.1 40 CFR part 261 - Regulations for Identifying Hazardous Waste

Definitions

Solid Waste. A solid waste is any garbage, refuse, sludge from a waste treatment plant or air pollution control facility, and other discarded material that results from industrial, commercial or mining and agricultural operations, or from community activities. Solid waste does not include the following: solid or dissolved material in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges that are point sources subject to permits under the Clean Water Act (CWA); or source material, special nuclear materials, or by-products as defined by the Atomic Energy Act (AEA) [RCRA Section 1004(27)].

Hazardous Waste. Hazardous waste is defined as solid waste that causes or contributes to an increase in mortality or an increase in serious illness, or that poses a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed [RCRA Section 1004(5)]. A solid waste is considered hazardous if it is not excluded by regulation and if it 1) is a listed hazardous waste, 2) exhibits a characteristic of a hazardous waste, or 3) contains a mixture of a solid waste and a listed hazardous waste (40 CFR part 261.3).

Characteristics of Ignitability, Corrosivity, and Reactivity. If a solid waste exhibits the characteristics of either ignitability, corrosivity,

or reactivity as defined in 40 CFR part 261, it is considered to be a hazardous waste and is subject to the provisions of RCRA Subtitle C.

Toxicity Characteristic. A solid waste exhibits toxicity characteristics if the extract from a representative sample of the waste contains any of the contaminants listed in Table 3.6 at a concentration equal to or greater than the respective value in the table. If the waste contains less than 0.5% filterable solids, the waste after filtering is considered to be the extract for the purposes of this section. A solid waste that exhibits the toxicity characteristics is considered to be a hazardous waste and is subject to the provisions of RCRA Subtitle C.

TABLE 3.6. Maximum Concentration of Contaminants for the Toxicity Characteristic (rb, rb/tb, rb/ab)[a]

EPA Hazardous Waste Number(a)	Contaminant	Level (mg/L)
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol	200.0
D024	m-Cresol	200.0
D025	p-Cresol	200.0
D026	Cresol	200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13(b)
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13(b)
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0

TABLE 3.6. (contd)

EPA Hazardous Waste Number(a)	Contaminant	Level (mg/L)
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0(b)
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex)	1.0
D043	Vinyl chloride	0.2

(a) levels for hazardous wastes D018 to D043 are effective September 25, for hazardous wastes D004 to D017 are technology-based standards founded on a risk-based goal (rb/tb); standards for hazardous wastes D018 to D043 are risk-based (rb), with the exception of D030, D032, D038 which are default analytical-based standards founded on a risk-based goal (rb/ab).

(b) The quantitation limit for this waste type is greater than the calculated regulatory limit. The quantitation limit therefore becomes the default regulatory limit (55 FR 11798, March 19, 1990).regulatory limits are, in practice, analytically-based standards founded on a risk-based goal.

Maximum Concentration of Contaminants. The maximum concentrations of contaminants that were determined to exhibit toxicity characteristics for hazardous waste categories D004 to D017 were derived from maximum contaminant levels (MCLs) under the Safe Drinking Water Act are equal to 100 times the SDWA maximum contaminant levels and are, therefore, technology-based standards founded on risk-based goals.

The regulatory levels for D018 to D043 wastes are based on health-based concentration thresholds and a dilution/attenuation factor that was developed using a subsurface fate and transport model.

3.6.2 40 CFR part 264 Subpart F - Releases from Solid Waste Management Units

Hazardous Constituent

Constituents are those substances listed in 40 CFR part 261 Appendix VIII. In addition, a Groundwater Monitoring List of Hazardous Constituents is in 40 CFR part 264 Appendix IX. The original basis for listing a solid waste as hazardous was the presence of hazardous constituents within that solid waste.

Concentration Limit. Limits are established for hazardous constituents in a RCRA treatment, storage, or TSD facility permit for the purpose of protecting groundwater. EPA Regional Administrator can exclude an Appendix VIII constituent from a facility permit if he/she finds that the constituent is not capable of posing a present or potential hazard to human health or the environment. Concentration limits that are established in a facility permit must not exceed the background levels of that constituent in groundwater, or must not exceed the respective value given in Table 3.7 if the background level is less than the value in the table. Limits are equal to maximum contaminant levels under the SDWA, and are therefore a combination of risk-based and technology-based standards.

Alternate Concentration Limit (ACL). ACL is an alternate limit established in a facility permit in lieu of hazardous-constituent background concentration levels or the levels in Table 3.7 establish an ACL, the EPA Regional Administrator must consider potential adverse effects on the quality of groundwater and of hydraulically connected surface are based on a site-specific environmental and human health risk assessment and are therefore risk-based standards.

3.6.3 40 CFR parts 264/265 Subpart M - Land Treatment

Definitions

Land Treatment. Land treatment is the operation of applying hazardous waste onto, or incorporating the waste into the soil so that it is degraded, transformed, or immobilized.

Cadmium Application Rate. Cadmium application rate refers to the amount of cadmium (in waste) that can be applied to land. The regulatory levels in Tables 3.8 and 3.9 are based on human health risk assessment.

TABLE 3.7. Limits for Hazardous Constituents in Facility Permits (rb/tb)[a]

EPA Hazardous Waste Number	Contaminant	Concentration Limit (mg/L)
D004	Arsenic	0.05
D005	Barium	1.0
D006	Cadmium	0.01
D007	Chromium	0.05
D008	Lead	0.05
D009	Mercury	0.002
D010	Selenium	0.01
D011	Silver	0.05
D012	Endrin	0.0002
D013	Lindane	0.004
D014	Methoxychlor	0.1
D015	Toxaphene	0.005
D016	2,4-D	0.1
D017	2,4,5-TP Silvex	0.01

(a) Standards for hazardous wastes D004 to D017 are technology-based standards founded on a risk-based goal (rb/tb).

TABLE 3.8. Annual Cadmium Application Rates (rb)

Time Period	Annual Cadmium Application Rate (kg/hectare) (a)	(b)
Before 6/30/84	0.5	2.0
7/1/84 to 12/31/86	0.5	1.25
1/1/87 to present	0.5	0.5

(a) Applies to land used for production of tobacco, leafy vegetables, or root crops grown for human consumption.
(b) Applies to other food-chain crops.

TABLE 3.9. Maximum Cumulative Cadmium Application (kg/hectare)

Soil Cation Exchange Capacity (milliequivalent/100g)	Background Soil pH <6.5	Background Soil pH >6.5
Less than 5	5	5
5 to 15	5	10
Greater than 5	5	20

3.6.4 40 CFR part 268 - Land Disposal Restrictions

Definitions

California List Hazardous Waste. California list hazardous wastes are subject to land disposal restrictions that specify technologies as treatment standards. The list was derived from California State regulations.

Land Disposal. Land disposal is defined as placement in or on the land. It includes placement in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome/bed formation, underground mine or cave, or placement in a concrete vault for disposal purposes.

Wastewater. Wastewater is defined by EPA to contain less than 1% total organic carbon and less than 1% total filterable solids. All other wastes (including soil and debris) are considered not to be wastewater for the purposes of this CFR part, unless specified otherwise.

Soft-Hammer Provisions. Soft-hammer provisions were effective until EPA set treatment standards or until May 8, 1990, when hard-hammer provisions became effective. Under soft-hammer provisions, wastes were allowed to be land disposed only if 1) the disposal unit met RCRA minimum technology requirements and 2) the generator investigated treatment options and used the best treatment that was available and practical.

Hard-Hammer Provisions. Hard-hammer provisions prohibit land disposal of restricted wastes if EPA fails to promulgate treatment standards by the statutory deadlines for solvent-containing, dioxin-containing, and California-list wastes and by May 8, 1990 for all the scheduled wastes, as defined in 40 CFR part 268.

Halogenated Organic Compounds (HOCs). HOCs are listed in 40 CFR part 268 Appendix III.

Treatment Standards. Treatment standards are concentration levels or specific technologies that must be achieved prior to disposal of hazardous wastes. Alternatively, EPA may assign to a hazardous waste a "no land disposal" designation. This designation is set when the waste is no longer generated, is totally recycled, is not currently being land disposed, or treatable such that no residual hazardous wastes are produced from the treatment. Treatment standards are based on the best demonstrated available technology (BDAT) for a specific waste. In addition to treatment standards, LDRs contain three other types of restrictions (national capacity extension, soft-hammer restrictions, and hard-hammer restrictions).

Tables 3.10 and 3.11 specify regulatory standards that are applicable to the hazardous wastes listed in 40 CFR part 268.

Burning of Hazardous Waste in Boilers and Industrial Furnaces

The EPA regulates air emissions from the burning of hazardous waste in boilers and industrial furnaces under 40 CFR parts 260, 261, 264, 265, 266, 270, and 271. These rules control emissions of toxic organic compounds, toxic metals, hydrogen chloride, chlorine gas, and particulate matter from boilers and industrial furnaces burning hazardous waste. The rules also subject owners and operators to the general facility standards applicable to hazardous waste treatment, storage, and disposal facilities (56 FR 7134).

3.7 STANDARDS UNDER THE SAFE DRINKING WATER ACT

The SDWA was enacted in 1974 and amended in 1986. To protect public drinking water sources, EPA is required to develop mechanisms to control bacterial and chemical contaminants and to regulate the underground injection of contaminants into groundwater.

The SDWA mandates the creation of primary and secondary standards to regulate the quality of water that is available to the public through community and non-community water systems. Primary standards protect public

TABLE 3.10. Treatment Standards for RCRA Wastes Under Land Disposal Restrictions (tb)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
D001 (Ignitability Characteristic)	Ignitable liquids based on 261.21(a)(1)-wastewaters				spec. tech.
	Ignitable liquids based on 261.21(a)(1)-Low TOC Ignitable Liquids Subcategory-less than 10% total organic carbon			spec. tech.	
	Ignitable liquids based on 261.21(a)(1)-High TOC Ignitable Liquids Subcategory-greater than or equal to 10% total organic carbon			spec. tech.	
	Ignitable compressed gases based on 261.21(a)(3)			spec. tech.[c]	
	Ignitable reactives 261.21(a)(2)			spec. tech.	
	Oxidizers based on 261.21(a)(4)			spec. tech.	spec. tech.
D002 (Corrosivity Characteristic)	Acid subcategory based on 261.22(a)(1)			spec. tech.	spec. tech.
	Alkaline subcategory based 261.22(a)(1)			spec. tech.	spec. tech.
	Other corrosives based on 261.22(a)(2)			spec. tech.	spec. tech.
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
D003 (Reactivity Characteristic)	Cyanides (Total)			590	Reserved
	Cyanides (Amenable)			30	0.86
	Reactive sulfides based on 261.23(a)(5); Explosives based on 261.23(a)(6),(7), and (8)			spec. tech.	spec. tech.
	Water reactives based on 261.23(a)(2),(3), & (4)			spec. tech.	
	Other reactives based on 261.23(a)(1)			spec. tech.	spec. tech.
D004 (EP Toxicity Characteristic)[d, e]	Arsenic	5.0			5.0
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
D005 (EP Toxicity Characteristic)[d]	Barium	100			100
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
D006 (EP Toxicity Characteristic)[d]	Cadmium	1.0			1.0
	Cadmium containing batteries			spec. tech.	
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
D007 (EP Toxicity Characteristic)[d]	Chromium (Total)	5.0			5.0
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
D008 (EP Toxicity Characteristic)[d]	Lead	5.0			5.0
	Lead acid batteries[f]			spec. tech.	
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
D009 (EP Toxicity Characteristic)[d, e]	Mercury[g]	0.20		spec. tech.	0.20
	Mercury[h]			spec. tech.	
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
	Elemental mercury contaminated with radioactive materials			spec. tech.	
	Hydraulic oil contaminated with mercury Radioactive Materials subcategory			spec. tech.	
D010 (EP Toxicity Characteristic)[d]	Selenium	5.7			1.0
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
D011 (EP Toxicity Characteristic)[d]	Silver	5.0			5.0
	Radioactive High-Level Wastes Generated During the Reprocessing of Fuel Rods Subcategory			spec. tech.	
D012 (EP Toxicity Characteristic)	Endrin			0.13	spec. tech.
D013 (EP Toxicity Characteristic)	Lindane			0.066	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
D014 (EP Toxicity Characteristic)	Methoxychlor			0.18	spec. tech.
D015 (EP Toxicity Characteristic)	Toxaphene			1.3	spec. tech.
D016 (EP Toxicity Characteristic)	2,4-D			10.0	spec. tech.
D017 (EP Toxicity Characteristic)	2,4,5-TP Silvex			7.9	spec. tech.
F001-F005 (Spent solvents)[i]	Acetone	0.59	0.05		
	Benzene			3.7	0.070
	n-Butyl alcohol	5.0	5.0		
	Carbon disulfide	4.81	1.05		
	Carbon tetrachloride	0.96	0.05		
	Chlorobenzene	0.05	0.15		
	Cresols (& cresylic acid)	0.75	2.82		
	Cyclohexanone	0.75	0.125		
	1,2-Dichlorobenzene	0.125	0.65		
	Ethyl acetate	0.75	0.05		
	Ethyl benzene	0.053	0.05		
	Ethyl ether	0.75	0.05		
	Isobutanol	5.0	5.0		
	Methanol	0.75	0.25		
	Methylene chloride	0.96	0.20		0.44[j]
	Methyl ethyl ketone	0.75	0.05		
	Methyl isobutyl ketone	0.33	0.05		
	Nitrobenzene	0.125	0.66		
	Pyridine	0.33	1.12		
	Tetrachloroethylene	0.05	0.079		
	Toluene	0.33	1.12		
	1,1,1-Trichloroethane	0.41	1.05		
	1,1,2-Trichloroethane			7.6	0.030
	1,1,2-Trichloro-1,2,2-tetriflouroethane	0.96	1.05		
	Trichloroethylene	0.091	0.062		
	Trichlorofluromethane	0.96	0.05		
	Xylene	0.15	0.05		

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
F005 (Spent Solvents)	2-Nitropropane			spec. tech.	spec. tech.
	2-Ethoxyethanol			spec. tech.	spec. tech.
F006 (Electroplating)	Cadmium	0.066			1.6
	Chromium (total)	5.2			0.32
	Cyanides (total)			590	1.2
	Cyanides (amenable)			30	0.86
	Lead	0.51			0.040
	Nickel	0.32			0.44
	Silver	0.072			
F007,F008,F009 (Electroplating)	Cadmium	0.066			
	Chromium (total)	5.2			0.32
	Cyanides (total)			590	1.9
	Cyanides (amenable)			30	0.10
	Lead	0.51			0.04
	Nickel	0.32			0.44
	Silver	0.072			
F010 (Metal heat-treating)[k]	Cyanides (total)			1.5	1.9
	Cyanides (amenable)				0.10
F011, F012 (Metal heat-treating)	Cadmium	0.066			
	Chromium (total)	5.2			0.32
	Cyanides (total)			110	1.9
	Cyanides (amenable)			9.1	0.10
	Lead	0.51			0.04
	Nickel	0.32			0.44
	Silver	0.072			
F019 (Aluminum coating by chemical conversion)	Cyanides (total)			590	1.2
	Cyanides (amenable)			30	0.86
	Chromium (total)	5.2			0.32

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
F020-F023,F026-F028 (Dioxin-containing)[i, l]	Hexachlorodibenzo-p-dioxins	<1 ppb	<1 ppb		
	Hexachlorodibenzofurans	<1 ppb	<1 ppb		
	Pentachlorodibenzo-p-dioxins	<1 ppb	<1 ppb		
	Pentachlorodibenzofurans	<1 ppb	<1 ppb		
	Tetrachlorodibenzo-p-dioxins	<1 ppb	<1 ppb		
	Tetrachlorodibenzofurans	<1 ppb	<1 ppb		
	2,4,5-Trichlorophenol	<0.05 ppm	<0.05 ppm		
	2,4,6-Trichlorophenol	<0.05 ppm	<0.05 ppm		
	2,3,4,6-Tetrachlorophenol	<0.05 ppm	<0.05 ppm		
	Pentachlorophenol	<0.01 ppm	<0.01 ppm		
F024 (Chlorinated aliphatic hydrocarbon prodn.)[k]	Organic standards			spec. tech.	spec. tech.
	2-Chloro-1,3-butadiene			0.28	0.28
	3-Chloropropene			0.28	0.28
	1,1-Dichloroethane			0.014	0.014
	1,2-Dichloroethane			0.014	0.014
	1,2-Dichloropropane			0.014	0.014
	cis-1,3-Dichloropropene			0.014	0.014
	trans-1,3-Dichloropropene			0.014	0.014
	Bis(2-ethylhexyl)phthalate			1.8	0.036
	Hexachloroethane			1.8	0.036
	Hexachlorodibenzo-furans			0.001	0.001
	Hexachlorodibenzo-p-dioxins			0.001	0.001
	Pentachlorodibenzo-furans			0.001	0.001
	Pentachlorodibenzo-p-dioxins			0.001	0.001
	Tetrachlorodibenzo-furans			0.001	0.001
	Chromium (total)	0.073			0.35
	Nickel	0.088			0.47
	Lead	0.021			
F025	Chloroform			6.2	0.046
	1,2-Dichloroethane			6.2	0.21
	1,1-Dichloroethylene			6.2	0.025
	Methylene chloride			31	0.089
	Carbon tetrachloride			6.2	0.057
	1,1,2-Trichloroethane			6.2	0.054

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Trichloroethylene			5.6	0.054
	Vinyl chloride			33	0.27
	Hexachlorobenzene			37	0.055
	Hexachlorobutadiene			28	0.055
	Hexachloroethane			30	0.055
F039 (wastes classified by more than one waste code or from a mixture of wastes)[e]	Acetone			160	0.28
	Acenaphtalene			3.4	0.059
	Acenaphthene			4.0	0.059
	Acetonitrile				0.17
	Acetophenone			9.7	0.010
	2-Acetylaminofluorene			140	0.059
	Acrylonitrile			84	0.24
	Aldrin			0.066	0.021
	4-Aminobiphenyl				0.13
	Aniline			14	0.81
	Anthracene			4.0	0.059
	Aroclor 1016			0.92	0.013
	Aroclor 1221			0.92	0.014
	Aroclor 1232			0.92	0.013
	Aroclor 1242			0.92	0.017
	Aroclor 1248			0.92	0.013
	Aroclor 1254			1.8	0.014
	Aroclor 1260			1.8	0.014
	alpha-BHC			0.066	0.00014
	beta-BHC			0.066	0.00014
	delta-BHC			0.066	0.023
	gamma-BHC			0.066	0.0017
	Benzene			36	0.14
	Benzo(a)anthracene			8.2	0.059
	Benzo(b)fluoranthene			3.4	0.055
	Benzo(k)fluoranthene			3.4	0.059
	Benzo(g,h,i)perylene			1.5	0.0055
	Benzo(a)pyrene			8.2	0.061
	Bromodichloromethane			15	0.35
	Bromoform			15	0.63

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Bromomethane (methyl bromide)			15	0.11
	4-Bromophenyl phenyl ether			15	0.055
	n-Butyl alcohol			2.6	5.6
	Butyl benzyl phthalate			7.9	0.017
	2-sec-Butyl-4,6-dinitrophenol			2.5	0.066
	Carbon tetrachloride			5.6	0.057
	Carbon disulfide				0.014
	Chlordane			0.13	0.0033
	p-Chloroaniline			16	0.46
	Chlorobenzene			5.7	0.057
	Chlorobenzilate				0.10
	Chlorodibromomethane			16	0.057
	Chloroethane			6.0	0.27
	bis(2-Chloroethoxy)methane			7.2	0.036
	bis(2-Chloroethyl) ether			7.2	0.033
	2-Chloroethyl vinyl ether				0.057
	Chloroform			5.6	0.046
	bis(2-Chloroisopropyl) ether			7.2	0.055
	p-Chloro-m-cresol			14	0.018
	Chloromethane (Methyl chloride)			33	0.19
	2-Choronaphthalene			5.6	0.055
	2-Chlorophenol			5.7	0.044
	3-Chloropropene			28	0.036
	Chrysene			8.2	0.059
	O-Cresol			5.6	0.11
	Cresol (m- and p-isomers)			3.2	0.77
	Cyclohexanone				0.36
	1,2-Dibromo-3-chloropropane			15	0.11
	1,2-Dibromoethane (Ethylene dobromide)			15	0.028
	Dibromomethane			15	0.11
	2,4-Dichlorophenoxyacetic acid (2,4-D)			10	0.72
	o,p'-DDD			0.087	0.023
	p,p'-DDD			0.087	0.023
	o,p'-DDE			0.087	0.031
	p,p'-DDE			0.087	0.031
	o,p'-DDT			0.087	0.0039

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	p,p'-DDT			0.087	0.0039
	Dibenzo(a,H)anthracene			8.2	0.055
	m-Dichlorobenzene			6.2	0.036
	o-Dichlorobenzene			6.2	0.088
	p-Dichlorobenzene			6.2	0.090
	Dichlorodifluoromethane			7.2	0.23
	1,1-Dichloroethane			7.2	0.059
	1,2-Dichloroethane			7.2	0.21
	1,1-Dichloroethylene			33	0.025
	trans-1,2-Dichloroethene			33	0.054
	2,4-Dichlorophenol			14	0.044
	2,6-Dichlorophenol			14	0.044
	1,2-Dichloropropane			18	0.85
	cis-1,3-Dichloropropene			18	0.036
	trans-1,3-Dichloropropene			18	0.036
	Dieldrin			0.13	0.017
	Diethyl phthalate			28	0.20
	p-Dimethylaminoazobenzene				0.13
	2,4-Dimethyl phenol			14	0.036
	Dimethyl phthalate			28	0.047
	Di-n-butyl phthalate			28	0.057
	1,4-Dinitrobenzene			2.3	0.32
	4,6-Dinitro-o-cresol			160	0.28
	2,4-Dinitrophenol			160	0.12
	2,4-Dinitrotoluene			140	0.32
	2,6-Dinitrotoluene			28	0.55
	Di-n-octyl phthalate			28	0.017
	Di-n-propylnitrosoamine			14	0.40
	1,2-Diphenyl hydrazine				0.087
	1,4-Dioxane			170	0.12
	Disulfoton			6.2	0.017
	Endosulfan I			0.066	0.023
	Endosulfan II			0.13	0.029
	Endosulfan sulfate			0.13	0.029
	Endrin			0.13	0.0028
	Endrin aldehyde			0.13	0.025

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Ethyl acetate			33	0.34
	Ethyl cyanide				0.24
	Ethyl benzene			6.0	0.057
	Ethyl ether			160	0.12
	bis(2-Ethylhexyl)phthalate			28	0.28
	Ethyl methacrylate			160	0.14
	Ethylene oxide				0.12
	Famphur			15	0.017
	Fluoranthene			8.2	0.068
	Fluorene			4.0	0.059
	Fluorotrichloromethane			33	0.020
	Heptachlor			0.066	0.0012
	Heptachlor epoxide			0.066	0.016
	Hexachlorobenzene			37	0.055
	Hexachlorobutadiene			28	0.055
	Hexachloroyclopentadiene			3.6	0.057
	Hexachlorodibenzo-furans			0.001	0.000063
	Hexachlorodibenzo-p-dioxins			0.001	0.000063
	Hexachloroethane			28	0.055
	Hexachloropropene			28	0.035
	Indeno(1,2,3,-c,d)pyrene			8.2	0.0055
	Iodomethane			65	0.019
	Isobutanol			170	5.6
	Isodrin			0.066	0.021
	Isosafrole			2.6	0.081
	Kepone			0.13	0.0011
	Methacrylonitrile			84	0.24
	Methapyrilene			1.5	0.081
	Methoxychlor			0.18	0.25
	3-Methylcholanthrene			15	0.0055
	4,4-Methylene-bis-(2-chloroaniline)			35	0.50
	Methylene chloride			33	0.089
	Methyl ethyl ketone			36	0.28
	Methyl isobutyl ketone			33	0.14
	Methylmethacrylate			160	0.14
	Methyl methansulfonate				0.018

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Methyl parathion			4.6	0.014
	Naphthalene			3.1	0.059
	2-Naphtylamine				0.52
	p-Nitroaniline			28	0.028
	Nitrobenzene			14	0.068
	5-Nitro-o-toluidine			28	0.32
	4-Nitrophenol			29	0.12
	N-Nitrosodiethylamine			28	0.40
	N-Nitrosodimethylamine				0.40
	N-Nitroso-di-n-butylamine			17	0.40
	N-Nitrosomethylethylamine			2.3	0.40
	N-Nitrosomorpholine			2.3	0.40
	N-Nitrosopiperidine			35	0.013
	N-Nitrosopyrrolidine			35	0.013
	Parathion			4.6	0.017
	Pentachlorobenzene			37	0.055
	Pentachlorodibenzo-furans			0.001	0.000035
	Pentachlorodibenzo-p-dioxins			0.001	0.000063
	Pentachloronitrobenzene			4.8	0.055
	Pentachlorophenol			7.4	0.089
	Phenacetin			16	0.081
	Phenanthrene			3.1	0.059
	Phenol			6.2	0.039
	Phorate			4.6	0.021
	Propanenitrile (ethyl cyanide)			360	0.24
	Pronamide			1.5	.093
	Pyrene			8.2	0.067
	Pyridine			16	0.014
	Safrole			22	0.081
	Silvex (2,4,5-TP)			7.9	0.72
	2,4,5-T			7.9	0.72
	1,2,4,5-Tetrachlorobenzene			19	0.055
	Tetrachlorodibenzo-furans			0.001	0.000063
	Tetrachlorodibenzo-p-dioxins			0.001	0.000063
	2,3,7,8-Tetrachlorodibenzo-p-dioxin				0.000063
	1,1,1,2-Tetrachloroethane			42	0.057

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	1,1,2,2-Tetrachloroethane			42	0.057
	Tetrachloroethene			5.6	0.056
	2,3,4,6-Tetrachlorophenol			37	0.030
	Toluene			28	0.080
	Toxaphene			1.3	0.0095
	1,2,4-Trichlorobenzene			19	0.055
	1,1,1-Trichloroethane			5.6	0.054
	1,1,2-Trichloroethane			5.6	0.054
	Trichloroethylene			5.6	0.054
	2,4,5-Trichlorophenol			37	0.18
	2,4,6-Trichlorophenol			37	0.035
	1,2,3-Trichloropropane			28	0.85
	1,1,2-Trichloro-1,2,2-trifluoro-ethane			28	0.057
	Vinyl chloride			33	0.27
	Xylene(s)			28	0.32
	Cyanides (total)			1.8	1.2
	Cyanides (amenable)				0.86
	Fluoride				35
	Sulfide				14
	Antimony	0.23			1.9
	Arsenic	5.0			5.0
	Barium	52			1.2
	Beryllium				0.82
	Cadmium	0.066			0.20
	Chromium (total)	5.2			0.37
	Copper				1.3
	Lead	0.51			0.28
	Mercury	0.025			0.15
	Nickel	0.32			0.55
	Selenium	5.7			0.82
	Silver	0.072			0.29
	Vanadium				0.042
K001 (Wood preserving)	Naphthalene			1.5	0.031
	Pentachlorophenol			1.5	0.031
	Phenanthrene			1.5	0.031

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Pyrene			1.5	0.028
	Toluene			28	0.028
	Xylenes (total)			33	0.032
	Lead	0.51			0.037
K002,K003,K004 (pigment prodn.)	Chromium (total)	0.094			2.9
	Lead	0.37			3.4
K005 (Chrome green pigment prodn.)	Chromium (total)	0.094			2.9
	Lead	0.37			3.4
	Cyanides (total)				0.74
K006 (Chrome oxide green pigment prodn.)	Chromium (total)				2.9
	Lead				3.4
K006 (anhydrous)	Chromium (total)	0.094			
	Lead	0.37			
K006 (hydrated)	Chromium (total)	5.2			
K007 (Iron blue pigment prodn.)	Chromium (total)	0.094			2.9
	Lead	0.37			3.4
	Cyanides (total)				0.74
K008 (Chrome green oxide pigment prod.)	Chromium (total)	0.094			2.9
	Lead	0.37			3.4
K009,K010 (Acetaldehyde prodn.)[k]	Chloroform			6.0	0.10
K011,K013,K014 (Acrylonitrile prodn.)[k]	Acetonitrile			1.8	38
	Acrylonitrile			1.4	0.06
	Acrylamide			23	19
	Benzene			0.03	0.02
	Cyanides (total)			57	21

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K015 (Benzyl chloride distillation)	Anthracene			3.4	1.0
	Benzal chloride			6.2	0.28
	Benzo (b and/or k) fluoranthene			3.4	0.29
	Phenanthrene			3.4	0.27
	Toluene			6.0	0.15
	Chromium (total)	1.7			0.32
	Nickel				0.44
	Lead	0.2			
K016 (Carbon tetrachloride prodn.)	Hexachlorobenzene			28	0.033
	Hexachlorobutadiene			5.6	0.007
	Hexachlorocyclopentadiene			5.6	0.007
	Hexachloroethane			28	0.033
	Tetrachloroethene			6.0	0.007
K017 (Epichlorohydrin prodn.)	1,2-Dichloropropane			18	0.85
	1,2,3-Trichloropropane			28	0.85
	Bis(2-chloroethyl)ether			7.2	0.033
K018 (Ethyl chloride prodn.)	Chloroethane			6.0	0.007
	1,1-Dichloroethane			6.0	0.007
	1,2-Dichloroethane			6.0	0.007
	Hexachlorobutadiene			5.6	0.033
	Hexachlorethane			28	0.007
	Pentachloroethane			5.6	0.007
	1,1,1-Trichloroethane			6.0	0.007
K019 (Ethylene dichloride prodn.)	1,2-Dichloroethane			6.0	0.007
	Bis(2-chloroethyl)ether			5.6	0.007
	Chlorobenzene			6.0	0.006
	Chloroform			6.0	0.007
	Fluorene				0.007
	Hexachloroethane			28	0.033
	Naphthalene			5.6	0.007
	Phenanthrene			5.6	0.007
	p-Dichlorobenzene				0.008

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Tetrachloroethene			6.0	0.007
	1,1,1-Trichloroethane			6.0	0.007
	1,2,4-Trichlorobenzene			19	0.023
	1,2,4,5-Tetrachlorobenzene				0.017
K020 (Vinyl chloride prodn.)	1,2-Dichloroethane			6.0	0.007
	1,1,2,2-Tetrachloroethane			5.6	0.007
	Tetrachloroethene			6.0	0.007
K021 (Fluoromethanes prodn.)	Chloroform			6.2	0.046
	Carbon tetrachloride			6.2	0.057
	Antimony	0.23			0.60
K022 (Phenol/acetone prodn.)	Acetophenone			19	0.010
	Toluene			0.034	0.080
	Diphenylamine				0.52
	Diphenylnitrosamine				0.40
	Diphenylamine + Diphenylnitrosamine			13	
	Phenol			12	0.039
	Chromium (total)	5.2			0.35
	Nickel	0.32			0.47
K023,K093,K094 (Phthalic anhydride prodn.)[k]	Phthalic anhydride			28	0.54
K024 (Phthalic anhydride prodn.)	Phthalic anhydride			28	0.54
K025 (Nitrobenzene prodn.)				spec. tech.	spec. tech.
K026 (Methyl ethyl pyridine prodn.)				spec. tech.	spec. tech.
K027 (Toluene diisocyanate prodn.)				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K028 (1,1,1-trichloroethane prodn.)[k]	1,1-Dichloroethane			6.0	0.007
	trans-1,2-Dichloroethane			6.0	0.033
	Hexachlorobutadiene			5.6	0.007
	Hexachloroethane			28	0.033
	Pentachloroethane			5.6	0,033
	1,1,1,2-Tetrachloroethane			5.6	0.007
	1,1,2,2-Tetrachloroethane			5.6	0.007
	1,1,1-Trichloroethane			6.0	0.007
	1,1,2-Trichloroethane			6.0	0.007
	Tetrachloroethylene			6.0	0.007
	Cadmium				6.4
	Chromium (total)	0.073			0.35
	Lead	0.021			0.037
	Nickel	0.088			0.47
K029 (1,1,1-trichloroethane prodn.)[k]	Chloroform			6.0	0.46
	1,2-Dichloroethane			6.0	0.21
	1,1-Dichloroethylene			6.0	0.025
	1,1,1-Trichloroethane			6.0	0.054
	Vinyl chloride			6.0	0.27
K030 (tri&tetrachloroethylene prodn.)	Hexachlorobutadiene			5.6	0.007
	Hexachloroethane			28	0.033
	Hexachloropropene			19	
	Pentachlorobenzene			28	
	Pentachloroethane			5.6	0.007
	1,2,4,5-Tetrachlorobenzene			14	0.017
	Tetrachloroethane			6.0	0.007
	1,2,4-Trichlorobenzene			19	0.023
	o-Dichlorobenzene				0.008
	p-Dichlorobenzene				0.008
K031 (MSMA & cacodylic acid prodn.)[e]	Arsenic	5.6			0.79

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K032 (Chlorodane prodn.)	Hexachloropentadiene			2.4	0.057
	Chlordane			0.26	0.0033
	Heptachlor			0.066	0.012
	Heptachlor epoxide			0.066	0.016
K033 (Chlorodane prodn.)	Hexachlorocyclopentadiene			2.4	0.057
K034 (Chlorodane prodn.)	Hexachlorocyclopentadiene			2.4	0.057
K035 (Creosote prodn.)	Acenaphthene			3.4	
	Anthracene			3.4	
	Benz(a)anthracene			3.4	0.059
	Benzo(a)pyrene			3.4	
	Chrysene			3.4	0.059
	Dibenz(a,h)anthracene			3.4	
	Fluoranthene			3.4	0.068
	Fluorene			3.4	
	Indeno(1,2,3-cd)pyrene			3.4	
	Cresols (m- and p-isomers)				0.77
	Naphthalene			3.4	0.059
	o-cresol				0.11
	Phenanthrene			3.4	0.059
	Phenol				0.039
	Pyrene			8.2	0.067
K036 (Disulfoton prodn.)	Disulfoton			0.1	0.025
K037 (Disulfoton prodn.)	Disulfoton			0.1	0.025
	Toluene			28	0.080
K038, K040 (Phorate prodn.)[k]	Phorate			0.1	0.025
K039 (Phorate prodn. filter cakes)[k]				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K041 (Toxaphene prodn.)	Toxaphene			2.6	0.0095
K042 (2,4,5-T prodn.)	1,2,4,5-Tetrachlorobenzene			4.4	0.055
	o-Dichlorobenzene			4.4	0.088
	p-Dichlorobenzene			4.4	0.090
	Pentachlorobenzene			4.4	0.055
	1,2,4-Trichlorobenzene			4.4	0.055
K043 (2,4-D prodn.)[k]	2,4-Dichlorophenol			0.38	0.049
	2,6-Dichlorophenol			0.34	0.013
	2,4,5-Trichlorophenol			8.2	0.016
	2,4,6-Trichlorophenol			7.6	0.039
	Tetrachlorophenols (total)			0.68	0.018
	Pentachlorophenol			1.9	0.22
	Tetrachloroethene			1.7	0.006
	Hexachlorodibenzo-p-dioxins			0.001	0.001
	Hexachlorodibenzo-furans			0.001	0.001
	Pentachlorodibenzo-p-dioxins			0.001	0.001
	Pentachlorodibenzo-furans			0.001	0.001
	Tetrachlorodibenzo-p-dioxins			0.001	0.001
	Tetrachlorodibenzo-furans			0.001	0.001
K044 (Explosives prodn.)				spec. tech.	spec. tech.
K045 (Spent carbon from explosives treatment)				spec. tech.	spec. tech.
K046 (Lead-based initiating 7cmpds.)	Lead	0.18			0.037
K047 (TNT operations)				spec. tech.	spec. tech.
K048,K049,K050,K051,K052 (Petroleum refining industry)[m]	Chromium (total)	1.7			0.2
	Nickel	0.20			

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K048 (Petro. refining industry)[m]	Benzene			14	0.011
	Benzo(a)pyrene			12	0.047
	Bis(2-ethylhexyl)phthalate			7.3	0.043
	Chrysene			15	0.043
	Di-n-butyl phthalate			3.6	0.060
	Ethylbenzene			14	0.011
	Naphthalene			42	0.033
	Phenanthrene			34	0.039
	Phenol			3.6	0.047
	Pyrene			36	0.045
	Toluene			14	0.011
	Xylenes			22	0.011
	Cyanides(total)			1.8	0.028
	Fluorene				0.050
	Lead				0.037
K049 (Petro. refining industry)[m]	Anthracene			28	0.039
	2,4-Dimethylphenol				0.033
	Benzene			14	0.011
	Benzo(a)pyrene			12	0.047
	Bis(2-ethylhexyl)phthalate			7.3	0.043
	Carbon disulfide				0.011
	Chrysene			15	0.043
	Cyanides (total)			1.8 .	0.028
	Ethylbenzene			14	0.011
	Naphthalene			42	0.033
	Phenanthrene			34	0.039
	Phenol			3.6	0.047
	Pyrene			36	0.045
	Toluene			14	0.011
	Xylenes			22	0.011
	Lead				0.037

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K050 (Petro. refining industry)[m]	Benzo(a)pyrene			12	0.047
	Phenol			3.6	0.047
	Cyanides (total)			1.8	0.028
	Lead				0.037
K051 (Petro. refining industry)[m]	Anthracene			28	0.039
	Acenaphthene				0.05
	Benzene			14	0.011
	Benzo(a)anthracene			20	0.043
	Benzo(a)pyrene			12	0.047
	Bis(2-ethylhexyl)phthalate			7.3	0.043
	Chrysene			15	0.043
	Di-n-butyl phthalate			3.6	0.06
	Ethylbenzene			14	0.011
	Naphthalene			42	0.033
	Phenanthrene			34	0.039
	Phenol			3.6	0.047
	Pyrene			36	0.045
	Toluene			14	0.011
	Xylenes			22	0.011
	Fluorene				0.05
	Cyanides (total)			1.8	0.028
	Lead				0.037
K052 (Petro. refining industry)[m]	Benzene			14	0.011
	Benzo(a)pyrene			12	0.047
	o-Cresol			6.2	0.011
	p-Cresol			6.2	0.011
	2,4-Dimethylphenol				0.033
	Ethylbenzene			14	0.011
	Naphthalene			42	0.033
	Phenanthrene			34	0.039
	Phenol			3.6	0.047
	Toluene			14	0.011
	Xylenes			22	0.011

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Cyanides (total)			1.8	0.028
	Lead				0.037
K060 (Coking operations)	Benzene			0.071	0.17
	Benzo(a)pyrene			3.6	0.035
	Naphthalene			3.4	0.028
	Phenol			3.4	0.042
	Cyanides (total)			1.2	1.9
K061 (Electric furnace steel prodn.)[n]	Emission control dust/sludge from primary production of steel in electric furnaces (high zinc subcategory - greater than or equal to 15% total zinc)			spec. tech.	
K061 (Low zinc subcategory - less than 15% total zinc	Cadmium	0.14			
	Chromium (total)	5.2			
	Lead	0.24			
	Nickel	0.32			
K061	Cadmium				1.61
	Chromium (total)				0.32
	Lead				0.51
	Nickel				0.44
K062 (Steel finishing spent liquor)	Chromium (total)	0.094			0.32
	Lead	0.37			0.04
	Nickel				0.44
K069 (Secondary lead smelting)	Emission control dust/sludge from secondary lead smelting: Non-Calcium Sulfate subcategory			spec. tech.	
K069 (Calcium Sulfate Subcategory)	Cadmium	0.14			
	Lead	0.24			
K069	Cadmium				1.6
	Lead				0.51

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K071 (Chlorine prodn.)	Mercury				0.030
K071 (Low mercury subcategory - less than 16 mg/kg mercury)	Mercury	0.025			
K073 (Chlorine prodn.)	Carbon tetrachloride			6.2	0.057
	Chloroform			6.2	0.046
	Hexachloroethane			30	0.055
	Tetrachloroethene			6.2	0.056
	1,1,1-Trichloroethane			6.2	0.054
K083 (Aniline prodn.)	Benzene			6.6	0.14
	Aniline			14	0.81
	Diphenylamine				0.52
	Diphenylnitrosamine				0.40
	Diphenylamine + Diphenylnitrosamine			14	
	Nitrobenzene			14	0.068
	Phenol			5.6	0.039
	Cyclohexanone			30	0.36
	Nickel	0.088			0.47
K084 (Veterinary pharmaceutical prodn.)[e]	Arsenic	5.6			0.79
K085 (Chlorobenzene prodn.)	Benzene			4.4	0.14
	Chlorobenzene			4.4	0.057
	o-Dichlorobenzene			4.4	0.088
	m-Dichlorobenzene			4.4	0.036
	p-Dichlorobenzene			4.4	0.090
	1,2,4-Trichlorobenzene			4.4	0.055
	1,2,4,5-Tetrachlorobenzene			4.4	0.055
	Pentachlorobenzene			4.4	0.055
	Hexachlorobenzene			4.4	0.055
	Aroclor 1016			0.92	0.013
	Aroclor 1221			0.92	0.014
	Aroclor 1232			0.92	0.013

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Aroclor 1242			0.92	0.017
	Aroclor 1248			0.92	0.013
	Aroclor 1254			1.8	0.014
	Aroclor 1260			1.8	0.014
K086 (Ink prodn.)[o]	Acetone			160	0.28
	Acetophenone			9.7	0.010
	bis(2-ethylhexyl)phthalate			28	0.28
	n-Butyl alcohol			2.6	5.6
	Butylbenzylphthalate			7.9	0.017
	Cyclohexanone				0.36
	1,2-Dichlorobenzene			6.2	0.088
	Diethyl phthalate			28	0.020
	Dimethyl phthalate			28	0.047
	Di-n-butyl phthalate			28	0.057
	Di-n-octyl phthalate			28	0.017
	Ethyl acetate			33	0.34
	Ethyl benzene			6.0	0.057
	Methanol				5.6
	Methylene chloride			33	0.089
	Methyl ethyl ketone			36	0.28
	Methyl isobutyl ketone			33	0.14
	Naphthalene			3.1	0.059
	Nitrobenzene			14	0.068
	Toluene			28	0.080
	1,1,1-Trichloroethane			5.6	0.054
	Trichloroethylene			5.6	0.054
	Xylenes			28	0.32
	Cyanides (total)			1.5	1.9
	Chromium (total)	0.094			0.32
	Lead	0.37			0.037
K087 (Coking operations)	Acenaphthalene			3.4	0.028
	Benzene			0.071	0.014
	Chrysene			3.4	0.028
	Fluoranthene			3.4	0.028

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Ideno (1,2,3-cd) pyrene			3.4	0.028
	Naphthalene			3.4	0.028
	Phenanthrene			3.4	0.028
	Toluene			0.65	0.008
	Xylenes			0.070	0.014
	Lead	0.51			0.037
K093,K094 (Phthalic anhydride prodn.)[k]	Phthalic anhydride			28	0.54
K095 (1,1,1-trichloroethane prodn.)[k]	1,1,1,2-Tetrachloroethane			5.6	0.057
	1,1,2,2-Tetrachloroethane			5.6	0.057
	Tetrachloroethene			6.0	0.056
	1,1,2-Trichloroethane			6.0	0.054
	Trichloroethylene			5.6	0.054
	Hexachloroethane			28	0.055
	Pentachloroethane			5.6	0.055
K096 (1,1,1-trichloroethane prodn.)[k]	1,3-Dichlorobenzene			5.6	0.036
	Pentachloroethane			5.6	0.055
	1,1,1,2-Tetrachloroethane			5.6	0.057
	1,1,2,2-Tetrachloroethane			5.6	0.057
	Tetrachloroethene			6.0	0.056
	1,2,4-Trichlorobenzene			19	0.055
	Trichloroethene			5.6	0.054
	1,1,2-Trichloroethane			6.0	0.054
K097 (Chlorodane prodn.)	Hexachlorocyclopentadiene			2.4	0.057
	Chlordane			0.26	0.0033
	Heptachlor			0.066	0.0012
	Heptachlor epoxide			0.066	0.016
K098 (Toxaphene prodn.)	Toxaphene			2.6	0.0095

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
K099 (2,4-D prodn.)	2,4-Dichlorophenoxyacetic acid			1.0	1.0
	Hexachlorodibenzo-p-dioxins			0.001	0.001
	Hexachlorodibenzofurans			0.001	0.001
	Pentachlorodibenzo-p-dioxins			0.001	0.001
	Pentachlorodibenzofurans			0.001	0.001
	Tetrachlorodibenzo-p-dioxins			0.001	0.001
	Tetrachlorodibenzofurans			0.001	0.001
K100 (Secondary lead smelting)	Cadmium	0.066			1.6
	Chromium (total)	5.2			0.32
	Lead	0.51			0.51
K101 (Vet. pharmaceutical prodn.)[e]	o-Nitroaniline			14	0.27
K101,K102 (Vet. pharmaceutical prodn.)[e, p]	Arsenic	5.6			0.79
	Cadmium	0.066			0.24
	Chromium (total)	5.2			
	Lead	0.51			0.17
	Nickel	0.32			
	Mercury				0.082
K102 (Vet. pharmaceutical prodn.)[e]	Ortho-Nitrophenol			13	0.028
K103 (Aniline prodn.)	Aniline			5.6	4.5
	Benzene			6.0	0.15
	2,4-Dinitrophenol			5.6	0.61
	Nitrobenzene			5.6	0.073
	Phenol			5.6	1.4
K104 (Nitrobenzene/Aniline prodn.)	Aniline			5.6	4.5
	Benzene			6.0	0.15
	2,4-Dinitrophenol			5.6	0.61

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
	Nitrobenzene			5.6	0.073
	Phenol			5.6	1.4
	Cyanides (total)			1.8	2.7
K105 (Chlorobenzene prodn.)	Benzene			4.4	0.14
	Chlorobenzene			4.4	0.057
	o-Dichlorobenzene			4.4	0.088
	p-Dichlorobenzene			4.4	0.090
	2,4,5-Trichlorophenol			4.4	0.18
	2,4,6-Trichlorophenol			4.4	0.035
	2-Chlorophenol			4.4	0.044
	Phenol			4.4	0.039
K106 (Low Mercury Subcategory-less than 260 mg/kg Mercury-residues from RMERC)[q, r]	Mercury	0.20			0.030
K106 (Low Mercury Subcategory-less than 260 mg/kg Mercury-that are not residues[s, r] from RMERC)	Mercury	0.025			0.030
	Wastewater treatment sludge from the mercury cell process in chlorine production:(High Mercury Subcategory - > = 260 mg/kg total mercury)			spec. tech.	
K113 (Toluenediamine prodn.)[k]				spec. tech.	spec. tech.
K114 (Toluenediamine prodn.)[k]				spec. tech.	spec. tech.
K115 (Toluenediame prodn.)[k]	Nickel	0.32			0.47
	Heavy ends from the purification of toluenediame in production of toluenediame via hydrogenation of dinitrotoluene			spec. tech.	spec. tech.
K116 (Toluenediamine prodn.)[k]				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard			
		Concentration in Waste Extract (40 CFR 268.41)		Concentration in Waste (40 CFR 268.43)	
		Nonwastewater (mg/L)	Wastewater (mg/L)	Nonwastewater (mg/kg)	Wastewater (mg/L)
P001 (Warfarin (>0.3%))				spec. tech.	spec. tech.
P002 (1-Acetyl-2-thiourea)				spec. tech.	spec. tech.
P003 (Acrolein)				spec. tech.	spec. tech.
P004 (Aldrin)	Aldrin			0.066	0.21
P005 (Allyl alcohol)				spec. tech.	spec. tech.
P006 (Aluminum phosphide)				spec. tech.	spec. tech.
P007 (5-Aminoethyl 3-isoxazolol)				spec. tech.	spec. tech.
P008 (4-Aminopyridine)				spec. tech.	spec. tech.
P009 (Ammonium picrate)				spec. tech.	spec. tech.
P010 (Arsenic acid)[e]	Arsenic	5.6			0.79
P011 (Arsenic pentoxide)[e]	Arsenic	5.6			0.79
P012 (Arsenic trioxide)[e]	Arsenic	5.6			0.79
P013 (Barium cyanide)	Cyanides (total)			110	1.9
	Cyanides (amenable)			9.1	0.10
	Barium	52			
P014 (Thiophenol (Benzene thiol))				spec. tech.	spec. tech.
P015 (Beryllium dust)				spec. tech.	
P016 (Bis(chloromethyl)ether)				spec. tech.	spec. tech.
P017 (Bromoacetone)				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
P018 (Brucine)				spec. tech.	spec. tech.
P020 (2-sec-Butyl-4,6-dinitrophenol)	2-sec-Butyl-4,6-dinitrophenol			2.5	0.066
P021 (Calcium cyanide)	Cyanides (total) Cyanides (amenable)			110 9.1	1.9 0.10
P022 (Carbon disulfide)	Carbon disulfide			spec. tech.	0.014
P023 (Chloroacetaldehyde)				spec. tech.	spec. tech.
P024 (p-Chloroaniline)	p-Chloroaniline			16	0.46
P026 (1-(o-Chlorophenyl) thiourea)				spec. tech.	spec. tech.
P027 (3-Chloropropionitrile)				spec. tech.	spec. tech.
P028 (Bensyl chloride)				spec. tech.	spec. tech.
P029 (Copper cyanide)	Cyanides (total) Cyanides (amenable)			110 9.1	1.9 0.10
P030 (Soluble cyanide salts (n.o.s.))	Cyanides (total) Cyanides (amenable)			110 9.1	1.9 0.10
P031 (Cyanogen)				spec. tech.	spec. tech.
P033 (Cyanogen chloride)				spec. tech.	spec. tech.
P034 (2-Cyclohexyl-4,6-dinitrophenol)				spec. tech.	spec. tech.
P036 (Dichlorophenylarsine)[e]	Arsenic	5.6			0.79

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
P037 (Dieldrin)	Dieldrin			0.13	0.017
P038 (Diethylarsine)[e]	Arsenic	5.6			0.79
P039 (Disulfoton)[k]	Disulfoton			0.10	0.017
P040 (o,o-Diethyl o-pyrazinyl phosphorothioate)[k]				spec. tech.	spec. tech.
P041 (Diethyl p-nitrophenyl phosphate)[k]				spec. tech.	spec. tech.
P042 (Epinephrine)				spec. tech.	spec. tech.
P043 (Diiopropyl fluorophosphate)[k]				spec. tech.	spec. tech.
P044 (Dimethoate)[k]				spec. tech.	spec. tech.
P045 (Thiofanox)				spec. tech.	spec. tech.
P046 (alpha, alpha-Dimethylphenethylamine)				spec. tech.	spec. tech.
P047 (4,6-Dinitro-o-cresol salts)				spec. tech	spec. tech.
P047 (4,6-Dinitro-o-cresol)	4,6-Dinitro-o-cresol			160	0.28
P048 (2,4-Dinitrophenol)	2,4-Dinitrophenol			160	0.12
P049 (2,4-Dithiobiuret)				spec. tech.	spec. tech.
P050 (Endosulfan)	Endosulfan I			0.066	0.023
	Endosulfan II			0.13	0.029
	Endosulfan sulfate			0.13	0.029

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
P051 (Endrin)	Endrin			0.13	0.0028
	Endrin aldehyde			0.13	0.025
P054 (Aziridine)				spec. tech.	spec. tech.
P056 (Fluoride)	Fluoride			spec. tech.	35
P057 (Fluoroacetamide)				spec. tech.	spec. tech.
P058 (Fluoroacetic acid, sodium salt)				spec. tech.	spec. tech.
P059 (Heptachlor)	Heptachlor			0.066	0.0012
	Heptachlor epoxide			0.066	0.016
P060 (Isodrin)	Isodrin			0.066	0.021
P062 (Hexaethyltetraphosphate)[k]				spec. tech.	spec. tech.
P063 (Hydrogen cyanide)	Cyanides (total)			110	1.9
	Cyanides (amenable)			9.1	0.10
P064 (Isocyanic acid, ethyl ester)				spec. tech.	spec. tech.
P065 (Mercury fulminate)[r]	Mercury				0.030
	Mercury[q]		0.20		
	Mercury[s]		0.025		
	Mercury fulminate[t]			spec. tech.	
	Mercury fulminate[u]			spec. tech.	
P066 (Methomyl)				spec. tech.	spec. tech.
P067 (2-Methylaziridine)				spec. tech.	spec. tech.
P068 (Methyl hydrazine)				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard			
		Concentration in Waste Extract (40 CFR 268.41)		Concentration in Waste (40 CFR 268.43)	
		Nonwastewater (mg/L)	Wastewater (mg/L)	Nonwastewater (mg/kg)	Wastewater (mg/L)
P069 (Methyllactonitrile)				spec. tech.	spec. tech.
P070 (Aldicarb)				spec. tech.	spec. tech.
P071 (Methyl parathion)[k]	Methyl parathion			0.10	0.025
P072 (1-Naphthyl-2-thiourea)				spec. tech.	spec. tech.
P073 (Nickel carbonyl)	Nickel	0.32		0.44	
P074 (Nickel cyanide)	Nickel	0.32			0.44
	Cyanides (total)			110	1.9
	Cyanides (amenable)			9.1	0.10
P075 (Nicotine and salts)				spec. tech.	spec. tech.
P076 (Nitric oxide)				spec. tech.	spec. tech.
P077 (p-Nitroaniline)	p-Nitroaniline			28	0.028
P078 (Nitrogen dioxide)				spec. tech.	spec. tech.
P081 (Nitroglycerin)				spec. tech.	spec. tech.
P082 (N-Nitrosodimethylamine)	N-Nitrosodimethylamine			spec. tech.	0.40
P084 (N-Nitrosomethylvinylamine)				spec. tech.	spec. tech.
P085 (Octamethylpyrophosphoramide)[k]				spec. tech.	spec. tech.
P087 (Osmium tetroxide)[v]				spec. tech.	
P088 (Endothall)				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
P089 (Parathion)[k]	Parathion			0.1	0.025
P092 (Phenylmercury)[r]	Mercury				0.030
	Mercury[q]	0.20			
	Mercury[s]	0.025			
	Phenyl mercury acetate[t]			spec. tech.	
	Phenyl mercury acetate[w]			spec. tech.	
P093 (N-Phenylthiourea)[x]				spec. tech.	spec. tech.
P094 (Phorate)[k]	Phorate			0.1	0.025
P095 (Phosgene)[x]				spec. tech.	spec. tech.
P096 (Phosphine)				spec. tech.	spec. tech
P097 (Famphur)[k]	Famphur			0.1	0.025
P098 (Potassium cyanide)	Cyanides (total)			110	1.9
	Cyanides (amenable)			9.1	0.10
P099 (Potassium silver cyanide)	Silver	0.072			0.29
	Cyanides (total)			110	1.9
	Cyanides (amenable)			9.1	0.10
P101 (Ethyl cyanide (Propanenitrile))	Ethyl cyanide (Propanenitrile)			360	0.24
P102 (Propargyl alcohol)				spec. tech.	spec. tech.
P103 (Selenourea)	Selenium	5.7			1.0
P104 (Silver cyanide)	Silver	0.072			0.29
	Cyanides (total)			110	1.9
	Cyanides (amenable)			9.1	0.10

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
P105 (Sodium azide)				spec. tech.	spec. tech.
P106 (Sodium cyanide)	Cyanides (total) Cyanides (amenable)			110 9.1	1.9 0.10
P108 (Strychnine and salts)[x]				spec. tech.	spec. tech.
P109 (Tetraethyldithiophyro-phosphate)[k]				spec. tech.	spec. tech.
P110 (Tetraethyl lead)	Lead	0.51			0.040
P112 (Tetranitromethane)				spec. tech.	spec. tech.
P113 (Thallic oxide)	Thallium			spec. tech.	0.14
P114 (Thallium selenite)	Selenium	5.7			1.0
P115 (Thallium(I)sulfate)	Thallium			spec. tech.	0.14
P116 (Thiosemicarbazide)[x]				spec. tech.	spec. tech.
P118 (Trichloromethanethiol)[x]				spec. tech.	spec. tech.
P119 (Ammonium vanadate)	Vanadium			spec. tech.	28
P120 (Vanadium pentoxide)	Vanadium			spec. tech.	28
P121 (Zinc cyanide)	Cyanides (total) Cyanides (amenable)			110 9.1	1.9 0.10
P122 (Zinc phosphide (<10%))				spec. tech.	spec. tech.
P123 (Toxaphene)	Toxaphene			1.3	0.0095

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U001 (Acetaldehyde)				spec. tech.	spec. tech.
U002 (Acetone)	Acetone			160	0.28
U003 (Acetonitrile)[x]	Acetonitrile			spec. tech.	0.17
U004 (Acetophenone)	Acetophenone			9.7	0.010
U005 (2-Acetylaminofluorene)	2-Acetylaminofluorene			140	0.059
U006 (Acetyl chloride)[x]				spec. tech.	spec. tech.
U007 (Acrylamide)[x]				spec. tech.	spec. tech.
U008 (Acrylic acid)				spec. tech.	spec. tech.
U009 (Acrylonitrile)	Acrylonitrile			84	0.24
U010 (Mitomycin C)[x]				spec. tech.	spec. tech.
U011 (Amitrole)[x]				spec. tech.	spec. tech.
U012 (Aniline)	Aniline			14	0.81
U014 (Auramine)[x]				spec. tech.	spec. tech.
U015 (Azaserine)[x]				spec. tech.	spec. tech.
U016 (Benz(c)acridine)				spec. tech.	spec. tech.
U017 (Benzal chloride)[x]				spec. tech.	spec. tech.
U018 (Benz(a)anthracene)	Benz(a)anthracene			8.2	0.059
U019 (Benzene)	Benzene			36	0.14

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U020 (Benzenesulfonyl chloride)[x]				spec. tech.	spec. tech.
U021 (Benzidine)[x]				spec. tech.	spec. tech.
U022 (Benzo(a)pyrene)	Benzo(a)pyrene			8.2	0.061
U023 (Benzotrichloride)				spec. tech.	spec. tech.
U024 (Bis(2-Chloroethoxy) methane)	Bis(2-chloroethoxy)methane			7.2	0.036
U025 (Bis(2-chloroethyl)ether)	Bis(2-chloroethyl)ether			7.2	0.033
U026 (Chlornaphazin)[x]				spec. tech.	spec. tech.
U027 (Bis(2-chloroisopropyl)ether)	Bis(2-chloroisopropyl)ether			7.2	0.055
U028 (Bis (2-ethylexyl) phthalate)[k]	Bis-(2-ethylhexyl)phthalate			28	0.54
U029 (Bromomethane)	Bromomethane (methyl bromide)			15	0.11
U030 (4-Bromophenyl phenyl ether)	4-Bromophenyl phenyl ether			15	0.055
U031 (n-Butyl alcohol)	n-Butyl alcohol			2.6	5.6
U032 (Calcium chromate)	Chromium (total)	0.094			0.32
U033 (Carbonyl fluoride)[x]				spec. tech.	spec. tech.
U034 (Trichloroacetaldehyde (chloral))[x]				spec. tech.	spec. tech.
U035 (Chlorambucil)[x]				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard			
		Concentration in Waste Extract (40 CFR 268.41)		Concentration in Waste (40 CFR 268.43)	
		Nonwastewater (mg/L)	Wastewater (mg/L)	Nonwastewater (mg/kg)	Wastewater (mg/L)
U036 (Chlordane (alpha and gamma))	Chlordane (alpha and gamma)			0.13	0.0033
U037 (Chlorobenzene)	Chlorobenzene			5.7	0.057
U038 (Chlorobenzilate)[x]	Chlorobenzilate			spec. tech.	0.10
U039 (p-Chloro-m-cresol)	p-Chloro-m-cresol			14	0.018
U041 (1-Chloro-2,3-epoxypropane (epichlorohydrin))[x]				spec. tech.	spec. tech.
U042 (2-Chloroethyl vinyl[x]	2-Chloroethyl vinyl			spec. tech.	0.057
U043 (Vinyl chloride)	Vinyl chloride			33	0.27
U044 (Chloroform)	Chloroform			5.6	0.046
U045 (Chloromethane (methylchloride))	Chloromethane (methyl chloride)			33	0.19
U046 (Chloromethyl methyl ether)[x]				spec. tech.	spec. tech.
U047 (2-Chloronaphthalene)	2-Chloronaphthalene			5.6	0.055
U048 (2-Chlorophenol)	2-Chlorophenol			5.7	0.044
U049 (4-Chloro-o-toluidine hydrochloride)[x]				spec. tech.	spec. tech.
U050 (Chrysene)	Chrysene			8.2	0.059

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U051 (Creosote)	Naphthalene			1.5	0.031
	Pentachlorophenol			7.4	0.18
	Phenanthrene			1.5	0.031
	Pyrene			28	0.028
	Toluene			33	0.028
	Xylenes (total)				0.032
	Lead	0.51			0.037
U052 (Cresols (Cresylic acid))	o-Cresol			5.6	0.11
	Cresols (m- and p- isomers)			3.2	0.77
U053 (Crotonaldehyde)				spec. tech.	spec. tech.
U055 (Cumene)				spec. tech.	spec. tech.
U056 (Cyclohexane)	Cyclohexane			spec. tech.	spec. tech.
U057 (Cyclohexanone)	Cyclohexanone			spec. tech.	0.36
U058 (Cyclophosphamide)[y]				spec. tech.	spec. tech.
U059 (Daunomycin)[x]				spec. tech.	spec. tech.
U060 (DDD)[x]	o,p'-DDD			0.087	0.023
	p,p'-DDD			0.087	0.023
U061 (DDT)[x]	o,p'-DDT			0.087	0.0039
	p,p'-DDT			0.087	0.0039
	o,p'-DDD			0.087	0.023
	p,p'-DDD			0.087	0.023
	o,p'-DDE			0.087	0.031
	p,p'-DDE			0.087	0.031
U062 (Diallate)[x]				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U063 (Dibenzo(a,h)anthracene)	Dibenzo(a,h)anthracene			8.2	0.055
U064 (1,2,7,8-Dibenzopyrene)				spec. tech.	spec. tech.
U066 (1,2-Dibromo-3-chloro-propane)	1,2-Dibromo-3-chloropropane			15	0.11
U067 (1,2-Dibromoethane (ethylenedibromide))	1,2-Dibromoethane (ethylenedibromide)			15	0.028
U068 (Dibromonethane)	Dibromonethane			15	0.11
U069 (Di-n-butyl phthalate)[k]	Di-n-butyl phthalate			28	0.54
U070 (o-Dichlorobenzene)	o-Dichlorobenzene			6.2	0.088
U071 (m-Dichlorobenzene)	m-Dichlorobenzene			6.2	0.036
U072 (p-Dichlorobenzene)	p-Dichlorobenzene			6.2	0.090
U073 (3,3'-Dichlorobenzidine)[x]				spec. tech.	spec. tech.
U074 (1,4-Dichloro-2-butene trans-1, 4-Dichloro-2-butene)[x]				spec. tech.	spec. tech.
U075 (Dichlorodifluoromethane)	Dichlorodifluoromethane			7.2	0.23
U076 (1,1-Dichloroethane)	1,1-Dichloroethane			7.2	0.059
U077 (1,2-Dichloroethane)	1,2-Dichloroethane			7.2	0.21
U078 (1,1-Dichloroethylene)	1,1-Dichloroethylene			33	0.025
U079 (1,2-Dichloroethylene)	trans-1,2-Dichloroethylene			33	0.054

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U080 (Methylene chloride)	Methylene chloride			33	0.089
U081 (2,4-Dichlorophenol)	2,4-Dichlorophenol			14	0.044
U082 (2,6-Dichlorophenol)	2,6-Dichlorophenol			14	0.044
U083 (1,2-Dichloropropane)	1,2-Dichloropropane			18	0.85
U084 (1,3-Dichloropropene)	cis-1,3-Dichloropropylene trans-1,3--Dichloropropylene			18 18	0.036 0.036
U085 (1,2,3,4-Diepoxybutane)				spec. tech.	spec. tech.
U086 (N,N-Diethylhydrazine)				spec. tech.	spec. tech.
U087 (O,O-diethyl-S-methyl-dithiophosphate)[x]				spec. tech.	spec. tech.
U088 (Diethyl phthalate)[k]	Diethyl phthalate			28	0.54
U089 (Diethyl stilbestrol)				spec. tech.	spec. tech.
U090 (Dihydrosafrole)				spec. tech.	spec. tech.
U091 (3,3'-Dimethoxybenzidine)[x]				spec. tech.	spec. tech.
U092 (Dimethylamine)[x]				spec. tech.	spec. tech.
U093 (p-Dimethylanimoazobenzene)[x]	p-Dimethylanimoazobenzene			spec. tech.	0.13
U094 (7,12-Dimethyl benz(a) anthracene)				spec. tech.	spec. tech.
U095 (3,3'-Dimethylbenzidine)[x]				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard			
		Concentration in Waste Extract (40 CFR 268.41)		Concentration in Waste (40 CFR 268.43)	
		Nonwastewater (mg/L)	Wastewater (mg/L)	Nonwastewater (mg/kg)	Wastewater (mg/L)
U096 (a,a-Dimethyl benzyl hydroperoxide)				spec. tech.	spec. tech.
U097 (Dimethylcarbomyl chloride)[x]				spec. tech.	spec. tech.
U098 (1,1-Dimethylhydrazine)				spec. tech.	spec. tech.
U099 (1,2-Dimethylhydrazine)				spec. tech.	spec. tech.
U101 (2,4-Dimethylphenol)	2,4-Dimethylphenol			14	0.036
U102 (Dimethyl phthalate)[k]	Dimethyl phthalate			28	0.54
U103 (Dimethyl sulfate)				spec. tech.	spec. tech.
U105 (2,4-Dinitrotoluene)	2,4-Dinitrotoluene			140	0.32
U106 (2,6-Dinitrotoluene)	2,6-Dinitrotoluene			28	0.55
U107 (Di-n-octyl phthalate)[k]	Di-n-octyl phthalate			28	0.54
U108 (1,4-Dioxane)	1,4-Dioxane			170	0.12
U109 (1,2-Diphenylhydrazine)				spec. tech.	spec. tech.
U110 (Dipropylamine)[x]				spec. tech.	spec. tech.
U111 (Di-n-propylnitrosoamine)	Di-n-propylnitrosoamine			14	0.40
U112 (Ethyl acetate)	Ethyl acetate			33	0.34
U113 (Ethyl acrylate)				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U114 (Ethylene bis-dithiocarbamic acid)[x]				spec. tech.	spec. tech.
U115 (Ethylene oxide)				spec. tech.	spec. tech.
U116 (Ethylene thiourea)[x]				spec. tech.	spec. tech.
U117 (Ethyl ether)	Ethyl ether			160	0.12
U118 (Ethyl methacrylate)	Ethyl methacrylate			160	0.14
U119 (Ethyl methane sulfonate)[x]				spec. tech.	spec. tech.
U120 (Fluoranthene)	Fluoranthene			8.2	0.068
U121 (Trichloromonofluoromethane)	Trichloromonofluoromethane			33	0.020
U122 (Formalaldehyde)				spec. tech.	spec. tech.
U123 (Formic acid)				spec. tech.	spec. tech.
U124 (Furan)				spec. tech.	spec. tech.
U125 (Furfural)				spec. tech.	spec. tech.
U126 (Glycidaldehyde)				spec. tech.	spec. tech.
U127 (Hexachlorobenzene)	Hexachlorobenzene			37	0.055
U128 (Hexachlorobutadiene)	Hexachlorobutadiene			28	0.055
U129 (Lindane)	alpha-BHC			0.066	0.00014
	beta-BHC			0.066	0.00014
	delta-BHC			0.066	0.023
	gamma-BHC (Lindane)			0.066	0.0017

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard			
		Concentration in Waste Extract (40 CFR 268.41)		Concentration in Waste (40 CFR 268.43)	
		Nonwastewater (mg/L)	Wastewater (mg/L)	Nonwastewater (mg/kg)	Wastewater (mg/L)
U130 (Hexachlorocyclopentadiene)[x]	Hexachlorocyclopentadiene			3.6	0.057
U131 (Hexachloroethane)	Hexachloroethane			28	0.055
U132 (Hexachlorophenene)[x]				spec. tech.	spec. tech.
U133 (Hydrazine)				spec. tech.	spec. tech.
U134 (Hydrogen fluoride)	Fluoride			spec. tech.	35
U135 (Hydrogen sulfide)				spec. tech.	spec. tech.
U136 (Cacodylic acid)[x]	Arsenic	5.6			0.79
U137 (Indeno(1,2,3-c,d)pyrene)	Indeno(1,2,3-c,d)pyrene			8.2	0.0055
U138 (Iodomethane)	Iodomethane			65	0.19
U140 (Isobutyl alcohol)	Isobutyl alcohol			170	5.6
U141 (Isosafrole)	Isosafrole			2.6	0.081
U142 (Kepone)	Kepone			0.13	0.0011
U143 (Lasiocarpine)[x]				spec. tech.	spec. tech.
U144 (Lead acetate)	Lead	0.51			0.040
U145 (Lead phosphate)	Lead	0.51			0.040
U146 (Lead subacetate)	Lead	0.51			0.040
U147 (Maleic anhydride)				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U148 (Maleic hydrazide)[x]				spec. tech.	spec. tech.
U149 (Malononitrile)[x]				spec. tech.	spec. tech.
U150 (Melphalan)[x]				spec. tech.	spec. tech.
U151 (Mercury)[r, y]	Mercury				0.030
	Mercury[q]	0.20			
	Mercury[s]	0.025			
	Mercury[z]			spec. tech.	
	Mercury: Elemental mercury contaminated with radioactive materials			spec. tech.	
U152 (Methacrylonitrile)	Methacrylonitrile			84	0.24
U153 (Methane thiol)[x]				spec. tech.	spec. tech.
U154 (Methanol)				spec. tech.	spec. tech.
U155 (Methapyrilene)	Methapyrilene			1.5	0.081
U156 (Methyl chlorocarbonate)[x]				spec. tech.	spec. tech.
U157 (3-Methylchloanthrene)	3-Methylcholanthrene			15	0.0055
U158 (4,4'-Methylenebis (2-chloroaniline)	4,4'-Methylenebis(2-chloroaniline)			35	0.50
U159 (Methyl ethyl ketone)	Methyl ethyl ketone			36	0.28
U160 (Methyl ethyl ketone peroxide)				spec. tech.	spec. tech.
U161 (Methyl isobutyl ketone)	Methyl isobutyl ketone			33	0.14
U162 (Methyl methacrylate)	Methyl methacrylate			160	0.14

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U163 (N-Methyl N'-nitro N-Nitrosoguanidine)[x]				spec. tech.	spec. tech.
U164 (Methylthiouracil)[x]				spec. tech.	spec. tech.
U165 (Naphthalene)	Naphthalene			3.1	0.059
U166 (1,4-Naphthoquinone)				spec. tech.	spec. tech.
U167 (1-Naphthlyamine)[x]				spec. tech.	spec. tech.
U168 (2-Naphthylamine)[x]	2-Naphthylamine			spec. tech.	0.52
U169 (Nitrobenzene)	Nitrobenzene			14	0.068
U170 (4-Nitrophenol)	4-Nitrophenol			29	0.12
U171 (2-Nitropropane)[x]				spec. tech.	spec. tech.
U172 (n-Nitrosodi-n-butylamine)	n-Nitrosodi-n-butylamine			17	0.40
U173 (N-Nitroso-di-n-ethanolamine)[x]				spec. tech.	spec. tech.
U174 (N-Nitrosodiethylamine)	n-Nitrosodiethylamine			28	0.40
U176 (N-Nitroso-N-ethylurea)[x]				spec. tech.	spec. tech.
U177 (N-Nitroso-N-methylurea)[x]				spec. tech.	spec. tech.
U178 (N-Nitroso-N-methylurethane)[x]				spec. tech.	spec. tech.
U179 (N-Nitrosopiperidine)	n-Nitrosopiperidine			35	0.013

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Regulatory Standard: Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
U180 (N-Nitrosopyrrolidine)	n-Nitrosopyrrolidine			35	0.013
U181 (5-Nitro-o-toluidine)	5-Nitro-o-toluidine			28	0.32
U182 (Paraldehyde)				spec. tech.	spec. tech.
U183 (Pentachlorobenzene)	Pentachlorobenzene			37	0.055
U184 (Pentachloroethane)[x]				spec. tech.	spec. tech.
U185 (Pentachloronitrobenzene)	Pentachloronitrobenzene			4.8	0.055
U186 (1,3-Pentadiene)				spec. tech.	spec. tech.
U187 (Phenacetin)	Phenacetin			16	0.081
U188 (Phenol)	Phenol			6.2	0.039
U189 (Phosphorus sulfide)				spec. tech.	spec. tech.
U190 (Phthalic anhydride)[k]	Phthalic anhydride			28	0.54
U191 (2-Picoline)[x]				spec. tech.	spec. tech.
U192 (Pronamide)	Pronamide			1.5	0.093
U193 (1,3-Propane sultone)[x]				spec. tech.	spec. tech.
U194 (n-Propylamine)[x]				spec. tech.	spec. tech.
U196 (Pyridine)	Pyridine			16	0.014
U197 (p-Benzoquinone)				spec. tech.	spec. tech.
U200 (Reserpine)[x]				spec. tech.	spec. tech.
U201 (Resorcinol)				spec. tech.	spec. tech.
U202 (Saccharin and salts)[x]				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard			
		Concentration in Waste Extract (40 CFR 268.41)		Concentration in Waste (40 CFR 268.43)	
		Nonwastewater (mg/L)	Wastewater (mg/L)	Nonwastewater (mg/kg)	Wastewater (mg/L)
U203 (Safrole)	Safrole			22	0.081
U204 (Selenium dioxide)	Selenium	5.7			1.0
U205 (Selenium sulfide)	Selenium	5.7			1.0
U206 (Streptozatocin)[x]				spec. tech.	spec. tech.
U207 (1,2,4,5-Tetrachlorobenzene)	1,2,4,5-Tetrachlorobenzene			19	0.055
U208 (1,1,1,2-Tetrachloroethane)	1,1,1,2-Tetrachloroethane			42	0.057
U209 (1,1,2,2-Tetrachloroethane)	1,1,2,2-Tetrachloroethane			42	0.057
U210 (Tetrachloroethylene)	Tetrachloroethylene			5.6	0.056
U211 (Carbon tetrachloride)	Carbon tetrachloride			5.6	0.057
U213 (Tetrahydrofuran)				spec. tech.	spec. tech.
U214 (Thallium(I)acetate)	Thallium			spec. tech.	0.14
U215 (Thallium(I)carbonate)	Thallium			spec. tech.	0.14
U216 (Thallium(I)chloride)	Thallium			spec. tech.	0.14
U217 (Thallium(I)nitrate)	Thallium			spec. tech.	0.14
U218 (Thioacetamide)[x]				spec. tech.	spec. tech.
U219 (Thiourea)[x]				spec. tech.	spec. tech.
U220 (Toluene)	Toluene			28	0.080
U221 (Toluenediamine)[k]				spec. tech.	spec. tech.
U222 (o-Toluidine hydrochloride)[x]				spec. tech.	spec. tech.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard			
		Concentration in Waste Extract (40 CFR 268.41)		Concentration in Waste (40 CFR 268.43)	
		Nonwastewater (mg/L)	Wastewater (mg/L)	Nonwastewater (mg/kg)	Wastewater (mg/L)
U223 (Toluene diisocyanate)[k]				spec. tech.	spec. tech.
U225 (Tribromomethane)	Tribromomethane (Bromoform)			15	0.63
U226 (1,1,1-Trichloroethane)	1,1,1-Trichloroethane			5.6	0.054
U227 (1,1,2-Trichloroethane)	1,1,2-Trichloroethane			5.6	0.054
U228 (Trichloroethylene)	Trichloroethylene			5.6	0.054
U234 (sym-Trinitrobenzene)[x]				spec. tech.	spec. tech.
U235 (tris-(2,3-dibromopropyl) phosphate)[k]	tris-(2,3-Dibromopropyl)phosphate			0.1	0.025
U236 (Trypan Blue)[x]				spec. tech.	spec. tech.
U237 (Uracil mustard)[x]				spec. tech.	spec. tech.
U238 (Ethyl carbamate)[x]				spec. tech.	spec. tech.
U239 (Xylenes)	Xylenes			28	0.32
U240 (2,4-Dichlorophenoxyacetic acid)[x]	2,4-Dichlorophenoxyacetic acid			10	0.72
U243 (Hexachloropropene)	Hexachloropropene			28	0.035
U244 (Thiram)[x]				spec. tech.	spec. tech.
U246 (Cyanogen bromide)				spec. tech.	spec. tech.
U247 (Methoxychlor)	Methoxychlor			0.18	0.25
U248 (Warfarin (≥3%))				spec. tech.	spec. tech.
U249 (Zinc Phosphide (<10%))				spec. tech.	spec. tech.
Mixed radioactive/hazardous wastes[v]				no land disp.	no land disp.

TABLE 3.10. (contd)

EPA Hazardous Waste Number (Name)[a]	Constituent[b]	Regulatory Standard: Concentration in Waste Extract (40 CFR 268.41) Nonwastewater (mg/L)	Concentration in Waste Extract (40 CFR 268.41) Wastewater (mg/L)	Concentration in Waste (40 CFR 268.43) Nonwastewater (mg/kg)	Concentration in Waste (40 CFR 268.43) Wastewater (mg/L)
Appendix IV and V Lab Packs (40 CFR 268)[i][aa]				spec. tech.	

spec. tech. = specified technology.
no land disp. = no land disposal.
tb = technology-based standard. Land disposal restrictions are based on BDAT.

(a) Refers to type of RCRA hazardous waste. Land disposal restrictions apply to wastes that meet the definition of the RCRA hazardous waste (refer to 40 CFR 261) and that have been placed in the ground.
(b) Constituents are listed only for those RCRA wastes that have concentration-level LDR treatment standards.
(c) This waste code exists in gaseous form and is not categorized as wastewater or nonwastewater forms.
(d) Effective date for inorganic solid debris is May 8, 1992.
(e) Effective date for nonwastewaters is May 8, 1992.
(f) This standard only applies to lead acid batteries that are identified as RCRA hazardous wastes and that are not excluded elsewhere from regulation under the land disposal restrictions of 40 CFR 268 or exempted under other EPA regulations (see 40 CFR 266 80).
(g) Applies to high mercury subcategory (greater than or equal to 260 mg/kg total mercury) contains mercury and organics (and are not incinerator residues).
(h) Applies to high mercury subcategory (greater than or equal to 260 mg/kg total mercury) in organics (including incinerator residues and residues from RMERC).
(i) Effective date for soil and debris is November 8, 1990.
(j) Applies to wastewaters from pharmaceutical industry only.
(k) Effective date for soil and debris is June 8, 1991.
(l) These waste codes are not subcategorized into wastewaters and nonwastewaters.
(m) Effective date for nonwastewater is November 8. 1990.
(n) Applies to low-zinc subcategory (less than 15 percent zinc). As of 8/8/90, high-zinc subcategory is prohibited from land disposal.
(o) Applies to solvent washes subcategory.
(p) Applies to low-arsenic subcategory (less than 1 percent arsenic).
(q) Applies to low-mercury subcategory (less than 260 mg/kg mercury) that are residues from RMERC.
(r) Effective date for high and low-mercury nonwastewater is May 8, 1992.
(s) Applies to low-mercury subcategory (less than 260 mg/kg mercury) that are not residues from RMERC.
(t) Applies to high mercury subcategory (greater than or equal to 260 mg/kg total mercury) either incinerator residues or residues from RMERC.
(u) Applies to all nonwastewaters that are not incinerator residues from RMERC, regardless of mercury content.
(v) Effective date is May 8, 1992.
(w) All nonwastewaters that are not incinerator residues and are not residues from RMERC, regardless of mercury content.
(x) Effective date for soil and debris is May 8, 1992.
(y) Effective date for soil and debris is June 8, 1992.
(z) Applies to high mercury subcategory (greater than or equal to 260 mg/kg total mercury).
(aa) Previously approved alternative treatment standard for land disposal.

TABLE 3.11. Land Disposal Restrictions for RCRA California List Wastes

	Constituent	Prohibition Level	Type of Restriction	Effective Date of Restriction
Liquid RCRA hazardous waste that contains free cyanides	Cyanides	1000 mg/L	hard-hammer restrictions	7/8/87(ns)
Liquid RCRA hazardous waste that contains metals	Arsenic Cadmium Chromium (VI) Lead Mercury Nickel Selenium Thallium	500 mg/L 100 mg/L 500 mg/L 500 mg/L 20 mg/L 134 mg/L 100 mg/L 130 mg/L	hard-hammer restrictions	7/8/87(ns)
Liquid RCRA hazardous waste that is a corrosive waste	pH	pH ≤ 2.0	prohibition level	7/8/87(tb)
Liquid RCRA hazardous waste that contains PCBs in concentration ≥ 50 ppm	PCB	50 ppm	99.9999% destruction by incineration	7/8/87(tb)
RCRA hazardous waste that contains halogenated organic compound (HOCs) in the following subcategories:				
Dilute wastewaters (<10,000 mg/kg)	HOC	1000 mg/kg	no land disposal (codified prohibition level)	7/8/87(tb)
Non-dilute wastewaters and non-liquids		1000 mg/kg	99.99% destruction by incineration	11/8/88(tb)
RCRA/CERCLA soil and debris		1000 mg/kg	99.99% destruction by incineration	11/8/90(tb)
Non-RCRA/CERCLA soil and debris		1000 mg/kg	99.99% destruction by incineration	11/8/90(tb)

health, and secondary standards regulate public welfare. The 1986 amendments mandate the creation of regulatory programs for filtering and disinfecting public water supplies.

On January 30, 1991 the Phase II regulations for 26 synthetic organic chemicals and 7 inorganic chemicals were printed in the Federal Register (56 FR 3526). On June 7, 1991 the national primary drinking water regulations for lead and copper were also printed int he Federal Register (56 FR 26480). Each of these printed texts contained errors which will be corrected by the EPA.

Changes have already been made in 40 CFR parts 141.86, 141.91 and 142.96 and are now effective. Changes in 40 CFR parts 141.80 to 141.85 will become effective on December 2, 1992 (57 FR 28785). On July 17, 1992, the EPA published its final standards for 23 organic and inorganic chemicals. These new standards will establish MCLGs (maximum contaminant level goals) for 18 SOCs (synthetic organic chemicals) and 5 IOCs (inorganic chemicals). The National Primary Drinking Water Regulations (NPDWRs) include monitoring, reporting, public notification requirements, and MCLs for these chemicals (57 FR 31776).

The SDWA is due for reauthorization, but there will be little action in 1992 on comprehensive legislation. EPA's drinking water programs can continue to operate without a reauthorization as long as Congress appropriates funding (ER 1992, 22 (39): 2195).

States may apply to EPA to be granted the primary enforcement responsibility for implementing EPA's regulations that protect drinking water sources. State programs must satisfy five statutory criteria to obtain this responsibility. These criteria include regulations that are no less stringent than EPA's national primary drinking water regulations, adequate provisions for the enforcement of the regulations, recording and reporting procedures that are needed to satisfy EPA regulations, variances and exemptions that are no less stringent than those allowed by SDWA, and plans for providing safe drinking water in emergency conditions. EPA retains the authority to oversee State programs and to take over enforcement if the States fail to do so (Wolf 1988).

3.7.1 40 CFR part 141 - National Primary Drinking Water Regulations Pursuant to Section 1412 of the Safe Drinking Water Act

Primary drinking water regulations consist of MCLGs and MCLs based on those goals, as defined below.

Definitions

Maximum Contaminant Level Goal. A MCLG is a level at which "no known or anticipated adverse effect on the health of persons occur and which allows an adequate margin of safety" [SDWA section 1412(b)(1)(B)]. MCLGs are risk-based standards that have only been determined for the contaminants specified in 40 CFR part 141 Subpart F (Table 3.17). MCLGs are nonenforceable health goals.

Maximum Contaminant Level. A MCL is a level set as close to a MCLG as is "feasible with the use of the best technologies, treatment techniques, and other means, which the Administrator finds are generally available (taking costs into consideration)" (SDWA section 1412). Factors include 1) the availability and performance of water treatment technologies; 2) other factors relative to technical feasibility, such as levels of reliable analytical detection; and 3) an assessment of the costs of the application of treatment technologies to achieve various concentrations (that would be as close to the MCLG as feasible). The value of the MCL is essentially established by the best generally available technology but is founded on a health-based goal. Thus, it is a combination of a risk-based and technology-based standard.

40 CFR part 141.11 - Maximum Contaminant Levels for Inorganic Chemicals (rb/tb)

MCLs for inorganic chemicals are given in Table 3.12.

40 CFR part 141.12 - Maximum Contaminant Levels for Organic Chemicals (rb/tb)

MCLs for organic chemicals are given in Table 3.13.

40 CFR part 141.13 - Maximum Contaminant Levels Turbidity (rb/tb)

MCLs for turbidity are given in Table 3.14.

TABLE 3.12. Maximum Contaminant Levels for Inorganic Chemicals

Contaminant	Level (mg/L)[a]
Arsenic	0.05
Antimony	0.006
Asbestos	7 million[b] fibers/liter
Barium	2(b)
Beryllium	0.004
Cadmium	0.005[b]
Chromium	0.1[b]
Cyanide	0.2
Fluoride	4.0
Lead	0.05
Mercury	0.002
Nickel	0.1
Nitrate (as N)	10
Nitrite	1(b)
Selenium	0.5(b)
Silver	0.05
Sulfate	Deferred
Thallium	0.002

(a) These levels, except those for nitrate, apply only to community water systems. The level for nitrate applies to both community and non-community water systems unless the State allows an exception for a non-community system based on several public health restrictions. With the permission of the State, the nitrate levels must not exceed 20 mg/L.
(b) MCLs are not effective until July 30, 1992 (56 FR 3526).

40 CFR part 141.14 - Maximum Microbiological Levels (rb/tb)

The MCLs for coliform bacteria apply to community and non-community water sources. They are based on the sampling and analytical method used.

Membrane Filter Technique

If the membrane filter technique is used, the coliform bacteria population shall not exceed any of the following limits:

- an arithmetic mean (of all samples per compliance period) of one per 100 ml, unless the State determines that for a variety of reasons one positive sample per month may be excluded from the

TABLE 3.13. Maximum Contaminant Levels for Organic Chemicals

Contaminant	Level (mg/L)[a]
Chlorinated hydrocarbons:	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
Chlorophenoxys:	
2,4-D	0.1
2,4,5-TP Silvex	0.01
Total Trihalomethanes (bromodichloromethane, dibromochloromethane, tribromomethane, and trichloromethane)	0.10
Volatile Organic Compounds:	
Dichloromethane	0.005
1,2,4-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005
Pesticides:	
Aldicarb	0.003
Aldicarb Sulfoxide	0.004
Aldicarb Sulfone	0.003
Dalapon	0.2
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Endrin	0.002
Glyphosate	0.7
Oxamyl (Vydate)	0.2
Picloram	0.5
Simazine	0.004
Other Organic Contaminants:	
Benzo(a)pyrene	0.0002
Di(2-ethylhexy)adipate	0.4
Di(2-ethylhexy)phthalate	0.006
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
2,3,7,8-TCDD (Dioxin)	3×10^{-8}

(a) The MCLs in this section apply to all community water systems. The MCL for total trihalomethanes is applicable only to community water systems that service 10,000 individuals or more and that add a disinfectant (oxidant) during any part of the drinking water treatment process.

TABLE 3.14. Maximum Contaminant Levels for Turbidity

Limit[a]	Measurement type
5 turbidity units	averaged for 2 consecutive days
1 turbidity unit	monthly average[b]

(a) Both community and non-community water systems that use surface water sources, in whole or in part, are regulated by these limits.
(b) Five or fewer units may be allowed by the State under certain circumstances.

calculation (this exception is at the primary agency's discretion and applies only to systems required to take 10 or fewer samples per month)

- 4 per 100 ml in more than one sample when less than 20 samples are taken
- 4 per 100 ml in more than 5% of the samples when 20 or more samples are taken per month.

Fermentation Tube Method

If the fermentation tube method is used, two different standards exist based on the volume of the sample. When 10-ml sample portions are used, coliform bacteria must not be found in:

- more than 10% of the portions in any one month, unless the State determines that following a series of checks, one positive sample may be excluded from the calculation (this exception is at the discretion of the State and only applies to those systems required to take 10 or fewer samples per month)
- 3 or more portions in more than one sample when less than 20 samples are collected per month
- 3 or more portions in more than 5% of the samples when the required number of samples is at least 20 per month.

100-ml Sample Portions

When 100-ml sample portions are used, coliform bacteria must not be found in:

- more than 60% of the portions in any month, unless the State determines that for a variety of reasons one positive sample may be excluded from the calculation (This exception is at the discretion

of the State and is only applicable to systems requiring 10 or fewer samples per month)

- 5 portions in more than one sample when less than 5 samples per month are required
- 5 portions in more than 20% of the samples when at least 5 samples are required per month.

For systems required to take less than 4 samples per month, compliance should be based on a three-month sampling period, except at the discretion of the State, which may maintain the one-month period.

40 CFR part 141.15 - Maximum Contaminant Levels for Radium-226, Radium-228, and Gross Alpha Particle Radioactivity in Community Water Systems (rb/tb)

- The MCL for combined radium-226 and radium-228 is 5 pCi/L.
- Gross alpha particle activity excluding radon and uranium but including radium 226 must not exceed 15 pCi/L.

40 CFR part 141.16 - Maximum Contaminant Levels for Beta Particle and Photon Radioactivity from Man-Made Radionuclides in Community Water Systems (rb/tb)

The annual average concentration in drinking water of beta particles and photon radioactivity from man-made radionuclides must not produce an annual dose equivalent greater than 4 mrem/year to the total body or any internal organ. For all radionuclides except those listed in Table 3.15, the concentration causing a 4-mrem dose equivalent is calculated based on a principle of a drinking water intake of 2 L/day and is calculated for the total body or any

TABLE 3.15. Average Annual Concentrations Assumed to Produce a Total Body or Organ Dose of 4 mrem/yr

Radionuclide	Critical Organ	pCi/L
Tritium	Total Body	20,000
Strontium-90	Bone Marrow	8

internal organ. If more than one radionuclide is present, the sum of the annual dose equivalents of all those present must not exceed 4 mrem/year.

40 CFR part 141 Subpart F - Recommended Maximum Contaminant Levels (RMCL) (rb) and 40 CFR part 141 Subpart G - National Revised Primary Drinking Water Regulations: Maximum Contaminant Levels (rb/tb)

MCLs and their respective MCLGs for organic and inorganic compounds are given in Table 3.16.

40 CFR part 141.52 - MCLGs for Microbiological Contaminants

MCLGs for microbiological contaminants are given in Table 3.17.

40 CFR part 141.63 - MCLs for Microbiological Contaminants

The MCLs for microbiological and biological contaminants are based on the presence or absence of total coliform bacteria in a sample rather than on the density of total coliform bacteria in a sample (Table 3.18).

In addition, the MCL for total coliform bacteria is violated when any fecal coliform or *E. coli* repeat sample or any total coliform repeat sample following a routine sample is positive.

40 CFR part 141 Subpart H - Filtration and Disinfection

Effective 12-31-90, this subpart established treatment techniques in lieu of maximum contaminant levels for

Giardia lamblia
viruses
heterotrophic plate count bacteria
Legionella
turbidity.

These technologies are required to protect against the potential adverse health effects of exposure to pathogenic organisms.

3.7.2 40 CFR part 143 - National Secondary Drinking Water Regulations Pursuant to Section 1412 of the Safe Drinking Water Act

Secondary drinking water standards given in Table 3.19 are intended to protect public welfare by regulating the aesthetic qualities of water in

TABLE 3.16. Maximum Contaminant Levels and Goals

Contaminant	MCL (mg/L) (rb/tb)	RMCL or MCL Goal (mg/L) (rb)
Organic Compounds:		
Benzene	0.005	0
Vinyl Chloride	0.002	0
Carbon tetrachloride	0.005	0
1,2-dichloroethane	0.005	0
Trichloroethylene	0.005	0
1,1-Dichloroethylene	0.007	0.007
1,1,1-Trichloroethane	0.20	0.20
para-Dichlorobenzene	0.075	0.075
Volatile Organic Compounds:		
Dichloromethane	0.005	0[a]
1,2,4-Trichlorobenzene	0.07	0.07[a]
1,1,2-Trichloroethane	0.005	0.003[a]
O-Dichlorobenzene	0.6	0.6
cis-1,2-Dichloroethylene	0.07	0.07
trans-1,2-Dichloroethylene	0.1	0.1
1,2-Dichloropropane	0.005	0
Ethylbenzene	0.7	0.7
Monochlorobenzene	0.1	0.1
Styrene	0.1	0.1
Tetrachloroethylene	0.005	0
Toluene	1	1
Xylenes (total)	10	10
Pesticides:		
Aldicarb	0.003	0.001[b]
Aldicarb Sulfoxide	0.004	0.001[b]
Aldicarb Sulfone	0.003	0.001[b]
Alachlor	0.002	0
Atrazine	0.003	0.003
Carbofuran	0.04	0.04
Chlordane	0.002	0
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0
2,4-D	0.071	0.07
Dalapon	0.2	0.2[a]
Dinoseb	0.007	0.007[a]
Diquat	0.02	0.02[a]
Endothall	0.1	0.1[a]
Endrin	0.002	0.002[a]
Ethylene dibromide (EDB)	0.00005	0
Glyphosate	0.7	0.7[a]
Heptachlor	0.0004	0
Heptachlor epoxide	0.0002	0

TABLE 3.16. (contd)

Contaminant	MCL (mg/L) (rb/tb)	RMCL or MCL Goal (mg/L) (rb)
Lindane	0.0002	0.0002
Methoxychlor	0.04	0.04
Oxamyl (Vydate)	0.2	0.2[a]
Pentachlorophenol	-	0.001[b]
Picloram	0.5	0.5[a]
Polychlorinated biphenyis (PCBs) (as decachlorobiphenyl)	0.0005	0
Simazine	0.004	0.004[a]
Toxaphene	0.003	0
2,4,5-TP (Silvex)	0.05	0.05
Other Organic Contaminants:		
Benzo(a)pyrene	0.0002	0[a]
Di(2-ethylhexy)adipate	0.4	0.4
Di(2-ethylhexy)phthalate	0.006	0[a]
Hexachlorobenzene	0.001	0[a]
Hexachlorocyclopentadiene	0.05	0.05[a]
2,3,7,8-TCDD (Dioxin)	3×10^{-8}	0[a]
Inorganic Compounds:		
Asbestos	7 mil fibers/L	7 mil fibers/L
Antimony	0.006	0.006[a]
Barium	2	2[b]
Beryllium	0.004	0.004[a]
Cadmium	0.005	0.005
Chromium	0.1	0.1
Copper	-	1.3
Cyanide	0.2	0.2[a]
Fluoride	4.0	4.0
Lead	0.05	0
Mercury	0.002	0.002
Nickel	0.1	0.1[a]
Nitrate	10	10
Nitrite	1	1
Total Nitrate and Nitrite	10	10
Selenium	0.05	0.05
Sulfate	Deferred	Deferred[a]
Thallium	0.0005	0.002[a]

(a) MCLGs not effective until January 17, 1994 (57 FR 31776).
(b) MCLGs not effective until January 1, 1993 (56 FR 30266).
(c) MCLs and MCLGs are not effective until July 30, 1992 (56 FR 3536).

TABLE 3.17. MCLGs for Microbiological Contaminants[a]

Contaminant	MCLG
Giardia lamblia	0
Viruses	0
Legionella	0
Total coliforms (including fecal coliforms and *Escherichia coli*	0

(a) Effective 12-31-90.

TABLE 3.18. MCLs for Microbiological Contaminants[a]

Number of Samples Collected Per Month	Maximum Positive Results for Compliance
≥40 samples	5.0% of samples
<40 samples	1 positive sample

(a) Effective 12-31-90.

TABLE 3.19. Secondary Drinking Water Standards

Contaminant	Level (welfare-based)
Aluminum	0.05 to 0.2 mg/L[a]
Chloride	250 mg/L
Color	15 color units
Copper	1 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor numbers
pH	6.5 - 8.5
Silver	0.1 mg/L[a]
Sulfate	250 mg/L
Total Dissolved Solids (TDS)	500 mg/L
Zinc	5 mg/L

(a) Secondary drinking water standards are not effective until July 30, 1992) (56 FR 3526).

community and non-community public systems. They are defined in terms of secondary maximum contaminant levels (SMCLs), which are the levels necessary to protect public welfare (welfare-based).

3.8 STANDARDS UNDER THE TOXIC SUBSTANCES CONTROL ACT

The Toxic Substances Control Act (TSCA) is intended to regulate chemical substances that present a hazard to human health or the environment. First enacted in 1976, TSCA greatly expanded Federal control of chemicals. The purpose of the Act is to control chemical hazardous at the source before they are released into society or the environment. The broad definition of a chemical substance means that the provisions for testing, premarket notification, and record keeping apply to pure chemical substances, impurities of materials, incidental reaction products, contaminants, co-products, and trace materials. Chemical mixtures are not included in the definition and are thus not subject to TSCA requirements.

TSCA preempts State laws in two specific cases. If EPA requires a chemical to be tested, states may not impose a similar testing requirement. Also, State laws are preempted when EPA has rules that involve the control of hazardous substances, except for disposal, or that affect manufacturers of hazardous substances. This preemption does not apply, however, when the State law is identical to EPA's, is promulgated under another Federal law, or prohibits the use of the substance in question in the State. EPA may exempt a state from Federal preemption if the State requirement provides a substantially higher degree of protection than the Federal requirement; does not place undue burden on interstate commerce; and does not cause the manufacturer, processor, distributor, or user of the chemical to violate Federal law (Wolf 1988).

On July 12, 1989, EPA issued a final rule under section 6 of TSCA which prohibited, at certain intervals, the future manufacture, importation, processing, and distribution in commerce of all asbestos-containing products, and required labeling of such products (15 USC 2605). On October 18, 1991,the

United States Court of Appeals for the Fifth Circuit in *Corrosion Proof Fittings vs. EPA, CA 5, No. 89-4596, 10/18/91*, vacated and remanded most of the rule (57 FR 11364).

Because TSCA achieves its objectives through testing, reporting, and record keeping requirements, the only regulation under TSCA that applies to DOE facilities deals specifically with PCBs.

3.8.1 Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions (40 CFR part 761)

Definitions

High-Concentration PCBs. PCBs that contain 500 ppm or greater PCBs, or those substances assumed to contain 500 ppm or greater PCBs in the absence of testing.

High-Contact Surface. A surface that is repeatedly touched, often for relatively long periods of time.

Impervious Solid Surfaces. Solid surfaces that are nonporous and thus are unlikely to absorb spilled PCBs within the short period of time required for cleanup of spills in this policy.

Low-Concentration PCBs. PCBs that are tested and found to contain less than 500 ppm PCBs, or those PCB-containing materials that EPA requires to be assumed to be at concentrations below 500 ppm (i.e., untested mineral oil dielectric fluid).

Nonimpervious Solid Surfaces. Solid surfaces that are porous and are more likely to absorb spilled PCBs prior to completion of the cleanup requirements prescribed in this policy.

PCB. Any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees, or any combination that contains such a substance.

Basis for Requirements

The manufacturing, processing, and distribution in commerce of PCBs at concentrations of 50 ppm or greater present an unreasonable risk of injury to

health. This finding is based on the well-documented human health and environmental hazard of PCB exposure, the high probability of human and environmental exposure to PCBs, the potential hazard of PCB exposure posed by the transportation of PCBs, and the evidence that contamination of the environment by PCBs has spread beyond the areas where they were used.

The cancer potency for PCBs has been estimated by EPA's Cancer Assessment Group and the Office of Toxic Substances. The estimate is based on dermal and inhalation exposure and on possible routes of exposure. "EPA has generally taken an environmentally conservative approach by establishing cleanup requirements based on risk and exposure considerations, and by excluding certain potentially higher-risk spill scenarios from the scope of the policy" (52 FR 10688).

Containment

With specific listed exceptions, no one may use any PCB in any concentration in other than a totally enclosed manner within the United States unless authorized by the EPA. The exceptions include items that are not included in the definitions of PCB products.

Concentrations Higher Than 50 ppm

PCBs at concentrations of 50 ppm or greater may be processed and distributed in commerce when in compliance with the requirements for disposal in 40 CFR part 761. PCBs at concentrations of 50 ppm or greater that were sold before July 1, 1979 (for purposes other than resale) may be distributed in commerce only in a totally enclosed manner after that date. Any materials contaminated with PCBs because of proximity to or spills from PCB items of a greater than 50 ppm concentration must be decontaminated in accordance with EPA spill cleanup policies before being used or distributed in commerce.

Concentrations Less Than 50 ppm

PCBs at concentrations of less than 50 ppm may be processed and distributed for purposes of disposal without restriction. They may also be exported for disposal.

Waste Oil

The use of waste oil that contains any detectable concentration of PCB as a sealant, coating, or dust control agent is prohibited.

Procedural Requirements

Procedural requirements are defined for storage, monitoring, labeling, and disposal. Operational and design specifications are listed for incinerators used for disposal of PCBs. Approval for the use of an incinerator is granted by the EPA.

Procedures are established for both liquid and non-liquid PCB wastes. Mass air emissions from an incinerator for disposal of non-liquid PCB wastes can be no greater than 0.001 g PCB/kg of the PCB introduced into the incinerator.

EPA will determine whether or not there is a need for a trial burn before the actual disposal burn.

Spills

Requirements for the cleanup of PCB spills vary, based on the size and type of spill. To clean up low-concentration spills involving less than 1 lb of PCBs by weight (less than 270 gal of untested mineral oil), solid surfaces must be double washed/rinsed. All indoor, residential surfaces other than vault areas must be cleaned to 10μg/100 cm^2 by standard commercial wipe tests. The cleanup of high-concentration spills and low-concentration spills that involve 1 lb or more PCBs by weight (270 gal or more of untested mineral oil), depends also on the location of the spill. Requirements for spills in outdoor electrical substations are given in Table 3.20. Table 3.21 gives cleanup standards for spills in restricted areas other than outdoor electrical substations. Spills in nonrestricted access areas are regulated by the limits given in Table 3.22.

3.9 STANDARDS UNDER THE OCCUPATIONAL SAFETY AND HEALTH ACT

The Occupational Safety and Health Act (OSHA) was passed by Congress in 1970. OSHA's specific goal is to maintain a safe and healthy environment

TABLE 3.20. Requirements for Decontaminating PCB Spills in Outdoor Electrical Substations

Medium	Surface	Maximum Concentration
Solid surfaces	Impervious and non-impervious	100 μg/100 cm^2
Soil		25 ppm PCBs by weight -or- 50 ppm PCB by weight with label or notice

TABLE 3.21. Requirements for Decontaminating PCB Spills in Other Restricted Access Areas Other Than Outdoor Electrical Substations

Medium	Surface	Maximum Concentration
Solid surfaces	High-contact	10 μg/100 cm^2
	Low-contact, indoor, impervious	10 μg/100 cm^2
	Low-contact, indoor, non-impervious	10 μg/100 cm^2 - or - 100 μg/100 cm^2 and encapsulated
	Low-contact, outdoor, impervious and non-impervious	100 μg/100 cm^2
Soil		25 ppm PCBs by weight

in the American workplace. Under the Act, the Occupational Safety and Health Administration was created within the Department of Labor. The National Institute of Occupational Safety and Health (NIOSH) was established by the Act as an agency of the Department of Health and Human Services (HHS). The purpose of NIOSH is to give technical assistance and to make recommendations on OSHA standards.

Two standing advisory committees were also formed to address special areas of concern to OSHA:

TABLE 3.22. Requirements for Decontaminating PCB Spills in Nonrestricted Access Areas

Medium	Surface	Maximum Concentration
Solid surfaces	Indoor & high-contact outdoor	10 μg/100 cm^2
	Indoor vault areas & low-contact, outdoor, impervious	10 μg/100 cm^2
	Low-contact, outdoor, nonimpervious	10 μg/100 cm^2 - or - 100 μg/100 cm^2 and encapsulated
Soil	Excavated to minimum depth of 10 in.	10 ppm PCBs by weight (clean soil replacement to contain >1 ppm PCBs)

- National Advisory Committee on Occupational Safety and Health (NACOSH) - makes recommendations and consults with the Secretary of HHS, and the Secretary of Labor on matters relating to the administration of the Act.

- Advisory Committee on Construction Safety and Health - advises the Secretary of Labor on formulation of construction safety and health standards and other regulations.

OSHA's regulations can be found in Title 29 of the CFR, parts 1900-1999.

When other Federal agencies adopt conflicting occupational safety and health regulations for the workplace, OSHA does not apply. Sections 3(5) and 4(b)(1) of the Act exclude Federal employees from the specific standards and protection of the Act. Although omitted from the general provisions of the Act, Section 19(a) of the OSHA places responsibility on the head of each Federal agency to "establish and maintain an effective and comprehensive occupational safety and health program which is consistent with standards promulgated under Section 6 of the Act..." This responsibility was further emphasized by Executive Order 12196, Section 1-2, February 26, 1980. It requires agencies to implement workplace safety and health standards similar to those required by OSHA.

The Comprehensive Occupational Safety and Health Reform Act (H.R.3160 and S.1622) was submitted on August 1, 1991, to both the House of Representatives and the Senate. One key point of this legislation is to provide for comprehensive OSHA coverage to all Federal, State, and local employees, and employees working in Federal nuclear facilities under the jurisdiction of the DOE. The Senate Labor Committee referred the bill to the Department of Labor for comment on August 15, 1991; no response had been issued as of April 1, 1992.

Orders DOE 5480.4 and 5483.1A require DOE employees and DOE contractors at government-owned, contractor-operated (GOCO) facilities to comply with OSHA regulations. OSHA's Hazardous Waste Operations and Emergency Response Standard (29 CFR part 1910.120) addresses many specific training requirements for workers. On March 6, 1989, the Department of Labor through its Occupational Safety and Health Administration, published its Hazardous Waste Operations and Emergency Response final rule. The scope of the rule is very broad, covering four major areas/specific worker populations. These areas include (1) cleanup operations at uncontrolled hazardous waste disposal sites that have been identified for cleanup by an environmental health or governmental agency, (2) routine operations at hazardous waste treatment, storage and disposal facilities or those portions of any facility regulated by 40 CFR parts 264 and 265, (3) emergency response operations at sites where hazardous substances have been or may by released, and (4) corrective actions at RCRA sites. The OSHA regulations at 29 CFR part 1910.120 set forth standards that employers must meet for the protection of employees involved in hazardous waste operations.

3.9.1 29 CFR part 1910.120 -Hazardous Waste Operations and Emergency Response Sections 1910.120(e) and (p)

These sections establish training requirements for all employees who may be exposed to health or safety hazards while working at environmental restoration sites and RCRA treatment, storage, and disposal (TSD) facilities. DOE also has an obligation to ensure that all non-DOE employees/contractors who must enter a DOE environmental restoration site or RCRA TSD facility do so safely. OSHA regulations require that all new employees (those hired after

March 6, 1989, the effective date of the rule) receive the 24-hour initial training. However, section 1910.120(p)(7)(ii) states that employers who can demonstrate that existing employees have had the initial 24-hour training need not require the training again for those employees.

Section 1910.120(c)

This section requires that environmental restoration sites be characterized to identify potential hazards so that the appropriate training requirements can be determined. An occupational safety and health site evaluation should be performed at all environmental restoration sites, even if actual cleanup is not to begin for several years. Information from this evaluation should be used to determine appropriate site controls, personal protective equipment (PPE), and training requirements for site entry until cleanup work begins.

PPE should be selected based on a number of factors, such as types of site hazards, performance of PPE materials in providing a barrier to these hazards, work activities, task-specific site conditions, and route of potential exposure to hazards (inhalation, skin absorption, ingestion, and eye or skin contact). Appendix B of Section 1910.120 divides PPE into four categories based on the degree of protection:

Level	Protection Required
A	Respiratory protection, positive pressure self-contained breathing apparatus (SCBA), disposable protective suit
B	Respiratory protection, positive pressure SCBA respiratory protection, air purifying respirators
C	Respiratory protection, minimal protection (coverall, boots, safety glasses, etc.)

Site Work Zones

When cleanup operations begin, site work zones will be established based on information from the site evaluation. Site work zones usually include an exclusion zone, a contamination reduction zone, and a clean zone.

Exclusion Zone

An exclusion zone is defined as the contaminated or potentially contaminated area of the environmental restoration site into which entry and exit are regulated at an established check point and within which appropriate levels of protective gear are required. There is a potential for exposure to health and safety hazards in this zone. Exclusion zones may require PPE levels A,B,C, or D, depending on the types of hazards present.

Contamination Reduction Zone

The decontamination or contamination reduction zone is the area used to decontaminate the clothing and equipment used by employees and serves as a buffer to prevent contamination from entering the clean zone.

Clean Zone

The clean zone is an area used as the command center to direct operations at the site. This should also be used to show that "the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards," in accordance with Section 1910.120(a)(1).

An important part of training workers is to develop a written, site-specific safety and health plan. Refer to Table 3.23 for training requirements. The plan must be discussed in the training program and must include the following:

- task-specific analyses of safety and health risks
- training assignments for employees
- procedures for using PPE
- medical surveillance requirements
- procedures for air sampling and environmental monitoring
- control measures for eliminating or limiting employees' exposure
- decontamination procedures
- plan for responding to emergencies

TABLE 3.23. OSHA 1910.120 Hazardous Waste Operations Training Requirements (Source: DOE/EH-0227P, DOE 1991)

Operation/Personnel	Site Safety Briefing	24-Hr	40-Hr	8-Hr Supervisor	8-Hr Refresher[a]
Treatment/Storage/ Disposal (TSD) Facilities					
Worker	X	X			X
Supervisor	X	X			X
Non-Worker/ Visitor[b,c]	X				
Environmental Restoration Sites (ERS)					
Routine/Occasional Worker	X	X[d]	X		X
Routine/Occasional Worker (Clean Zone)	X				
On-Site Supervisor	X	X[e]	X	X	X
Non-Worker/Visitor[b,c]					
- Level A or B PPE	X		X		X
- Level C PPE	X	X			X
- Level D or No PPE	X				
Emergency Response[f]					

(a) Annual requirement;however, personnel not receiving refresher training within 3 years of initial training or last refresher course (at a minimum) should repeat the initial course.
(b) All visitors should be issued and instructed on the use of required personal protective equipment (PPE), receive a site-specific safety briefing, and be escorted by trained personnel.
(c) Non-workers are DOE employees and DOE contractors not directly involved with hazardous waste or other TSD/ERS operations (e.g., management, audit, and oversight personnel). Visitors include those covered and not covered by OSHA. Visitors not covered by OSHA who are gained an EH-1 waiver from training requirements should comply with footnote 2 requirements above.
(d) 24-hour training is adequate for these workers only for entry into areas where Level D PPE is sufficient. For routine workers, area must also have been monitored and fully characterized.
(e) Supervisors of ERS on-site workers who require only the 24-hour course need only take the 24-hour initial and 8-hour initial supervisor courses.
(f) Training requirements for emergency response programs are described in OSHA 29 CFR part 1910.120(p)(8) and (q).

- procedures for entering confined spaces
- spill-containment program

In addition to the components of the safety and health plan, training programs must thoroughly cover the following elements:

- names of personnel responsible for safety and health at the work site

- work practices that minimize risks form hazards
- safe use of engineering controls and equipment

Employers and their health and safety personnel should become thoroughly familiar with the specific requirements of this regulation. Workers have had the "right to know" about hazardous chemicals in their workplaces since 1983. Called the Hazard Communication Standard (HCS), it has proven to be a powerful standard for workers as long as employers comply. Initially, the standard applied only to manufacturing industries, but OSHA extended HCS to nonmanufacturing industries in August of 1987. The HCS requires all chemical manufacturers to develop Material Safety Data Sheets (MSDs) for all the hazardous chemicals they produce.

3.9.2 29 CFR part 1910.1000 - Air Contaminants -- Permissable Exposure Limits

These Permissable Exposure Limits protect workers against a variety of health effects which could cause serious material health impairment. The Permissable Exposure Limits were instituted by OSHA using the Recommended Exposure Limits developed by NIOSH and the Threshold Limit Values published by the American Conference of Governmental Industrial Hygienists. Refer to Appendix A for 29 CFR part 1910.1000 Tables Z-1 parts A & B, Z-2, and Z-3.

29 CFR part 1910 - Occupational Safety And Health Standards

Subpart A	General
Subpart B	Adoption and Extension of Established Federal Standards
Subpart C	General Safety and Health Provisions
Subpart D	Walking-Working Surfaces
Subpart E	Means of Egress
Subpart F	Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms
Subpart G	Occupational Health and Environmental Control
Subpart H	Hazardous Materials
Subpart I	Personal Protective Equipment

Subpart J	General Environmental Controls
Subpart K	Medical and First Aid
Subpart L	Fire Protection
Subpart M	Compressed Gas and Compressed Air Equipment
Subpart N	Materials Handling and Storage
Subpart O	Machinery and Machine Guarding
Subpart P	Hand and Portable Powered Tools and Other Hand-Held Equipment
Subpart Q	Welding, Cutting and Brazing
Subpart R	Special Industries
Subpart S	Electrical
Subpart T	Commercial Diving Operations
Subparts U-Y	Reserved

29 CFR part 1915 - Occupational Safety And Health Standards For Shipyard Employment

Subpart A	General Provisions
Subpart B	Explosive and Other Dangerous Atmospheres
Subpart C	Surface Preparation and Preservation
Subpart D	Welding, Cutting and Heating
Subpart E	Scaffolds, Ladders and Other Working Surfaces
Subpart F	General Working Conditions
Subpart G	Gear and Equipment for Rigging and Materials Handling
Subpart H	Tools and Related Equipment
Subpart I	Personal Protective Equipment
Subpart J	Ship's Machinery and Piping Systems
Subpart K	Portable, Unfired Pressure Vessels, Drums and Containers,

	Other Than Ship's Equipment
Subpart L	Electrical Machinery

29 CFR part 1918 - Safety And Health Regulations for Longshoring

Subpart A	General Provisions
Subpart B	Gangways and Gear Certification
Subpart C	Means of Access
Subpart D	Working Surfaces
Subpart E	Opening and Closing Hatches
Subpart F	Ship's Cargo Handling Gear
Subpart G	Cargo Handling Gear and Equipment Other Than Ship's Gear
Subpart H	Handling Cargo
Subpart I	General Working Conditions
Subpart J	Personal Protective Equipment

29 CFR part 1926 - Safety And Health Regulations For Construction

Subpart A	General
Subpart B	General Interpretations
Subpart C	General Safety and Health Provisions
Subpart D	Occupational Health and Environmental Controls
Subpart E	Personal Protective and Life Saving Equipment
Subpart F	Fire Protection and Prevention
Subpart G	Signs, Signals, and Barricades
Subpart H	Materials Handling, Storage, Use, and Disposal
Subpart I	Tools - Hand and Power
Subpart J	Welding and Cutting
Subpart K	Electrical
Subpart L	Scaffolding

Subpart M	Floor and Wall Openings
Subpart N	Cranes, Derricks, Hoists, Elevators, and Conveyors
Subpart O	Motor Vehicles, Mechanized Equipment, and Marine Operations
Subpart P	Excavations
Subpart Q	Concrete and Masonry Construction
Subpart R	Steel Erection
Subpart S	Underground Construction, Caissons, Cofferdams and Compressed Air
Subpart T	Demolition
Subpart U	Blasting and Use of Explosives
Subpart V	Power Transmission and Distribution
Subpart W	Rollover Protective Structures; Overhead Protection
Subpart X	Stairways and Ladders

29 CFR part 1928 - Occupational Safety And Health Standards For Agriculture

Subpart A	General
Subpart B	Applicability of Standards
Subpart C	Roll-Over Protective Standards
Subpart D	Safety for Agricultural Equipment
Subparts E-H	Reserved
Subpart I	General Environmental Controls

29 CFR part 1960 - Basic Program Elements For Federal Employee Occupational Safety and Health Programs and Related Matters

Subpart A	General
Subpart B	Administration
Subpart C	Standards
Subpart D	Inspection and Abatement

Subpart E	General Services Administration and Other Federal Agencies
Subpart F	Occupational Safety and Health Committees
Subpart G	Allegations of Reprisal
Subpart H	Training
Subpart I	Record keeping and Reporting Requirements
Subpart J	Evaluation of Federal Occupational Safety and Health Programs
Subpart K	Field Federal Safety and Health Councils

3.10 STANDARDS IN ORDERS DOE

DOE establishes its own standards and regulations to supplement those mandated by Federal statutes. In some cases, Orders DOE mandate that the agency should comply with Federal regulations that would otherwise not apply. In other cases, the orders clarify DOE's interpretation of how Federal regulations apply to DOE operations. Each Order DOE deals with a particular aspect of the Department's activities and operations.

This section discusses Orders DOE that apply to hazardous waste remediation, decontamination, and decommissioning activities. Radiation standards for exposed persons are summarized by type of radiation source, and each standard is cross-referenced with the applicable Order DOE. More detailed descriptions of the Orders DOE are then provided.

3.10.1 Summary of Orders DOE

Because the terminology used in the Orders DOE can be very specific, the following list of definitions is provided.

Definitions

Absorbed Dose. The energy imparted to matter by ionizing radiation per unit mass of irradiated material at a specific place in that material.

ALARA (as low as reasonably achievable). As defined for use in Order DOE 5400.5, ALARA is the process objective of attaining dose levels as far

below applicable limits as social, technical, economic, practical, and public policy considerations permit.

Annual Limit on Intake. The quantities of a single radionuclide which, if inhaled or ingested during one year, would irradiate a person to the limiting dose value for control of the workplace.

BAT (Best Available Technology). Selection from among alternative treatment technologies based on evaluation process including factors related to technology, economics, and public policy considerations. At a minimum, the evaluation should include age of equipment and facilities, process employed, engineering aspects of the application of various types of control techniques, process changes, cost of achieving effluent reduction, non-water quality environmental impact, safety considerations, and public policy considerations.

Derived Air Concentration (DAC). Quantity obtained by dividing the annual limit on intake for any given radionuclide by the volume of air breathed by an average worker during a working year.

Derived Concentration Guide (DCG). Concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure path, would result in an EDE of 100 mrem. DCGs are guides, not release limits; they are screening values for discharges under the BAT process and for making dose estimates.

Dose Equivalent (dose e.). The product of absorbed dose in a tissue times a quality factor. A dose absorbed in a tissue times a quality factor. Dose equivalent allows for the possibility of non-stochastic effects, those effects for which the severity of the effect varies with the dose and for which a threshold may exist.

Effective Dose Equivalent (EDE). The summation of the products of the dose equivalents received by specified organs or tissues of the body and a organ or tissue-specific weighting factor. EDE is a risk-equivalent value that can be used to estimate the health-effects risk of an exposed individual. This measure is based on the possibility of stochastic effects (a malignant or hereditary disease for which the probability of an effect occurring, rather than its severity, is the critical measure).

Quality Factor. Quality factors (Table 3.24) are used to calculate dose equivalents from absorbed doses.

Weighting Factor. For a particular tissue or organ, a weighting factor represents the fraction of the total health risk that results from uniform whole-body irradiation. Weighting factors are listed in Table 3.25.

Radiation exposure standards are found in Orders DOE 5480.11, 5400.5, and 5820.2A. A summary of these standards is provided in Table 3.26.

3.10.2 Order DOE 5400.1 - General Environmental Protection Program (November 9, 1988)

Purpose

To establish environmental protection program requirements, authorities, and responsibilities for DOE operations to assure compliance with applicable

TABLE 3.24. Quality Factors by Radiation Type (Order DOE 5480.11)

Radiation Type	Quality Factor
X-rays, gamma rays, positrons, and electrons (including tritium beta particles)	1
Neutrons, ≤10 keV	3
Neutrons, >10 keV	10
Protons and singly charged particles of unknown energy with rest mass > one atomic mass unit	10
Alpha particles and Multiple-charged particles (and particles of unknown charge) of unknown energy	20

Note: For neutrons of known energies, more detailed quality factors are given in Order DOE 5480.11.

TABLE 3.25. Weighting Factors for Tissues and Organs (Order DOE 5480.11)

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

(a) Includes the other five organs with the highest dose (e.g., liver, kidney, spleen, thymus, adrenal, pancreas, stomach, small intestine, or upper and lower large intestine, but excluding skin, lens of the eye, and extremities). The weighting factor for each of these other five organs is 0.06.

Federal, State and local environmental protection laws and regulations, Executive Orders, and internal DOE policies.

General Policy

Order DOE 5400.1 states the following regarding environmental protection: "It is DOE policy to conduct its operations in an environmentally safe and sound manner. Protection of the environment and the public are responsibilities of paramount importance and concern to DOE. All DOE activities should recognize and reflect this concern and public trust. To that end, DOE is firmly committed to ensuring incorporation of national environmental protection goals in the formulation and implementation of DOE programs. It has an equal commitment to advance the goals of restoring and enhancing environmental quality, and ensuring public health."

3.10.3 Order DOE 5400.5 - Radiation Protection of the Public and the Environment (to Change 1, June 5, 1990)

Purpose

To establish standards and requirements for operations of DOE and DOE contractors with respect to protection of members of the public and the environment against undue risk from radiation.

TABLE 3.26. Summary of Regulations in Orders DOE

Subject	Limit	Type	Basis	Order DOE
Occupational Workers				
Adult	5 rem	EDE	rb	5480.11
Adult (lens of the eye)	15 rem	dose e.	na	5480.11
Adult (any other organ, tissue or extremity)	50 rem	dose e.	na	5480.11
Planned Special Exposure	10 rem	EDE	rb	5480.11
Unborn Child	0.5 rem	tot. dose .e.	na	5480.11
Minors/Students	0.1 rem	EDE	rb	5480.11
Public Entering Controlled Area	0.1 rem 5 rem	EDE dose e.	rb na	5480.11 5480.11
Facility Design Limits:				
Continuously Occupied	0.5 mrem	objective		5480.11
Non-Continuously Occupied	1 rem 3 rem	objtv(EDE) objtv(dose e)	rb na	5480.11 5480.11
Facility Control Limits:	5 rem 50 rem	EDE dose e.	rb na	5480.11 5480.11
Emergency Limits:				
Exposures	10 rem	objective		5480.11
Volunteers	25 rem	objective		5480.11
Any Member	(Appendix B)	DACs		5480.11
Materials and Equipment	(Appendix C)		na	5480.11
Public Dose Limit				
Any Member	100 mrem	EDE	rb	5400.5

TABLE 3.26. (contd)

Subject	Limit	Type	Basis	Order DOE
Airborne Emissions				
Any Member	10 mrem	EDE	rb	5400.5
Disposal Facilities for Spent Nuclear Fuel, High-level, and Transuranic Wastes				
Any Member	25 mrem	dose e.	na	5400.5
	75 mrem	dose e.	na	5400.5
Drinking Water				
Any Member	4 mrem	EDE	rb	5400.5
Ra-226+ Ra-288	5E-9 μCi/ml	EDE	rb	5400.5
Gross α	1.5E-8 μCi/ml	EDE	rb	5400.5
Downstream Systems	40 CFR part 141	MCLs	rb/tb	5400.5
Low-Level Waste Disposal				
Any Member	25 mrem	EDE	rb	5820.2A
	40 CFR part 61			5820.2A
Inadvertent Intruder	100 mrem	EDE	rb	5820.2A
	500 mrem	EDE	rb	5820.2A
Discharges of Liquid Waste				
Surface H_2O w/annual avg conc rad > DCG		BAT	tb	5400.5
Waterways	5 pCi/g above background		na	5400.5
	50 pCi/g above background		na	5400.5
Native Aquatic Animal Organisms	1 rad	absorbed dose	na	5400.5
Sanitary Sewerage Monthly average > 5xDCG	(Appendix D)	BAT	tb	5400.5

TABLE 3.26. (contd)

Subject	Limit	Type	Basis	Order DOE
Release of Property				
Equipment, Materials, and Personal Property	(See Table 3.27)			5400.5
Remediated Properties	40 CFR part 192			5400.5
Residual Radioactivity				
Ra-226, Th-230, and Th-232	5 pCi/g 15 pCi/g	basic dose basic dose	na na	5400.5 5400.5
Airborne Radon:				
Annual Average Rn Decay	0.02 WL 0.03 WL	objective absolute	na na	5400.5 5400.5
Gamma Sources Inside Structures	20 μR/h above background	basic dose	na	5400.5
Air/water	100 mrem	EDE	rb	5400.5
Interim Storage Controls Rn-222	100 pCi/L	conc.	na	5400.5
	30 pCi/L	annual average concentration	na	5400.5
	3 pCi/L	annual average concentration	na	5400.5
Flux Rate	20 pCi/m^2-sec		na	5400.5
Long-Term Management Rn-222	20 pCi/m^2/s	annual average release rate	na	5400.5
Increases	0.5 pCi/L	annual average concentration	na	5400.5

DOE Public Dose Limit

The EDE for members of the public who are exposed to radiation sources as a result of routine DOE activities may not exceed 100 mrem (1 mSv) in a year.

DOE operators must report DOE-related EDE contributions of 10 mrem or more in a year.

DOE operators are required to make a reasonable effort to be aware of sources of radiation other than DOE man-made sources (excluding also medical sources, consumer products, residual fallout from past nuclear accidents and weapons test, and naturally occurring radiation sources) which, when combined with the DOE sources, have the potential to exceed contributions of 10 mrem (0.1 mSv) EDE in a year.

Operators must make a reasonable effort to limit the public's EDE from multiple radiation sources to 100 mrem or less in a year.

If avoidance of higher exposures is impracticable, the Operations Office of a facility may request specific authorization from EH-1 for a temporary public dose limit higher than 100 mrem (1 mSv), but the limit may not exceed 500 mrem (5 mSv) for the year. The International Commission on Radiological Protection (ICRP) recommends a principal stochastic dose limit of 100 mrem EDE in a year for exposures to the public, and a subsidiary dose limit of 500 mrem EDE in a year, for some years, if the dose averaged over a lifetime does not exceed the principal limit of 100 mrem EDE per year. Specific sources excepted above are also excepted here).

Airborne Emissions

The EDE for members of the public who are exposed to radioactive materials (including radon-220, radon-222, and their respective decay products) released to the atmosphere as a result of routine DOE activities may not exceed 10 mrem in a year.

The public dose limits above are established by EPA regulation 40 CFR part 61, Subpart H, under the Clear Air Act (CAA). Subpart Q and T of

40 CFR part 61 provide radon flux limits for DOE radium storage and disposal facilities and for DOE inactive uranium mill tailings sites regulated under 40 CFR part 192.

Sources from Management and Storage of Spent Nuclear Fuel, High-Level, and Transuranic Wastes at Disposal Facilities

Members of the public shall not be exposed to direct radiation or radioactive material released from DOE management and storage activities at a disposal facility for spent nuclear material or for high-level or TRU wastes that are not regulated by the NRC, which would cause them to receive an annual dose equivalent that exceeds 25 mrem to the whole body or a committed dose equivalent that exceeds 75 mrem to any organ.

DOE facilities are in some cases subject to the regulatory requirements of the NRC and the EPA: 10 CFR parts 60 and 72, 40 CFR parts 61, 191, and 192.

Drinking Water Pathway

Consistent with 40 CFR part 141, drinking water systems supplied by DOE shall not cause persons to receive an EDE greater than 4 mrem/yr. Combined radium-226 and radium-228 shall not exceed 5×10^{-9} μCi/ml and gross alpha activity (including radium-226, but excluding radon and uranium) shall not exceed 1.5×10^{-8} μCi/ml. This dose limit is the EDE for individuals whose exclusive source of drinking water contains radionuclides at a monthly average level of 4% of the DCG value.

DOE activities shall not cause other drinking water systems downstream of its effluent discharges to exceed the drinking water radiological limits in 40 CFR part 141.

The ALARA Process

A program for implementing the ALARA process must be developed. Contractors will be required to implement the ALARA process for all DOE activities and facilities that cause public doses.

DOE's primary public dose limit is based on consideration of potential risk or radiation-induced fatal cancers and serious genetic defects.

The ALARA process includes all factors related to societal, technological, economic, and other public policy considerations at a minimum; factors considered shall include:

- maximum dose to members of the public
- collective dose to the population
- alternative processes
- doses for each process alternative
- costs for each of the technological alternatives
- examination of the changes in cost among alternatives
- changes in societal impact associated with process alternatives.

Qualitative analyses are acceptable because quantifying of the parameters in a cost-benefit analysis is difficult. The bases for such judgments should be documented.

Management and Control of Radioactive Materials

The management and control radioactive materials differs with the type of material. Gasseous, liquid, and solid wastes are regulated under this part.

Discharges of Liquid Waste to Surface Waters. BAT is the prescribed level of treatment for discharges to surface waters that would otherwise contain at the point of discharge and prior to dilution, radioactive material at annual average concentrations greater than DCG value.

BAT is not required for discharges to surface waters that exhibit radionuclide concentrations below DCG levels. The cost consideration component of the BAT analysis precludes additional treatment in such cases. ALARA provisions are applicable.

Liquid waste that contains radioactive material in the form of settleable solids may be released to natural waterways if the concentration in the waste does not exceed 5 pCi/g above background level for α-emitting radionuclides or 50 pCi/g above background level of settleable solids for ß-gamma-emitting radionuclides.

The absorbed dose to native aquatic animal organisms must not exceed 1 rad/day from exposure to radioactive material discharged in liquid wastes to natural waterways.

Discharges of Liquid Waste to Aquifers and Phaseout of Soil Columns. The BAT selection process must be applied to those liquid waste streams that will continue to be discharged to soil columns. The use of soil columns to retain suspended or dissolved radionuclides from liquid waste streams must be discontinued at the earliest practicable time in favor of an acceptable alternative disposal means. New or increased discharges to active and virgin soil columns are prohibited.

To prevent further spread of previously deposited radionuclides, the discharge of liquids, even when uncontaminated, is prohibited.

Discharges of Liquid Waste to Sanitary Sewerage. If the averaged monthly concentration of radionuclides in liquid waste discharged into sanitary sewerage systems would otherwise be greater than five times the DCG values at the point of discharge, the BAT selection process must be implemented. If the sewerage system is owned by the Federal government the concentrations may be greater than those specified above, except for systems with drain fields. In such cases, ALARA process considerations are required, as is liquid waste treatment prior to discharge to surface water from such a sewerage system.

Release of Property. Real property is subject to the requirements of Section 120(h) of CERCLA and to any other applicable Federal, State, and local requirements. 40 CFR part 192 is applicable to properties remediated by DOE under Title I of the Uranium Mill Tailings Radiation Control Act.

Personal property may be released for unrestricted use if the contamination levels are within the limits in Table 3.27. The concentration limits in Table 3.27 also apply to the release of materials and equipment.

"No guidance is currently available for release of material that has been contaminated in depth such as activated material or smelted contaminated metals" (Order DOE 5400.5).

TABLE 3.27. Surface Contamination Guidelines (from Order DOE 5400.5)

Radionuclides[b]	Allowable Total Residual Surface Contamination (dpm/100 cm^2)[a]		
	Average[c,d]	Maximum[d,e]	Removable[d,f]
Transuranics, I-125, I-129, Ra-226, Ac-227, Ra-228, Th-228, Th-230, Pa-231.	Reserved	Reserved	Reserved
Th-Natural, Sr-90, I-126, I-131, I-133, Ra-223, Ra-224, U-232, Th-232.	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay product, alpha emitters.	5,000	15,000	1,000
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.[g]	5,000	15,000	1,000

(a) As used in this table, disintegrations per minute (dpm) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriated detector for background, efficiency, and geometric factors associated with the instrumentation.
(b) Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.
(c) Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of less surface area, the average should be derived for each such object.
(d) The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.
(e) The MCL applies to an area of not more than 100 cm^2.
(f) The amount of removable material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter of soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.
(g) This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

Guidelines for Residual Radioactive Material. Residual concentrations of Ra-226, Th-230, and Th-232 should be no more than 5 pCi/g averaged over the first 15 cm of soil below the surface and 15 pCi/g averaged over 15-cm-thick layers of soil more than 15 cm below the surface.

The objective of remedial action for airborne radon decay products shall be an annual average radon decay product concentration that does not exceed 0.02 working level (WL). (A WL is any combination of short-lived radon decay products in 1 L of air that will result in the emission of 1.3×10^5 MeV of potential alpha energy.) The concentration shall not exceed 0.03 WL in any case.

The average level of gamma radiation inside a structure to be released without restrictions shall not exceed the background level by more than 20 μR/h. External gamma radiation on open land must comply with the basic limit and the ALARA process.

Residual radionuclides in air and water shall be controlled to the same levels as the public dose limits and as required by applicable Federal and/or State laws.

Interim Storage. Control and stabilization features for interim storage facilities must be designed for an effective life of 50 years with a minimum life of at least 25 years. Controls must be designed so that Rn-222 concentrations will not exceed 100 pCi/L at any given point, an annual average concentration of 30 pCi/L over the facility site, or an annual average concentration of 3 pCi/L at or above any location outside the facility site. Flux rates from the storage of radon-producing wastes must not exceed 20 pCi/m^2-s (as required by 40 CFR part 61).

Concentrations of radionuclides in groundwater and quantities of residual radioactive material must not exceed applicable Federal or State standards.

Access controls must be designed to provide, to the extent reasonable, an effective life of at least 25 years as described in 40 CFR part 192.

Long Term Management. Control features for long-term management shall be designed to provide an effective life of 1000 years, with a minimum life of at least 200 years. Control features shall also be designed to limit Rn-222 emissions from wastes to less than an annual average release rate of 20 pCi/m^2/s and to prevent increases in annual average concentration outside the contaminated area by more than 0.5 pCi/L.

Groundwater shall be protected with applicable Federal and State standards.

Access controls should be designed such as those in 40 CFR part 192 and should be effective to the extent reasonable for at least 200 years.

3.10.4 Order DOE 5480.1B - Environment, Safety, and Health Program for Department of Energy Operations (to change 4, March 27, 1990)

Order DOE 5480.1B establishes the ES&H program for DOE operations, cancels Order DOE 5480.1A of 8-13-81, and redesignates the chapters of Order DOE 5480.1A to new order numbers.

Individual chapters of Order DOE 5480.1A remain in effect until new orders are finalized, even though the order itself has been cancelled.

3.10.5 Order DOE 5480.4 - Environmental Protection, Safety, and Health Protection Standards (to Change 1, May 16, 1990)

Purpose

This order specifies requirements for mandatory environmental protection, safety, and health (ES&H) standards that are applicable to all DOE and DOE contractor operations.

Employee Safety and Health

Order DOE 5480.4 and Order DOE 5483.1A are applicable to DOE contractor employee safety and health programs that are not subject to jurisdiction of the U.S. Department of Labor, Occupational Safety and Health Administration. (A list of contractors is maintained by the Office of Operational Safety, PE-24.) These orders require compliance with OSHA standards in the following regulations: 29 CFR part 1910, 29 CFR part 1915, 29 CFR part 1918, 29 CFR part 1926, 29 CFR part 1928. Those contractors not included on the listing of contractors maintained by the Office of Operational Safety are required to comply with 29 CFR part 1905. The Occupational Safety and Health Program for Federal employees is required to comply with 29 CFR part 1960.

Order DOE 5480.1A, Chapter III is applicable to programs that assure the safe packaging of fissile and other radioactive materials. This Order requires compliance with transportation and packaging standards, including DOT hazardous materials regulations, 49 CFR parts 100-199.

Regulations

Order DOE 5480.4 contains lists of standards that are mandatory for DOE, either as a result of non-DOE Federal or State ES&H statutes, or as a matter of DOE policy.

3.10.6 Order DOE 5480.11 - Radiation Protection for Occupational Workers (December 21, 1988)

General Policy

Order DOE 5480.11 gives occupational radiation protection standards for DOE and DOE contractors for internal and external exposure of operational workers, unborn children, minors and students; for planned special exposures; and for exposure of members of the public who enter a DOE-controlled area.

Adults

DOE policy is to maintain radiation exposures within limits of the Order and as far below these limits as is reasonably achievable.

The annual EDE from both internal and external sources received in any year must not exceed 5 rem to the whole body. The annual dose equivalent is not to exceed 15 rem to the lens of the eye, or 50 rem to any other organ, tissue (including skin), or extremity.

Unborn Children

The total dose equivalent to an unborn child must not exceed 0.5 rem.

Planned Special Exposure

A planned special exposure is not to exceed 2 times the annual EDE (5 rem) when added to annual occupational dose anticipated for the year. A planned special exposure requires approval.

Minors (including students)

Individuals under the age of 18 are not allowed in controlled areas where they would be exposed to more than 0.1 rem/yr from the sum of the committed EDEs from internal irradiation plus the annual EDEs from external irradiation.

Public Entering Controlled Area

The EDE from exposure during direct onsite access must not exceed 0.1 rem/yr from internal and external irradiation; the dose equivalent to any tissue (including skin and lens of eye) must not exceed 5 rem per year.

Derived Air Concentrations (DACs) - Appendix B to this report gives the limits for radiation exposures due to inhalation.

Concentrations of radionuclides in drinking water in controlled areas are regulated by standards in 40 CFR part 141.

Release of Materials and Equipment

Materials and equipment shall not be released if measurements or prior use suggest that contamination levels exceed the guides specified in Appendix C of this report.

Requirements in this order do not apply to induced radioactivity or D&D release limits.

Design Objectives

External Radiation. Exposure in continuously occupied areas must be ALARA and must not exceed 0.5 mrem/hr on average.

Exposure in non-continuously occupied areas must be ALARA and must not exceed 20% of the EDE of 5 rem/yr for the whole body or the dose equivalent of 15 rem/yr to individual organs and tissues.

Internal Radiation. Exposure due to inhalation is to be avoided under normal operating conditions to the extent reasonably achievable.

Emergency Conditions

The planned exposure objective is not to exceed 10 rem/yr for individuals in operations that are essential to reduce potential hazards, to protect health, or to prevent substantial loss of property. The official in charge may allow emergency exposures not to exceed 25 rem/yr for volunteers.

3.10.7 Order DOE 5820.2A - Radioactive Waste Management (September 26, 1988)

Purpose

Establishes policies, guidelines, and minimum requirements by which DOE manages its radioactive and mixed waste and contaminated facilities.

High-Level Waste

Designs for new storage and treatment facilities must meet the requirements of Order DOE 6430.1, applicable EH Orders, and 40 CFR part 264 (Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities).

Existing facilities must be reviewed based on the requirements of Order DOE 5481.1B

Design-specific standards exist for storage, transfer, and monitoring operations.

Singly-contained pipelines may be used routinely for liquid wastes that have a total radioactivity concentration of less than 0.05 Ci/gal; under certain conditions, these pipelines may be used on a temporary basis for higher activity waste.

Groundwater or vadose zone monitoring wells meeting RCRA requirements in accordance with 40 CFR part 264 shall be installed around clusters of liquid waste storage tanks.

Quality assurance activities shall be consistent with Order DOE 5700.6B. High-level waste operations shall comply with the applicable requirements of the American National Standards Institute/American Society of Mechanical Engineers Nuclear Quality Assurance-1 and other appropriate national consensus standards.

Transuranic Waste (TRU)

Without regard to source or form, TRU waste is waste that is contaminated with alpha-emitting radionuclides having half-lives exceeding 20 years and in concentrations exceeding 100 nCi/g at the time of assay. Heads of field elements can determine that other alpha-contaminated wastes, peculiar to a specific site, mush be managed as TRU waste. TRU waste must be stored

such that radiation exposures are maintained as low as reasonably achievable. While in storage, wastes must be monitored periodically to ensure that they are not releasing their radioactive and/or hazardous constituents.

Low-Level Waste

Disposal must "assure that external exposure to the waste and concentrations of radioactive material which may be released into surface water, ground water, soil, plants and animals results in an EDE that does not exceed 25 mrem/yr to any member of the public. Releases to the atmosphere shall meet the requirements of 40 CFR part 61. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."

Disposal must "assure that the committed EDEs received by individuals who inadvertently may intrude into the facility after the loss of active institutional control (100 years) will not exceed 100 mrem/yr for continuous exposure or 500 mrem for a single acute exposure."

Disposal must protect groundwater resources, consistent with Federal, State, and local requirements.

Liquid wastes must be converted to contain as little freestanding and noncorrosive liquid as is reasonably achievable. At no time can the liquid exceed 1% of the volume when the waste is in a disposal container or 0.5% of the volume of waste if processed to a stable form.

Waste in a gaseous form must be packaged at a pressure that will not exceed 1.5 atmospheres at 20°C. The environmental monitoring program must conform with Order DOE 5484.1.

By-Product Material and NORM

Disposal of wastes that contain by-product material and naturally occurring and accelerator-produced radioactive material in large volumes must be managed according to the requirements of 40 CFR part 192; small volumes may be managed as low-level waste.

3.11 EXECUTIVE ORDERS

52 FR 2822 - Radiation Protection Guidance to Federal Agencies for Occupational Exposure.

3.11.1 Presidential Guidance

This Presidential Guidance for workers is based on the ICRP risk-based system.

Occupational Exposure

Radiation doses received as a result of occupational exposure are not to exceed an EDE of 5 rems (0.05 Sv).

Internal Exposure

Special care should be given to controlling internal exposure. The anticipated committed EDE from internal exposure plus any annual EDE from external exposure should not exceed 5 rems (0.05 Sv) in adult workers. The anticipated committed dose equivalent to any organ or tissue should not exceed 50 rems (0.5 Sv). Committed EDE from internal sources is $H_{E,50} = \Sigma W_T H_{T,50}$. W_T is the weighting factor previously defined. The committed dose equivalent, $H_{T,50}$, is the sum of all dose equivalents to an organ or tissue T that may accumulate over an individual's anticipated remaining lifetime (assumed 50 years) from radionuclides taken into the body during one year.

Minors

Occupational dose equivalents to individuals under the age of 18 should not exceed one-tenth of the values defined here for adult workers.

Unborn Children

Doses to unborn children should not exceed 0.5 rem (0.005 Sv) during the entire gestation period.

ALARA

In all cases, occupational exposures should be maintained as low as reasonably achievable. Occupational exposure of workers should not be allowed unless an overall benefit is expected from the activity causing the exposure.

Basis

These limits utilize the concept of risk-based weighting of doses to different body parts. Thus, the standards are inherently risk-based.

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APPENDIX A

AIR CONTAMINANTS -- PERMISSIBLE EXPOSURE LIMITS

Title 29 Code of Federal Regulations Part 1910.1000

(as amended July 1, 1992)

APPENDIX A

1910.1000 AIR CONTAMINANTS

(as amended July 1, 1992)

An employee's exposure to any substance listed in Tables Z- 1-A, Z-2 or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section.

(a) Table Z-1-A -- (1) Substances in Transitional Limits Columns with limits preceded by "C" -- Ceiling Values. An employee's exposure to any substance in Table Z-1-A under the Transitional Limits columns, the exposure limit of which is preceded by a "C", shall at no time exceed the exposure limit given for that substance in Table Z-1-A under the Transitional Limits columns.

(2) Other Substances in Transitional Limits Columns -- 8- hour Time Weighted Average. An employee's exposure to any substance in Table Z-1-A under the Transitional Limits columns, the exposure limit of which is not preceded by a "C", shall not exceed the 8-hour Time Weighted Average given for that substance in Table Z-1-A under the Transitional Limits columns in any 8-hour work shift of a 40-hour work week.

(3) Final Rule Limits Columns. An employee's exposure to any substance listed in Table Z-1-A shall not exceed the Time Weighted Average (TWA), Short Term Exposure Limit (STEL) and Ceiling Limit specified for that substance in Table Z-1-A under the Revised Limits columns.

(4) Skin Designation. To prevent or reduce skin absorption, an employee's skin exposure to substances listed in Table Z-1-A with an "X" in one or both of the Skin Designation columns following the substance name shall be prevented or reduced to the extent necessary in the circumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or work practices.

(5) Definitions. The following definitions are applicable to the Final Rule Limits columns of Table Z-1-A:

(i) Time weighted average (TWA) is the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded.

(ii) Short term exposure limit (STEL) is the employee's 15-minute time weighted average exposure which shall not be exceeded at any time during a work day unless another time limit is specified in a parenthetical notation below the limit. If another time period is specified, the time weighted average exposure over that time period shall not be exceeded at any time during the working day.

(iii) Ceiling is the employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time over a working day.

(6) Additional Definition. The terms "substance", "air contaminant," and "material" are equivalent in meaning for 29 CFR 1910.1000.

(b) Table Z-2. Table Z-2 is applicable for the transitional period and to the extent set forth in paragraph (f) of this section.

(1) 8-hour time weighted averages. An employee's exposure to any material listed in table Z-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that material in Table Z-2.

(2) Acceptable ceiling concentrations. An employee's exposure to a material listed in Table Z-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration limit given for the material in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under "acceptable maximum peak above the ceiling concentration for an 8-hour shift".

(3) Example. During an 8-hour work shift, an employee may be exposed to a concentration of Substance A (with a 10 ppm TWA, 25 ppm ceiling and 50 ppm peak above 25 ppm (but never above 50 ppm) only for a maximum of 10 minutes.

Such exposure must be compensated for by exposures to concentrations less than 10 ppm so that the cumulative exposure for the entire 8-hour work shift does not exceed a weighted average of 10 ppm.

(c) Table Z-3. Table Z-3 is applicable for the transitional period and to the extent set forth in paragraph (f) of this section. An employee's exposure to any substance listed in Table Z-3 in any 8-hour work shift of a 40-hour work week shall not exceed the 8-hour time weighted average limit given for that material in the table.

(d) Computation formulae. The computation formula which shall apply to employee exposure to more than one substance for which 8-hour time weighted averages are listed in subpart Z of 29 CFR Part 1910 in order to determine whether an employee is exposed over the regulatory limit is as follows:

(1)(i) The cumulative exposure for an 8-hour work shift shall be computed as follows:

$$E = (C(a)T(a)+C(b)T(b)+ \ldots C(n)T(n)) \div 8$$

Where: E is the equivalent exposure for the working shift.

C is the concentration during any period of time T where the concentration remains constant.

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average specified in Subpart Z or 29 CFR Part 1910 for the material involved.

(ii) To illustrate the formula prescribed in paragraph (d)(1)(i) of this section, assume that Substance A has an 8- hour time weighted average limit of 100 ppm noted in Table Z- 1-A. Assume that an employee is subject to the following exposure:

Two hours exposure at 150 p/m

Two hours exposure at 75 p/m

Four hours exposure at 50 p/m

Substituting this information in the formula, we have

$$(2 \times 150 + 2 \times 75 + 4 \times 50) \div 8 = 81.25 \text{ p/m}$$

Since 81.25 ppm is less than 100 p.p.m, the 8-hour time weighted average limit, the exposure is acceptable.

(2)(i) In case of a mixture of air contaminants an employer shall compute the equivalent exposure as follows:

$$Em = (C(1) \div L(1) + C(2) \div L(2)) + \ldots (C(n)/L(n))$$

Where: E(m) is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that substance specified in Subpart Z of 29 CFR Part 1910.

The value of E(m) shall not exceed unity (1).

(ii) To illustrate the formula prescribed in paragraph (d)(2)(i) of this section, consider the following exposures:

Material	Actual Concentration 8-hour exposure (ppm)	8-hour TWA PEL (ppm)
B	500	1000
C	45	200
D	40	200

Substituting in the formula, we have:

$Em = 500 \div 1{,}000 + 45 \div 200 + 40 \div 200$

$Em = 0.500 + 0.225 + 0.200$

$Em = 0.925$

Since Em is less than unity (1), the exposure combination is within acceptable limits.

(e) To achieve compliance with paragraphs (a) through (d) of this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with ^U 1910.134.

(f) Effective dates, start-up dates and transitional provisions -- (1) Effective date. The effective date for the permissible exposure limits specified in the Final Rule Limits columns of Table Z-1-A is March 1, 1989.

(2) Start-up dates. (i) The permissible exposure limits specified in the Final Rule Limits columns of Table Z-1-A shall be achieved by any reasonable combination of engineering controls, work practices and personal protective equipment effective September 1, 1989, through December 30, 1992. (See Note at end of Table Z-1-A.).

(ii)(A) The permissible exposure limits specified in the Final Rule Limits columns of Table Z-1-A shall be achieved by the method of compliance specified in paragraph (e) of this section effective December 31, 1992, if by December 31, 1991 a final rule has been published in the Federal Register amending or determining not to amend paragraph (e) of this section.

(B) If no final rule has been published in the Federal Register by December 31, 1991, amending or determining not to amend paragraph (e) of this section, then the permissible limits specified in the Final Rule Limits columns of Table Z- 1-A shall be achieved by the methods of compliance specified by paragraph (e) of this section effective December 31, 1993, and paragraph (f)(2)(i) of this section shall remain in effect through December 30, 1993.

(iii) The skin designations in the Final Rule Limits columns become effective September 1, 1989. The skin designations in the Transitional Limits columns are in effect from March 1, 1989, through August 31, 1989.

(3) Transitional provisions. (i) The permissible exposure limits specified in the Transitional Limits columns of Table Z-1-A, Table Z-2 and Table Z-3 shall continue to be achieved by the methods of compliance specified in paragraph (e) of this section through December 30, 1992. If paragraph (f)(2)(ii)(B) of this section takes effect, this provision is extended through December 30, 1993. The permissible exposure limits specified in Tables Z-2 and Z-3 for substances mentioned in the Final Rule Limits column of Table Z-1-A only by cross reference to Table Z-2 or Z-3 shall remain in effect indefinitely and continue to be achieved by the methods of compliance specified in paragraph (e) of this section.

(ii) The permissible exposure limits specified in the Transitional Limits columns of Table Z-1-A, Z-2 and Z-3 shall be applicable to the extent cross referenced 29 CFR Parts 1915, 1917 and 1918.

(iii) If any new or amended provisions or new or revised limits for any substance or substances are either administratively stayed or judicially stayed or vacated, then the existing provisions or limits for those substances specified in the Transitional Limits columns of Table Z-1-A, Table Z-2 or Table Z-3 shall remain in effect until such stay is lifted, or indefinitely, if the limit is vacated.

(4) Enforcement of the limits are indefinitely stayed for: aluminum alkyls; ethylidene norbornene; hexafluoracetone; mercury (alkyl compounds); oxygen difluoride; phenylphosphine; and sulfur pentafluoride; until OSHA publishes in the Federal Register a notice that a sampling and analytical technique is available.

TABLE Z-1-A, part 1. Limits For Air Contaminants

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Acetaldehyde	75-07-0	200	360	-
Acetic acid	64-19-7	10	25	-
Acetic anhydride	108-24-7	5	20	-
Acetone[h]	67-64-1	1000	2400	-
Acetonitrile	75-05-8	40	70	-
2-Acetylaminofluorine; see 1910.1014	53-96-3			
Acetylene dichloride; see 1,2-Dichloroethylene				
Acetylene tetrabromide	79-27-6	1	14	-
Acetylsalicylic acid (Aspirin)	50-78-2	-	-	-
Acrolein	107-02-8	0.1	0.25	-
Acrylamide	79-06-1	-	0.3	X
Acrylic acid	79-10-7	-	-	-
Acrylonitrile; see 1910.1045	107-13-1			
Aldrin	309-00-2	-	0.25	X
Allyl alcohol	107-18-6	2	5	X
Allyl chloride	107-05-1	1	3	-
Allyl glycidyl ether (AGE)	106-92-3	(C)10	(C)45	-
Allyl propyl disulfide	2179-59-1	2	12	-
alpha-Alumina	1344-28-1			
Total dust		-	15	-
Respirable fraction		-	5	-
Aluminum (as Al)	7429-90-5			
Metal				
Total dust		-	15	-
Respirable fraction		-	5	-
Pyro powders		-	-	-
Welding fumes***		-	-	-
Soluble salts		-	-	-
Alkyls		-	-	-
4-Aminodiphenyl; see 1910.1011	92-67-1			
2-Aminoethanol; see Ethanolamine				

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
2-Aminopyridine	504-29-0	0.5	2	-
Amitrole	61-82-5	-	-	-
Ammonia	7664-41-7	50	35	-
Ammonium chloride fume	12125-02-9	-	-	-
Ammonium sulfamate	7773-06-0			
Total dust		-	15	-
Respirable fraction		-	5	-
n-Amyl acetate	628-63-7	100	525	-
sec-Amyl acetate	626-38-0	125	650	-
Aniline and homologs	62-53-3	5	19	X
Anisidine (o-,p-isomers)	29191-52-4	-	0.5	X
Antimony and compounds (as Sb)	7440-36-0	-	0.5	-
ANTU (alpha Naphthyl-thiourea)	86-88-4	-	0.3	-
Arsenic, organic compounds (as As)	7440-38-2	-	0.5	-
Arsenic, inorganic compounds (as As); see 1910.1018	7440-38-2			
Arsine	7784-42-1	0.05	0.2	-
Asbestos; see 1910.1001 & 1910.1101	Varies			
Atrazine	1912-24-9	-	-	-
Azinphos-methyl	86-50-0	-	0.2	X
Barium, soluble compounds (as Ba)	7440-39-3	-	0.5	-
Barium sulfate	7727-43-7			
Total dust		-	15	-
Respirable fraction		-	5	-
Benomyl	17804-35-2			
Total dust		-	15	-
Respirable fraction		-	5	-
Benzene; see 1910.1028	71-43-2	See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028[d]		

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Benzidine; see 1910.1010	92-87-5			
p-Benzoquinone; see Quinone				
Benzo(a)pyrene; see Coal tar pitch volatiles				
Benzoyl peroxide	94-36-0	-	5	-
Benzyl chloride	100-44-7	1	5	-
Beryllium and beryllium compounds (as Be)	7440-41-7	See Table Z-2		
Biphenyl; see Diphenyl				
Bismuth telluride, Undoped	1304-82-1			
Total dust		-	15	-
Respirable fraction		-	5	-
Bismuth telluride, Se-doped		-	-	-
Borates, tetra, sodium salts				
Anhydrous	1330-43-4	-	-	-
Decahydrate	1303-96-4	-	-	-
Pentahydrate	12179-04-3	-	-	-
Boron oxide	1303-86-2			
Total dust		-	15	-
Respirable fraction		-	-	-
Boron tribromide	10294-33-4	-	-	-
Boron trifluoride	7637-07-2	(C)1	(C)3	-
Bromacil	314-40-9	-	-	-
Bromine	7726-95-6	0.1	0.7	-
Bromine pentafluoride	7789-30-2	-	-	-
Bromoform	75-25-2	0.5	5	X
Butadiene (1,3-Butadiene)	106-99-0	1000	2200	-
Butane	106-97-8	-	-	-
Butanethiol; see Butyl mercaptan				
2-Butanone (Methyl ethyl ketone)	78-93-3	200	590	-
2-Butoxyethanol	111-76-2	50	240	X
n-Butyl-acetate	123-86-4	150	710	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
sec-Butyl acetate	105-46-4	200	950	-
tert-Butyl acetate	540-88-5	200	950	-
Butyl acrylate	141-32-2	-	-	-
n-Butyl alcohol	71-36-3	100	300	-
sec-Butyl alcohol	78-92-2	150	450	-
tert-Butyl alcohol	75-65-0	100	300	-
Butylamine	109-73-9	(C)5	(C)15	X
tert-Butyl chromate (as CrO(3))	1189-85-1	-	(C)0.1	X
n-Butyl glycidyl ether (BGE)	2426-08-6	50	270	-
n-Butyl lactate	138-22-7	-	-	-
Butyl mercaptan	109-79-5	10	35	-
o-sec-Butylphenol	89-72-5	-	-	-
p-tert-Butyltoluene	98-51-1	10	60	-
Cadmium fume (as Cd)	7440-43-9	See Table Z-2		
Cadmium dust (as Cd)	7440-43-9	See Table Z-2		
Calcium carbonate	1317-65-3			
Total dust		-	15	-
Respirable fraction		-	5	-
Calcium cyanamide	156-62-7	-	-	-
Calcium hydroxide[i]	1305-62-0	-	-	-
Calcium oxide[j]	1305-78-8	-	5	-
Calcium silicate	1344-95-2			
Total dust		-	15	-
Respirable fraction		-	5	-
Calcium sulfate	7778-18-9			
Total dust		-	15	-
Respirable fraction		-	5	-
Camphor, synthetic	76-22-2	-	2	-
Caprolactam	105-60-2			
Dust		-	-	-
Vapor		-	-	-
Captafol (Difolatan[R])	2425-06-1	-	-	-
Captan	133-06-2	-	-	-
Carbaryl (Sevin[R])	63-25-2	-	5	-
Carbofuran (Furadan[R])	1563-66-2	-	-	-
Carbon black	1333-86-4	-	3.5	-
Carbon dioxide	124-38-9	5000[e]	9000	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Carbon disulfide	75-15-0	See Table Z-2		
Carbon monoxide	630-08-0	50	55	-
Carbon tetrabromide	558-13-4	-	-	-
Carbon tetrachloride	56-23-5	See Table Z-2		
Carbonyl fluoride	353-50-4	-	-	-
Catechol (Pyrocatechol)	120-80-9	-	-	-
Cellulose	9004-34-6			
Total dust		-	15	-
Respirable fraction		-	5	-
Cesium hydroxide	21351-79-1	-	-	-
Chlordane	57-74-9	-	0.5	X
Chlorinated camphene	8001-35-2	-	0.5	X
Chlorinated diphenyl oxide	55720-99-5	-	0.5	-
Chlorine	7782-50-5	(C)1	(C)3	-
Chlorine dioxide	10049-04-4	0.1	0.3	-
Chlorine trifluoride	7790-91-2	(C)0.1	(C)0.4	-
Chloroacetaldehyde	107-20-0	(C)1	(C)3	-
a-Chloroacetophenone (Phenacyl chloride)	532-27-4	0.05	0.3	-
Chloroacetyl chloride	79-04-9	-	-	-
Chlorobenzene	108-90-7	75	350	-
o-Chlorobenzylidene malononitrile	2698-41-1	0.05	0.4	-
Chlorobromomethane	74-97-5	200	1050	-
2-Chloro-1,3-butadiene; see b-Chloroprene				
Chlorodifluoromethane	75-45-6	-	-	-
Chlorodiphenyl (42% Chlorine) (PCB)	53469-21-9	-	1	X
Chlorodiphenyl (54% Chlorine) (PCB)	11097-69-1	-	0.5	X
1-Chloro,2,3-epoxypropane; see Epichlorohydrin				
2-Chloroethanol; see Ethylene chlorohydrin				
Chloroethylene; see Vinyl chloride				

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Chloroform (Trichloromethane)	67-66-3	(C)50	(C)240	-
bis(Chloromethyl) ether; see 1910.1008	542-88-1			
Chloromethyl methyl ether; see 1910.1006	107-30-2			
1-Chloro-1-nitropropane	600-25-9	20	100	-
Chloropentafluoro-ethane	76-15-3	-	-	-
Chloropicrin	76-06-2	0.1	0.7	-
beta-Chloroprene	126-99-8	25	90	X
o-Chlorostyrene	2039-87-4	-	-	-
o-Chlorotoluene	95-49-8	-	-	-
2-Chloro-6-trichloro-methyl pyridine	1929-82-4			
Total dust		-	15	-
Respirable fraction		-	5	-
Chlorpyrifos	2921-88-2	-	-	-
Chromic acid and chromates (as CrO(3))	Varies with compound	See Table Z-2		
Chromium (II) compounds (as Cr)	7440-47-3	-	0.5	-
Chromium (III) compounds (as Cr)	7440-47-3	-	0.5	-
Chromium metal (as Cr)	7440-47-3	-	1	-
Chrysene; see Coal tar pitch volatiles				
Clopidol	2971-90-6			
Total dust		-	15	-
Respirable fraction		-	5	-
Coal dust (less than 5% SiO(2)), Respirable quartz fraction	--	See Table Z-3		

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	mg/m[3][b]	Skin Designation
Coal dust (greater than or equal to 5% SiO(2)), Respirable fraction	--	See Table Z-3		
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene	65966-93-2	-	0.2	-
Cobalt metal, dust, and fume (as Co)	7440-48-4	-	0.1	-
Cobalt carbonyl (as Co)	10210-68-1	-	-	-
Cobalt hydrocarbonyl (as Co)	16842-03-8	-	-	-
Coke oven emissions; see 1910.1029	--			
Copper	7440-50-8			
Fume (as Cu)		-	0.1	-
Dusts and mists (as Cu)		-	1	-
Cotton dust (raw), This 8-hour TWA applies respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garreting. See also 1910.1043 for cotton dust limits alicable to other sectors.	--	-	1	
Crag herbicide (Sesone)	136-78-7			
Total dust		-	15	-
Respirable fraction		-	5	-
Cresol, all isomers	1319-77-3;	5	22	X
Crotonaldehyde	123-73-9; 4170-30-3	2	6	- -
Crufomate	299-86-5	-	-	-
Cumene	98-82-8	50	245	X
Cyanamide	420-04-2	-	-	-
Cyanides (as CN)	varies with compound	-	5	-
Cyanogen	460-19-5	-	-	-
Cyanogen chloride	506-77-4	-	-	-
Cyclohexane	110-82-7	300	1050	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Cyclohexanol	108-93-0	50	200	-
Cyclohexanone	108-94-1	50	200	-
Cyclohexene	110-83-8	300	1015	-
Cyclohexylamine	108-91-8	-	-	-
Cyclonite	121-82-4	-	-	-
Cyclopentadiene	542-92-7	75	200	-
Cyclopentane	287-92-3	-	-	-
Cyhexatin	13121-70-5	-	-	-
2,4-D (Dichlorylphenoxy-acetic acid)	94-75-7	-	10	-
Decaborane	17702-41-9	0.05	0.3	X
Demeton (Systox(R))	8065-48-3	-	0.1	X
Dichlorodiphenyltri-chloroethane (DDT)	50-29-3	-	1	X
Dichlorvos (DDVP)	62-73-7	-	1	X
Diacetone alcohol (4-Hydroxy-4-methyl-2-pentanone)	123-42-2	50	240	-
1,2-Diaminoethane; see Ethylenediamine				
Diazinon	333-41-5	-	-	-
Diazomethane	334-88-3	0.2	0.4	-
Diborane	19287-45-7	0.1	0.1	-
1,2-Dibromo-3-chloropropane; see 1910.1044	96-12-8			
2-N-Dibutylamino-ethanol	102-81-8	-	-	-
Dibutyl phosphate	107-66-4	1	5	-
Dibutyl phthalate	84-74-2	-	5	-
Dichloroacetylene	7572-29-4	-	-	-
o-Dichlorobenzene	95-50-1	(C)50	(C)300	-
p-Dichlorobenzene	106-46-7	75	450	-
3,3'-Dichlorobenzidine; see 1910.1007	91-94-1			
Dichlorodifluoro-methane	75-71-8	1000	4950	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
1,3-Dichloro-5,5-dimethyl hydantoin	118-52-5	-	0.2	-
1,1-Dichloroethane	75-34-3	100	400	-
1,2-Dichloroethylene	540-59-0	200	790	-
Dichloroethyl ether	111-44-4	(C)15	(C)90	X
Dichloromethane; see Methylene chloride				
Dichloromonofluoromethane	75-43-4	1000	4200	-
1,1-Dichloro-1-nitroethane	594-72-9	(C)10	(C)60	-
1,2-Dichloropropane; see Propylene dichloride				
1,3-Dichloropropene	542-75-6	-	-	-
2,2-Dichloropropionic acid	75-99-0	-	-	-
Dichlorotetrafluoroethane	76-14-2	1000	7000	-
Dicrotophos	141-66-2	-	-	-
Dicyclopentadiene	77-73-6	-	-	-
Dicyclopentadienyl iron	102-54-5			
Total dust		-	15	-
Respirable fraction		-	5	-
Dieldrin	60-57-1	-	0.25	X
Diethanolamine	111-42-2	-	-	-
Diethylamine	109-89-7	25	75	-
2-Diethylaminoethanol	100-37-8	10	50	X
Diethylene triamine	111-40-0	-	-	-
Diethyl ether; see Ethyl ether				
Diethyl ketone	96-22-0	-	-	-
Diethyl phthalate	84-66-2	-	-	-
Difluorodibromomethane	75-61-6	100	860	-
Diglycidyl ether (DGE)	2238-07-5	(C)0.5	(C)2.8	-
Dihydroxybenzene; see Hydroquinone				
Diisobutyl ketone	108-83-8	50	290	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Diisopropylamine	108-18-9	5	20	X
4-Dimethylaminoazobenzene; see 1910.1015	60-11-7			
Dimethoxymethane; see Methylal				
Dimethyl acetamide	127-19-5	10	35	X
Dimethylamine	124-40-3	10	18	-
Dimethylaminobenzene; see Xylidine				
Dimethylaniline (N-Dimethyl-aniline)	121-69-7	5	25	X
Dimethylbenzene; see Xylene				
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate	300-76-5	-	3	-
Dimethylformamide	68-12-2	10	30	X
2,6-Dimethyl-4-heptanone; see Diisobutyl ketone				
1,1-Dimethylhydrazine	57-14-7	0.5	1	X
Dimethylphthalate	131-11-3	-	5	-
Dimethyl sulfate	77-78-1	1	5	X
Dinitolmide (3,5-Dinitro-o-toluamide)	148-01-6	-	-	-
Dinitrobenzene (all isomers)	(alpha-)528-29-0 (meta-)99-65-0 (para-)100-25-4	-	1	X
Dinitro-o-cresol	534-52-1	-	0.2	X
Dinitrotoluene	25321-14-6	-	1.5	X
Dioxane (Diethylene dioxide)	123-91-1	100	360	X
Dioxathion (Delnav)	78-34-2	-	-	-
Diphenyl (Biphenyl)	92-52-4	0.2	1	-
Diphenylamine	122-39-4	-	-	-
Diphenylmethane diisocyanate; see Methylene bisphenyl isocyanate				
Dipropylene glycol methyl ether	34590-94-8	100	600	X
Dipropyl ketone	123-19-3	-	-	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Diquat	85-00-7	-	-	-
Di-sec octyl phthalate (Di-2-ethylhexyl-phthalate)	117-81-7	-	5	-
Disulfiram	97-77-8	-	-	-
Disulfoton	298-04-4	-	-	-
2,6-Di-tert-butyl-p-cresol	128-37-0	-	-	-
Diuron	330-54-1	-	-	-
Divinyl benzene	1321-74-0	-	-	-
Emery	112-62-9			
Total dust		-	15	-
Respirable fraction		-	5	-
Endosulfan	115-29-7	-	-	-
Endrin	72-20-8	-	0.1	X
Epichlorohydrin	106-89-8	5	19	X
EPN	2104-64-5	-	0.5	X
1,2-Epoxypropane; see Propylene oxide				
2,3-Epoxy-1-propanol; see Glycidol				
Ethanethiol; see Ethyl mercaptan				
Ethanolamine	141-43-5	3	6	-
Ethion	563-12-2	-	-	-
2-Ethoxyethanol	110-80-5	200	740	X
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	100	540	X
Ethyl acetate	141-78-6	400	1400	-
Ethyl acrylate	140-88-5	25	100	X
Ethyl alcohol (Ethanol)	64-17-5	1000	1900	-
Ethylamine	75-04-7	10	18	-
Ethyl amyl ketone (5-Methyl-3-heptanone)	541-85-5	25	130	-
Ethyl benzene	100-41-4	100	435	-
Ethyl bromide	74-96-4	200	890	-
Ethyl butyl ketone (3-Heptanone)	541-86-5	50	230	-
Ethyl chloride	75-00-3	1000	2600	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Ethyl ether	60-29-7	400	1200	-
Ethyl formate	109-94-4	100	300	-
Ethyl mercaptan	75-08-1	(C)10	(C)25	-
Ethyl silicate	78-10-4	100	850	-
Ethylene chlorohydrin	107-07-3	5	16	X
Ethylenediamine	107-15-3	10	25	-
Ethylene dibromide	106-93-4	See Table Z-2		
Ethylene dichloride	107-06-2	See Table Z-2		
Ethylene glycol	107-21-1	-	-	-
Ethylene glycol dinitrate[k]	628-96-6	(C)0.2	(C)1	X
Ethylene glycol methyl acetate; see Methyl cellosolve acetate				
Ethyleneimine; see 1910.1012	151-56-4			
Ethylene oxide; see 1910.1047	75-21-8			
Ethylidene chloride; see 1,1-Dichloroethane				
Ethylidene norbornene	16219-75-3	-	-	-
N-Ethylmorpholine	100-74-3	20	94	X
Fenamiphos	22224-92-6	-	-	-
Fensulfothion (Dasanit)	115-90-2	-	-	-
Fenthion	55-38-9	-	-	-
Ferbam Total dust	14484-64-1	-	15	-
Ferrovanadium dust	12604-58-9	-	1	-
Fluorides (as F)	Varies with compound		2.5	
Fluorine	7782-41-4	0.1		-
Fluorotrichloromethane (Trichlorofluoromethane)	75-69-4	1000	5600	-
Fonofos	944-22-9	-	-	-
Formaldahyde; see 1910.1048;	50-00-0	See Table Z-2 for operations or sectors excluded or for which limit(s) is(are) stayed.		

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Formamide	75-12-7	-	-	-
Formic acid	64-18-6	5	9	-
Furfural	98-01-1	5	20	X
Furfuryl alcohol	98-00-0	50	200	-
Gasoline	8006-61-9	-	-	-
Germanium tetra-hydride	7782-65-2	-	-	-
Glutaraldehyde	111-30-8	-	-	-
Glycerin (mist)	56-81-5			
Total dust		-	15	-
Respirable fraction		-	5	-
Glycidol	556-52-5	50	150	-
Glycol monoethyl ether; see 2-Ethoxyethanol				
Grain dust (oat, wheat, barley)	--	-	-	-
Graphite, natural respirable dust	7782-42-5	See Table Z-3		
Graphite, synthetic	--			
Total dust		-	15	-
Respirable fraction		-	5	-
Guthion[R]; see Azinphos methyl				
Gypsum	13397-24-5			
Total dust		-	15	-
Respirable fraction		-	5	-
Hafnium	7440-58-6	-	0.5	-
Heptachlor	76-44-8	-	0.5	X
Heptane (n-Heptane)	142-82-5	500	2000	-
Hexachlorobutadiene	87-68-3	-	-	-
Hexachlorocyclo-pentadiene	77-47-4	-	-	-
Hexachloroethane	67-72-1	1	10	X
Hexachloronaphthalene	1335-87-1	-	0.2	X
Hexafluoroacetone	684-16-2	-	-	-
n-Hexane	110-54-3	500	1800	-
Hexane isomers	Varies with compound	-	-	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
2-Hexanone (Methyl n-butyl ketone)	591-78-6	100	410	-
Hexone (Methyl isobutyl ketone)	108-10-1	100	410	-
sec-Hexyl acetate	108-84-9	50	300	-
Hexylene glycol	107-41-5	-	-	-
Hydrazine	302-01-2	1	1.3	X
Hydrogenated terphenyls	61788-32-7	-	-	-
Hydrogen bromide	10035-10-6	3	10	-
Hydrogen chloride	7647-01-0	(C)5	(C)7	-
Hydrogen cyanide	74-90-8	10	11	X
Hydrogen fluoride (as F)	7664-39-3	See Table Z-2		-
Hydrogen peroxide	7722-84-1	1	1.4	-
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2	-
Hydrogen sulfide	7783-06-4	See Table Z-2		-
Hydroquinone	123-31-9	-	2	-
2-Hydroxypropyl acrylate	999-61-1	-	-	-
Indene	95-13-6	-	-	-
Indium and compounds (as In)	7440-74-6	-	-	-
Iodine	7553-56-2	(C)0.1	(C)1	-
Iodoform	75-47-8	-	-	-
Iron oxide fume Total particulate	1309-37-1	-	10	-
Iron pentacarbonyl (as Fe)	13463-40-6	-	-	-
Iron salts (soluble) (as Fe)	Varies with compound	-	-	-
Isoamyl acetate	123-92-2	100	525	-
Isoamyl alcohol (primary and secondary)	123-51-3	100	360	-
Isobutyl acetate	110-19-0	150	700	-
Isobutyl alcohol	78-83-1	100	300	-
Isooctyl alcohol	26952-21-6	-	-	-
Isophorone	78-59-1	25	140	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Isophorone diisocyanate	4098-71-9	-	-	-
2-Isopropoxyethanol	109-59-1	-	-	-
Isopropyl acetate	108-21-4	250	950	-
Isopropyl alcohol	67-63-0	400	980	-
Isopropylamine	75-31-0	5	12	-
N-Isopropylaniline	768-52-5	-	-	-
Isopropyl ether	108-20-3	500	2100	-
Isopropyl glycidyl ether (IGE)	4016-14-2	50	240	-
Kaolin	--			
Total dust		-	15	-
Respirable fraction		-	5	-
Ketene	463-51-4	0.5	0.9	-
Lead inorganic (as Pb); see 1910.1025	7439-92-1			
Limestone	1317-65-3			
Total particulate		-	15	-
Respirable fraction		-	-	-
Lindane	58-89-9	-	0.5	X
Lithium hydride	7580-67-8	-	0.025	-
L.P.G. (Liquefied petroleum gas)	68476-85-7	1000	1800	-
Magnesite	546-93-0			
Total dust		-	15	-
Respirable fraction		-	5	-
Magnesium oxide fume	1309-48-4			
Total Particulate		-	15	-
Malathion	121-75-5			
Total dust		-	15	X
Maleic anhydride	108-31-6	0.25	1	
Manganese compounds (as Mn)	7439-96-5	-	(C)5	-
Manganese fume (as Mn)	7439-96-5	-	(C)5	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Manganese cyclopentadienyl tricarbonyl (as Mn)	12079-65-1	-	-	-
Manganese tetroxide (as Mn)	1317-35-7	-	-	-
Marble	1317-65-3			
Total dust		-	15	-
Respirable fraction		-	5	-
Mercury (aryl and inorganic)(as Hg)	7439-97-6	See Table Z-2		-
Mercury (organo) alkyl compounds (as Hg)	7439-97-6	See Table Z-2		-
Mercury (vapor) (as Hg)	7439-97-6	See Table Z-2		-
Mesityl oxide	141-79-7	25	100	-
Methacrylic acid	79-41-4	-	-	-
Methanethiol; see Methyl mercaptan				
Methomyl (Lannate)	16752-77-5	-	-	-
Methoxychlor	72-43-5			
Total dust		-	15	-
2-Methoxyethanol; see Methyl cellosolve				
4-Methoxyphenol	150-76-5	-	-	-
Methyl acetate	79-20-9	200	610	-
Methyl acetylene (Propyne)	74-99-7	1000	1650	-
Methyl acetylene-propadiene mixture (MAPP)	--	1000	1800	-
Methyl acrylate	96-33-3	10	35	X
Methylacrylonitrile	126-98-7	-	-	-
Methylal (Dimethoxymethane)	109-87-5	1000	3100	-
Methyl alcohol	67-56-1	200	260	-
Methylamine	74-89-5	10	12	-
Methyl amyl alcohol; see Methyl isobutyl carbinol				
Methyl n-amyl ketone	110-43-0	100	465	-
Methyl bromide	74-83-9	(C)20	(C)80	X

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Methyl butyl ketone; see 2-Hexanone				
Methyl cellosolve (2-Methoxyethanol)	109-86-4	25	80	X
Methyl cellosolve acetate (2-Methoxyethyl acetate)	110-49-6	25	120	X
Methyl chloride	74-87-3	See Table Z-2		
Methyl chloroform (1,1,1-Trichloroethane)	71-55-6	350	1900	-
Methyl 2-cyanoacrylate	137-05-3	-	-	-
Methylcyclohexane	108-87-2	500	2000	-
Methylcyclohexanol	25639-42-3	100	470	-
o-Methylcyclohexanone	583-60-8	100	460	X
Methylcyclopentadienyl manganese tricarbonyl (as Mn)	12108-13-3	-	-	-
Methyl demeton	8022-00-2	-	-	-
4,4'-Methylene bis (2-chloroaniline) (MBOCA)	101-14-4	-	-	-
Methylene bis(4-cyclohexylisocyanate)	5124-30-1	-	-	-
Methylene chloride	75-09-2	See Table Z-2		
Methyl ethyl ketone (MEK); see 2-Butanone				
Methyl ethyl ketone peroxide (MEKP)	1338-23-4	-	-	-
Methyl formate	107-31-3	100	250	-
Methyl hydrazine (Monomethyl hydrazine)	60-34-4	(C)0.2	(C)0.35	X
Methyl iodide	74-88-4	5	28	X
Methyl isoamyl ketone	110-12-3	-	-	-
Methyl isobutyl carbinol	108-11-2	25	100	X
Methyl isobutyl ketone; see Hexone				
Methyl isocyanate	624-83-9	0.02	0.05	X
Methyl isopropyl ketone	563-80-4	-	-	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Methyl mercaptan	74-93-1	(C)10	(C)20	-
Methyl methacrylate	80-62-6	100	410	
Methyl parathion	298-00-0	-	-	-
Methyl propyl ketone; see 2-Pentanone				
Methyl silicate	681-84-5	-	-	-
alpha-Methyl styrene	98-83-9	(C)100	(C)480	-
Methylene bisphenyl isocyanate (MDI)	101-68-8	(C)0.02	(C)0.2	-
Metribuzin	21087-64-9	-	-	-
Mica; see Silicates				
Molybdenum (as Mo)	7439-98-7			
Soluble compounds		-	5	-
Insoluble compounds				
Total dust		-	15	-
Monocrotophos (Azodrin[R])	6923-22-4	-	-	-
Monomethyl aniline	100-61-8	2	9	X
Morpholine	110-91-8	20	70	X
Naphtha (Coal tar)	8030-30-6	100	400	-
Naphthalene	91-20-3	10	50	-
alpha-Naphthylamine; see 1910.1004	134-32-7			
beta-Naphthylamine; see 1910.1009	91-59-8			
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007	-
Nickel, metal and insoluble compounds (as Ni)	7440-02-0	-	1	-
Nickel, soluble compounds (as Ni)	7440-02-0	-	1	-
Nicotine	54-11-5	-	0.5	X
Nitric acid	7697-37-2	2	5	-
Nitric oxide	10102-43-9	25	30	-
p-Nitroaniline	100-01-6	1	6	X
Nitrobenzene	98-95-3	1	5	X

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
p-Nitrochloro-benzene	100-00-5	-	1	X
4-Nitrodiphenyl; see 1910.1003	92-93-3			
Nitroethane	79-24-3	100	310	-
Nitrogen dioxide	10102-44-0	(C)5	(C)9	-
Nitrogen trifluoride	7783-54-2	10	29	-
Nitroglycerin[l]	55-63-0	(C)0.2	(C)2	X
Nitromethane	75-52-5	100	250	-
1-Nitropropane	108-03-2	25	90	-
2-Nitropropane	79-46-9	25	90	-
N-Nitrosodimethylamine; see 1910.1016	62-79-9			
Nitrotoluene				
o-isomer	88-72-2;			
m-isomer	99-08-1;	5	30	X
p-isomer	99-99-0			
Nitrotrichloromethane; see Chloropicrin				
Nonane	111-84-2	-	-	-
Octachloro-naphthalene	2234-13-1	-	0.1	X
Octane	111-65-9	500	2350	-
Oil mist, mineral	8012-95-1	-	5	-
Osmium tetroxide (as Os)	20816-12-0	-	0.002	-
Oxalic acid	144-62-7	-	1	-
Oxygen difluoride	7783-41-7	0.05	0.1	-
Ozone	10028-15-6	0.1	0.2	-
Paraffin wax fume	8002-74-2	-	-	-
Paraquat, respirable dust	4685-14-7 1910-42-5 2074-50-2	-	0.5	X
Parathion	56-38-2	-	0.1	X
Particulates not otherwise regulated	--			
Total dust	--	-	15	-
Respirable fraction	--	-	5	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Pentaborane	19624-22-7	0.005	0.01	-
Pentachloronaphthalene	1321-64-8	-	0.5	X
Pentachlorophenol	87-86-5	-	0.5	X
Pentaerythritol	115-77-5			
Total dust		-	15	-
Respirable fraction		-	5	-
Pentane	109-66-0	1000	2950	-
2-Pentanone (Methyl propyl ketone)	107-87-9	200	700	-
Perchloroethylene (Tetrachloroethylene)	127-18-4	See Table Z-2		
Perchloromethyl mercaptan	594-42-3	0.1	0.8	-
Perchloryl fluoride	7616-94-6	3	13.5	-
Perlite	--			
Total dust		-	15	-
Respirable fraction		-	5	-
Petroleum distillates (Naphtha)		500	2000	-
Phenol	108-95-2	5	19	X
Phenothiazine	92-84-2	-	-	-
p-Phenylene diamine	106-50-3	-	0.1	X
Phenyl ether, vapor	101-84-8	1	7	-
Phenyl ether-biphenyl mixture, vapor	--	1	7	-
Phenylethylene; see Styrene				
Phenyl glycidyl ether (PGE)	122-60-1	10	60	-
Phenylhydrazine	100-63-0	5	22	X
Phenyl mercaptan	108-98-5	-	-	-
Phenylphosphine	638-21-1	-	-	-
Phorate	298-02-2	-	-	-
Phosdrin (Mevinphos[R])	7786-34-7	-	0.1	X
Phosgene (Carbonyl chloride)	75-44-5	0.1	0.4	-
Phosphine	7803-51-2	0.3	0.4	-
Phosphoric acid	7664-38-2	-	1	-
Phosphorus (yellow)	7723-14-0	-	0.1	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Phosphorus oxychloride	10025-87-3	-	-	-
Phosphorus pentachloride	10026-13-8	-	1	-
Phosphorus pentasulfide	1314-80-3	-	1	-
Phosphorus trichloride	7719-12-2	0.5	3	-
Phthalic anhydride	85-44-9	2	12	-
m-Phthalodinitrile	626-17-5	-	-	-
Picloram	1918-02-1			
Total dust		-	15	-
Respirable fraction		-	5	-
Picric acid	88-89-1	-	0.1	X
Piperazine dihydrochloride	142-64-3	-	-	-
Pindone (2-Pivalyl-1,3-indandione)	83-26-1	-	0.1	-
Plaster of Paris	26499-65-0			
Total dust		-	15	-
Respirable fraction		-	5	-
Platinum (as Pt)	7440-06-4			
Metal		-	-	-
Soluble salts		-	0.002	-
Portland cement	65997-15-1			
Total dust		See Table Z-3		
Respirable fraction		See Table Z-3		
Potassium hydroxide	1310-58-3	-	-	-
Propane	74-98-6	1000	1800	-
Propargyl alcohol	107-19-7	-	-	-
beta-Propriolactone; see 1910.1013	57-57-8			
Propionic acid	79-09-4	-	-	-
Propoxur (Baygon)	114-26-1	-	-	-
n-Propyl acetate	109-60-4	200	840	-
n-Propyl alcohol	71-23-8	200	500	-
n-Propyl nitrate	627-13-4	25	110	-
Propylene dichloride	78-87-5	75	350	-
Propylene glycol dinitrate	6423-43-4	-	-	-
Propylene glycol monomethyl ether	107-98-2	-	-	-
Propylene imine	75-55-8	2	5	X

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Propylene oxide	75-56-9	100	240	-
Propyne; see Methyl acetylene				
Pyrethrum	8003-34-7	-	5	-
Pyridine	110-86-1	5	15	-
Quinone	106-51-4	0.1	0.4	-
Resorcinol	108-46-3	-	-	-
Rhodium (as Rh), metal fume and insoluble compounds	7440-16-6	-	0.1	-
Rhodium (as Rh), soluble compounds	7440-16-6	-	0.001	-
Ronnel	299-84-3	-	15	-
Rosin core solder pyrolysis products, as formaldehyde	--	-	-	-
Rotenone	83-79-4	-	5	-
Rouge	--			
Total dust		-	15	-
Respirable fraction		-	5	-
Selenium compounds (as Se)	7782-49-2	-	0.2	-
Selenium hexafluoride (as Se)	7783-79-1	0.05	0.4	-
Silica, amorphous, precipitated and gel	112926-00-8	See Table Z-3		
Silica, amorphous, diatomaceous earth, containing less than 1% crystalline silica	61790-53-2	See Table Z-3		
Silica, crystalline cristobalite (as quartz), respirable dust	14464-46-1	See Table Z-3		
Silica, crystalline quartz (as quartz), respirable dust	14808-60-7	See Table Z-3		

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Silica, crystalline tripoli (as quartz), respirable dust	1317-95-9	See Table Z-3		
Silica, crystalline tridymite (as quartz), respirable dust	15468-32-3	See Table Z-3		
Silica, fused, respirable dust	60676-86-0	See Table Z-3		
Silicates (less than 1% crystalline silica)				
Mica (respirable dust)	12001-26-2	See Table Z-3		
Soapstone, total dust	--	See Table Z-3		
Soapstone, respirable dust	--	See Table Z-3		
Talc (containing asbestos): use asbestos limit	--	See Table Z-3		
Talc (containing no asbestos), respirable dust	14807-96-6	See Table Z-3		
Tremolite		See Table Z-3		
Silicon	7440-21-3			
Total dust		-	15	-
Respirable fraction		-	5	-
Silicon carbide	409-21-2			
Total dust		-	15	-
Respirable fraction		-	5	-
Silicon tetrahydride	7803-62-5	-	-	-
Silver, metal and soluble compounds (as Ag)	7440-22-4	-	0.01	-
Soapstone; see Silicates				
Sodium azide	26628-22-8			
(as HN(3))		-	-	-
(as NaN(3))		-	-	-
Sodium bisulfite	7631-90-5	-	-	-
Sodium fluoroacetate	62-74-8	-	0.05	X
Sodium hydroxide	1310-73-2	-	2	-
Sodium metabisulfite	7681-57-4	-	-	-
Starch	9005-25-8			
Total dust		-	15	-
Respirable fraction		-	5	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Stibine	7803-52-3	0.1	0.5	-
Stoddard solvent	8052-41-3	500	2900	-
Strychnine	57-24-9	-	0.15	-
Styrene	100-42-5	See Table Z-2		
Subtilisins (Proteolytic enzymes)	9014-01-1	-	-	-
Sucrose	57-50-1			
Total dust		-	15	-
Respirable fraction		-	5	-
Sulfur dioxide	7446-09-5	5	13	-
Sulfur hexafluoride	2551-62-4	1000	6000	-
Sulfuric acid	7664-93-9	-	1	-
Sulfur monochloride	10025-67-9	1	6	-
Sulfur pentafluoride	5714-22-7	0.025	0.25	-
Sulfur tetrafluoride	7783-60-0	-	-	-
Sulfuryl fluoride	2699-79-8	5	20	-
Sulprofos	35400-43-2	-	-	-
Systox[R], see Demeton				
2,4,5-T	93-76-5	-	10	-
Talc; see Silicates				
Tantalum, metal and oxide dust	7440-25-7	-	5	-
TEDP (Sulfotep)	3689-24-5	-	0.2	X
Tellurium and compounds (as Te)	13494-80-9	-	0.1	-
Tellurium hexafluoride (as Te)	7783-80-4	0.02	0.2	-
Temephos	3383-96-8			
Total dust		-	15	-
Respirable fraction		-	5	-
TEPP	107-49-3	-	0.05	X
Terphenyls	26140-60-3	(C)1	(C)9	-
1,1,1,2-Tetrachloro-2,2-difluoroethane	76-11-9	500	4170	-
1,1,2,2-Tetrachloro-1,2-difluoroethane	76-12-0	500	4170	-
1,1,2,2-Tetrachloroethane	79-34-5	5	35	X
Tetrachoroethylene; see Perchloroethylene				

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Tetrachloromethane; see Carbon tetrachloride				
Tetrachloronaphthalene	1335-88-2	-	2	X
Tetraethyl lead (as Pb)	78-00-2	-	0.075	X
Tetrahydrofuran	109-99-9	200	590	-
Tetramethyl lead, (as Pb)	75-74-1	-	0.075	X
Tetramethyl succinonitrile	3333-52-6	0.5	3	X
Tetranitromethane	509-14-8	1	8	-
Tetrasodium pyrophosphate	7722-88-5	-	-	-
Tetryl (2,4,6-Trinitrophenyl-methyl-nitramine)	479-45-8	-	1.5	X
Thallium, soluble compounds (as Tl)	7440-28-0	-	0.1	X
4,4'-Thiobis(6-tert, Butyl-m-cresol)	96-69-5			
Total dust		-	15	-
Respirable fraction		-	5	-
Thioglycolic acid	68-11-1	-	-	-
Thionyl chloride	7719-09-7	-	-	-
Thiram	137-26-8	-	5	-
Tin, inorganic compounds (except oxides) (as Sn)	7440-31-5	-	2	-
Tin, organic compounds (as Sn)	7440-31-5	-	0.1	-
Tin oxide (as Sn)	21651-19-4	-	-	-
Titanium dioxide	13463-67-7			
Total dust		-	15	-
Toluene	108-88-3	See Table Z-2		
Toluene-2,4-diisocyanate (TDI)	584-84-9	(C)0.02	(C)0.14	-
m-Toluidine	108-44-1	-	-	-
o-Toluidine	95-53-4	5	22	X
p-Toluidine	106-49-0	-	-	-
Toxaphene; see Chlorinated camphene				
Tremolite; see Silicates				
Tributyl phosphate	126-73-8	-	5	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Trichloroacetic acid	76-03-9	-	-	-
1,2,4-Trichlorobenzene	120-82-1	-	-	-
1,1,1-Trichloroethane; see Methyl chloroform				
1,1,2-Trichloroethane	79-00-5	10	45	X
Trichloroethylene	79-01-6	See Table Z-2		
Trichloromethane; see Chloroform				
Trichloronaphthalene	1321-65-9	-	5	X
1,2,3-Trichloropropane	96-18-4	50	300	-
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1000	7600	-
Triethylamine	121-44-8	25	100	-
Trifluorobromomethane	75-63-8	1000	6100	-
Trimellitic anhydride	552-30-7	-	-	-
Trimethylamine	75-50-3	-	-	-
Trimethyl benzene	25551-13-7	-	-	-
Trimethyl phosphite	121-45-9	-	-	-
2,4,6-Trinitrophenyl; see Picric acid				
2,4,6-Trinitrophenylmethyl nitramine; see Tetryl				
2,4,6-Trinitrotoluene (TNT)	118-96-7	-	1.5	X
Triorthocresyl phosphate	78-30-8	-	0.1	-
Triphenyl amine	603-34-9	-	-	-
Triphenyl phosphate	115-86-6	-	3	-
Tungsten (as W)	7440-33-7			
Insoluble compounds		-	-	-
Soluble compounds		-	-	-
Turpentine	8006-64-2	100	560	-
Uranium (as U)	7440-61-1			
Soluble compunds		-	0.05	-
Insoluble compounds		-	0.25	-

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
n-Valeraldehyde	110-62-3	-	-	-
Vanadium	1314-62-1			
Respirable dust (as V(2)O(5))		--	(C)0.5	-
Fume (as V(2)O(5))		--	(C)0.1	-
Vegetable oil mist	--			
Total dust		-	15	-
Respirable fraction		-	5	-
Vinyl acetate	108-05-4	-	-	-
Vinyl benzene; see Styrene				
Vinyl bromide	593-60-2	-	-	-
Vinyl chloride; see 1910.1017	75-01-4			
Vinylcyanide; see Acrylonitrile				
Vinyl cyclohexene dioxide	106-87-6	-	-	-
Vinylidene chloride (1,1-Dichloroethylene)	75-35-4	-	-	-
Vinyl toluene	25013-15-4	100	480	-
VM & P Naphtha	8032-32-4	-	-	-
Warfarin	81-81-2	-	0.1	-
Welding fumes (total particulate)***	--	-	-	-
Wood dust, all soft and hard woods, except Western red cedar	--	-	-	-
Wood dust, Western red cedar	--	-	-	-
Xylenes (o-, m-, p-isomers)	1330-20-7	100	435	-
m-Xylene alpha, alpha'-diamine	1477-55-0	-	-	-
Xylidine	1300-73-8	5	25	X

TABLE Z-1-A, part 1. (contd)

Substance	CAS No.[f]	Transitional Limits PEL* ppm[a]	Transitional Limits PEL* mg/m[3][b]	Skin Designation
Yttrium	7440-65-5	-	1	-
Zinc chloride fume	7646-85-7	-	1	-
Zinc chromate (as CrO(3))	Varies with Compound	See Table Z-2		
Zinc oxide fume	1314-13-2	-	5	-
Zinc oxide	1314-13-2			
Total dust		-	15	-
Respirable fraction		-	5	-
Zinc stearate	557-05-1			
Total dust		-	15	-
Respirable fraction		-	5	-
Zirconium compounds (as Zr)	7440-67-7	-	5	-

TABLE Z-1-A, part 2. Limits For Air Contaminants

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Acetaldehyde	100	180	150	270	-	-	-
Acetic acid	10	25	-	-	-	-	-
Acetic anhydride	-	-	-	-	5	20	-
Acetone[h]	750	1800	1000[h]	2400[h]	-	-	-
Acetonitrile	40	70	60	105	-	-	-
2-Acetylaminofluorine; see 1910.1014							
Acetylene dichloride; see 1,2-Dichloroethylene							
Acetylene tetrabromide	1	14	-	-	-	-	-
Acetylsalicylic acid (Aspirin)	-	5	-	-	-	-	-
Acrolein	0.1	0.25	0.3	0.8	-	-	-
Acrylamide	-	0.03	-	-	-	-	X
Acrylic acid	10	30	-	-	-	-	X
Acrylonitrile; see 1910.1045							
Aldrin	-	0.25	-	-	-	X	
Allyl alcohol	2	5	4	10	-	-	X
Allyl chloride	1	3	2	-	-	-	-
Allyl glycidyl ether (AGE)	5	22	10	44	-	-	-
Allyl propyl disulfide	2	12	3	18	-	-	-
alpha-Alumina							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Aluminum (as Al)							
Metal							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Pyro powders	-	5	-	-	-	-	-
Welding fumes***	-	5	-	-	-	-	-
Soluble salts	-	2	-	-	-	-	-
Alkyls	-	2	-	-	-	-	-
4-Aminodiphenyl; see 1910.1011							
2-Aminoethanol; see Ethanolamine							
2-Aminopyridine	0.5	2	-	-	-	-	-
Amitrole	-	0.2	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Ammonia	-	-	35	27	-	-	-
Ammonium chloride fume	-	10	-	20	-	-	-
Ammonium sulfamate							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
n-Amyl acetate	100	525	-	-	-	-	-
sec-Amyl acetate	125	650	-	-	-	-	-
Aniline and homologs	2	8	-	-	-	-	X
Anisidine (o-,p-isomers)	-	0.5	-	-	-	-	X
Antimony and compounds (as Sb)	-	0.5	-	-	-	-	-
ANTU (Alpha Naphthyl-thiourea)	-	0.3	-	-	-	-	-
Arsenic, organic compounds (as As)	-	0.5	-	-	-	-	-
Arsenic, inorganic compounds (as As); see 1910.1018							
Arsine	0.05	0.2	-	-	-	-	-
Asbestos; see 1910.1001 & 1910.1101							
Atrazine	-	5	-	-	-	-	-
Azinphos-methyl	-	0.2	-	-	-	-	X
Barium, soluble compounds (as Ba)	-	0.5	-	-	-	-	-
Barium sulfate							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Benomyl							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Benzene; see 1910.1028	See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028[d]						
Benzidine; see 1910.1010							
p-Benzoquinone; see Quinone							

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Benzo(a)pyrene; see Coal tar pitch volatiles							
Benzoyl peroxide	-	5	-	-	-	-	-
Benzyl chloride	1	5	-	-	-	-	-
Beryllium and beryllium compounds (as Be)	See Table Z-2					-	-
Biphenyl; see Diphenyl							
Bismuth telluride, Undoped							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Bismuth telluride, Se-doped	-	5	-	-	-	-	-
Borates, tetra, sodium salts							
Anhydrous	-	10	-	-	-	-	-
Decahydrate	-	10	-	-	-	-	-
Pentahydrate	-	10	-	-	-	-	-
Boron oxide							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	-	-	-	-	-	-
Boron tribromide	-	-	-	-	1	10	-
Boron trifluoride	-	-	-	-	1	3	-
Bromacil	1	10	-	-	-	-	-
Bromine	0.1	0.7	0.3	2	-	-	-
Bromine pentafluoride	0.1	0.7	-	-	-	-	-
Bromoform	0.5	5	-	-	-	-	X
Butadiene (1,3-Butadiene)	1000	2200					
Butane	800	1900	-	-	-	-	-
Butanethiol; see Butyl mercaptan							
2-Butanone (Methyl ethyl ketone)	200	590	300	885	-	-	-
2-Butoxyethanol	25	120	-	-	-	-	X
n-Butyl-acetate	150	710	200	950	-	-	-
sec-Butyl acetate	200	950	-	-	-	-	-
tert-Butyl acetate	200	950	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Butyl acrylate	10	55	-	-	-	-	-
n-Butyl alcohol	-	-	-	-	50	150	X
sec-Butyl alcohol	100	305	-	-	-	-	-
tert-Butyl alcohol	100	300	150	450	-	-	-
Butylamine	-	-	-	-	5	15	X
tert-Butyl chromate (as CrO(3))	-	-	-	-	-	0.1	X
n-Butyl glycidyl ether (BGE)	25	135	-	-	-	-	-
n-Butyl lactate	5	25	-	-	-	-	-
Butyl mercaptan	0.5	1.5	-	-	-	-	-
o-sec-Butylphenol	5	30	-	-	-	-	X
p-tert-Butyltoluene	10	60	20	120	-	-	-
Cadmium fume (as Cd)		0.1				0.3	
Cadmium dust (as Cd)		0.2				0.6	
Calcium carbonate							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Calcium cyanamide	-	0.5	-	-	-	-	-
Calcium hydroxide[i]	-	5[i]	-	-	-	-	-
Calcium oxide[j]	-	5[j]	-	-	-	-	-
Calcium silicate							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Calcium sulfate							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Camphor, synthetic	-	2	-	-	-	-	-
Caprolactam							
Dust	-	1	-	3	-	-	-
Vapor	5	20	10	40	-	-	-
Captafol (Difolatan[R])	-	0.1	-	-	-	-	-
Captan	-	5	-	-	-	-	-
Carbaryl (Sevin[R])	-	5	-	-	-	-	-
Carbofuran (Furadan[R])	-	0.1	-	-	-	-	-
Carbon black	-	3.5	-	-	-	-	-
Carbon dioxide	10,000	18,000	30,000	54,000	-	-	-
Carbon disulfide	4	12	12	36	-	-	X
Carbon monoxide	35	40	-	-	200	229	-
Carbon tetrabromide	0.1	1.4	0.3	4	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Carbon tetrachloride	2	12.6	-	-	-	-	-
Carbonyl fluoride	2	5	5	15	-	-	-
Catechol (Pyrocatechol)	5	20	-	-	-	-	X
Cellulose							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Cesium hydroxide	-	2	-	-	-	-	-
Chlordane	-	0.5	-	-	-	-	X
Chlorinated camphene	-	0.5	-	1	-	-	X
Chlorinated diphenyl oxide	-	0.5	-	-	-	-	-
Chlorine	0.5	1.5	1	3	-	-	-
Chlorine dioxide	0.1	0.3	0.3	0.9	-	-	-
Chlorine trifluoride	-	-	-	-	0.1	0.4	-
Chloroacetaldehyde	-	-	-	-	1	3	-
a-Chloroacetophenone (Phenacyl chloride)	0.05	0.3	-	-	-	-	-
Chloroacetyl chloride	0.05	0.2	-	-	-	-	-
Chlorobenzene	75	350	-	-	-	-	-
o-Chlorobenzylidene malononitrile	-	-	-	-	0.05	0.4	X
Chlorobromomethane	200	1050	-	-	-	-	-
2-Chloro-1,3-butadiene; see b-Chloroprene							
Chlorodifluoromethane	1000	3500	-	-	-	-	-
Chlorodiphenyl (42% Chlorine) (PCB)	-	1	-	-	-	-	X
Chlorodiphenyl (54% Chlorine) (PCB)	-	0.5	-	-	-	-	X
1-Chloro,2,3-epoxypropane; see Epichlorohydrin							
2-Chloroethanol; see Ethylene chlorohydrin							
Chloroethylene; see Vinyl chloride							
Chloroform (Trichloromethane)	2	9.78	-	-	-	-	-
bis(Chloromethyl) ether; see 1910.1008							

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Chloromethyl methyl ether; see 1910.1006							
1-Chloro-1-nitropropane	2	10	-	-	-	-	-
Chloropentafluoroethane	1000	6320	-	-	-	-	-
Chloropicrin	0.1	0.7	-	-	-	-	-
beta-Chloroprene	10	35	-	-	-	-	X
o-Chlorostyrene	50	285	75	428	-	-	-
o-Chlorotoluene	50	250	-	-	-	-	-
2-Chloro-6-trichloromethyl pyridine							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Chlorpyrifos	-	0.2	-	-	-	-	X
Chromic acid and chromates (as CrO(3))	-	-	-	-	-	0.1	-
Chromium (II) compounds (as Cr)	-	0.5	-	-	-	-	-
Chromium (III) compounds (as Cr)	-	0.5	-	-	-	-	-
Chromium metal (as Cr)	-	1	-	-	-	-	-
Chrysene; see Coal tar pitch volatiles							
Clopidol							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Coal dust (less than 5% SiO(2)), Respirable fraction		2	-	-	-	-	-
Coal dust (greater than or equal to 5% SiO(2)), Respirable quartz fraction		0.1	-	-	-	-	-
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene	-	0.2	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3] [b]	STEL[c] ppm[a]	STEL[c] mg/m[3] [b]	CEILING ppm[a]	CEILING mg/m[3] [b]	Skin Designation
Cobalt metal, dust, and fume (as Co)	-	0.05	-	-	-	-	-
Cobalt carbonyl (as Co)	-	0.1	-	-	-	-	-
Cobalt hydrocarbonyl (Co)	-	0.1	-	-	-	-	-
Coke oven emissions; see 1910.1029							
Copper							
Fume (as Cu)	-	0.1	-	-	-	-	-
Dusts and mists (as Cu)	-	1	-	-	-	-	-
Cotton dust (raw), This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garretting. See also 1910.1043 for cotton dust limits applicable to other sectors.	-	1	-	-	-	-	-
Crag herbicide (Sesone)							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Cresol, all isomers	5	22	-	-	-	-	X
Crotonaldehyde	2	6	-	-	-	-	-
Crufomate	-	5	-	-	-	-	-
Cumene	50	245	-	-	-	-	X
Cyanamide	-	2	-	-	-	-	-
Cyanides (as CN)	-	5	-	-	-	-	-
Cyanogen	10	20	-	-	-	-	-
Cyanogen chloride	-	-	-	-	0.3	0.6	-
Cyclohexane	300	1050	-	-	-	-	-
Cyclohexanol	50	200	-	-	-	-	X
Cyclohexanone	25	100	-	-	-	-	X
Cyclohexene	300	1015	-	-	-	-	-
Cyclohexylamine	10	40	-	-	-	-	-
Cyclonite	-	1.5	-	-	-	-	X
Cyclopentadiene	75	200	-	-	-	-	-
Cyclopentane	600	1720	-	-	-	-	-
Cyhexatin	-	5	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
2,4-D (Dichlorylphenoxy-acetic acid)	-	10	-	-	-	-	-
Decaborane	0.05	0.3	0.15	0.9	-	-	X
Demeton (Systox[R])	-	0.1	-	-	-	-	X
Dichlorodiphenyltrichloroethane (DDT)	-	1	-	-	-	-	X
Dichlorvos (DDVP)	-	1	-	-	-	-	X
Diacetone alcohol (4-Hydroxy-4-methyl-2-pentanone)	50	240	-	-	-	-	-
1,2-Diaminoethane; see Ethylenediamine							
Diazinon	-	0.1	-	-	-	-	X
Diazomethane	0.2	0.4	-	-	-	-	-
Diborane	0.1	0.1	-	-	-	-	-
1,2-Dibromo-3-chloropropane; see 1910.1044							
2-N-Dibutylamino-ethanol	2	14	-	-	-	-	-
Dibutyl phosphate	1	5	2	10	-	-	-
Dibutyl phthalate	-	5	-	-	-	-	-
Dichloroacetylene	-	-	-	-	0.1	0.4	-
o-Dichlorobenzene	-	-	-	-	50	300	-
p-Dichlorobenzene	75	450	110	675	-	-	-
3,3'-Dichlorobenzidine; see 1910.1007							
Dichlorodifluoro-methane	1000	4950	-	-	-	-	-
1,3-Dichloro-5,5-dimethyl hydantoin	-	0.2	-	0.4	-	-	-
1,1-Dichloroethane	100	400	-	-	-	-	-
1,2-Dichloroethylene	200	790	-	-	-	-	-
Dichloroethyl ether	5	30	10	60	-	-	X
Dichloromethane; see Methylene chloride							
Dichloromonofluoro-methane	10	40	-	-	-	-	-
1,1-Dichloro-1-nitro-ethane	2	10	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
1,2-Dichloropropane; see Propylene dichloride							
1,3-Dichloropropene	1	5	-	-	-	-	X
2,2-Dichloropropionic acid	1	6	-	-	-	-	-
Dichlorotetrafluoroethane	1000	7000	-	-	-	-	-
Dicrotophos	-	0.25	-	-	-	-	X
Dicyclopentadiene	5	30	-	-	-	-	-
Dicyclopentadienyl iron							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Dieldrin	-	0.25	-	-	-	-	X
Diethanolamine	3	15	-	-	-	-	-
Diethylamine	10	30	25	75	-	-	-
2-Diethylaminoethanol	10	50	-	-	-	-	X
Diethylene triamine	1	4	-	-	-	-	-
Diethyl ether; see Ethyl ether							
Diethyl ketone	200	705	-	-	-	-	-
Diethyl phthalate	-	5	-	-	-	-	-
Difluorodibromomethane	100	860	-	-	-	-	-
Diglycidyl ether (DGE)	0.1	0.5	-	-	-	-	-
Dihydroxybenzene; see Hydroquinone							
Diisobutyl ketone	25	150	-	-	-	-	-
Diisopropylamine	5	20	-	-	-	-	X
4-Dimethylaminoazobenzene; see 1910.1015							
Dimethoxymethane; see Methylal							
Dimethyl acetamide	10	35	-	-	-	-	X
Dimethylamine	10	18	-	-	-	-	-
Dimethylaminobenzene; see Xylidine							
Dimethylaniline (N-Dimethyl-aniline)	5	25	10	50	-		X

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Dimethylbenzene; see Xylene							
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate	-	3	-	-	-	-	X
Dimethylformamide	10	30	-	-	-	-	X
2,6-Dimethyl-4-heptanone; see Diisobutyl ketone							
1,1-Dimethylhydrazine	0.5	1	-	-	-	-	X
Dimethylphthalate	-	5	-	-	-	-	-
Dimethyl sulfate	0.1	0.5	-	-	-	-	X
Dinitolmide (3,5-Dinitro-o-toluamide)	-	5	-	-	-	-	-
Dinitrobenzene (all isomers)	-	1	-	-	-	-	X
Dinitro-o-cresol	-	0.2	-	-	-	-	X
Dinitrotoluene	-	1.5	-	-	-	-	X
Dioxane (Diethylene dioxide)	25	90	-	-	-	-	X
Dioxathion (Delnav)	-	0.2	-	-	-	-	X
Diphenyl (Biphenyl)	0.2	1	-	-	-	-	-
Diphenylamine	-	10	-	-	-	-	-
Diphenylmethane diisocyanate; see Methylene bisphenyl isocyanate							
Dipropylene glycol methyl ether	100	600	150	900	-	-	X
Dipropyl ketone	50	235	-	-	-	-	-
Diquat	-	0.5	-	-	-	-	-
Di-sec octyl phthalate (Di-2-ethylhexyl-phthalate)	-	5	-	10	-	-	-
Disulfiram	-	2	-	-	-	-	-
Disulfoton	-	0.1	-	-	-	-	X
2,6-Di-tert-butyl-p-cresol	-	10	-	-	-	-	-
Diuron	-	10	-	-	-	-	-
Divinyl benzene	10	50	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Emery							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Endosulfan	-	0.1	-	-	-	-	X
Endrin	-	0.1	-	-	-	-	X
Epichlorohydrin	2	8	-	-	-	-	X
EPN	-	0.5	-	-	-	-	X
1,2-Epoxypropane; see Propylene oxide							
2,3-Epoxy-1-propanol; see Glycidol							
Ethanethiol; see Ethyl mercaptan							
Ethanolamine	3	8	6	15	-	-	-
Ethion	-	0.4	-	-	-	-	X
2-Ethoxyethanol	200	740					X
2-Ethoxyethyl acetate (Cellosolve acetate)	100	540					X
Ethyl acetate	400	1400	-	-	-	-	-
Ethyl acrylate	5	20	25	100	-	-	X
Ethyl alcohol (Ethanol)	1000	1900	-	-	-	-	-
Ethylamine	10	18	-	-	-	-	-
Ethyl amyl ketone (5-Methyl-3-heptanone)	25	130	-	-	-	-	-
Ethyl benzene	100	435	125	545	-	-	-
Ethyl bromide	200	890	250	1110	-	-	-
Ethyl butyl ketone (3-Heptanone)	50	230	-	-	-	-	-
Ethyl chloride	1000	2600	-	-	-	-	-
Ethyl ether	400	1200	500	1500	-	-	-
Ethyl formate	100	300	-	-	-	-	-
Ethyl mercaptan	0.5	1	-	-	-	-	-
Ethyl silicate	10	85	-	-	-	-	-
Ethylene chlorohydrin	-	-	-	-	1	3	X
Ethylenediamine	10	25	-	-	-	-	-
Ethylene dibromide			See Table Z-2				
Ethylene dichloride	1	4	2	8	-	-	-
Ethylene glycol	-	-	-	-	50	125	-
Ethylene glycol dinitrate[k]	-	-	-	0.1[k]	-	-	X

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Ethylene glycol methyl acetate; see Methyl cellosolve acetate							
Ethyleneimine; see 1910.1012							
Ethylene oxide; see 1910.1047							
Ethylidene chloride; see 1,1-Dichloroethane							
Ethylidene norbornene	-	-	-	-	5	25	-
N-Ethylmorpholine	5	23	-	-	-	-	X
Fenamiphos	-	0.1	-	-	-	-	X
Fensulfothion (Dasanit)	-	0.1	-	-	-	-	-
Fenthion	-	0.2	-	-	-	-	X
Ferbam Total dust	-	10	-	-	-	-	-
Ferrovanadium dust	-	1	-	3	-	-	-
Fluorides (as F)	-	2.5	-	-	-	-	-
Fluorine	0.1	0.2	-	-	-	-	-
Fluorotrichloromethane (Trichlorofluoromethane)	-	-	-	-	1000	5600	-
Fonofos	-	0.1	-	-	-	-	X
Formaldehyde; see 1910.1048;	See Table Z-2 for operations or sectors excluded from 1910.1048 or for which limit(s) is (are) stayed.						
Formamide	20	30	30	45	-	-	-
Formic acid	5	9	-	-	-	-	-
Furfural	2	8	-	-	-	-	X
Furfuryl alcohol	10	40	15	60	-	-	X
Gasoline	300	900	500	1500	-	-	-
Germanium tetrahydride	0.2	0.6	-	-	-	-	-
Glutaraldehyde	-	-	-	-	0.2	0.8	
Glycerin (mist) Total dust	-	10	-	-	-	-	
Respirable fraction	-	5	-	-	-	-	

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Glycidol	25	75	-	-	-	-	-
Glycol monoethyl ether; see 2-Ethoxyethanol							
Grain dust (oat, wheat, barley)	-	10	-	-	-	-	-
Graphite, natural respirable dust	-	2.5	-	-	-	-	-
Graphite, synthetic							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Guthion[R]; see Azinphos methyl							
Gypsum							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Hafnium	-	0.5	-	-	-	-	-
Heptachlor	-	0.5	-	-	-	-	X
Heptane (n-Heptane)	400	1600	500	2000	-	-	-
Hexachlorobutadiene	0.02	0.24	-	-	-	-	-
Hexachlorocyclopentadiene	0.01	0.1	-	-	-	-	-
Hexachloroethane	1	10	-	-	-	-	X
Hexachloronaphthalene	-	0.2	-	-	-	-	X
Hexafluoroacetone	0.1	0.7	-	-	-	-	X
n-Hexane	50	180	-	-	-	-	-
Hexane isomers	500	1800	1000	3600	-	-	-
2-Hexanone (Methyl n-butyl ketone)	5	20	-	-	-	-	-
Hexone (Methyl isobutyl ketone)	50	205	75	300	-	-	-
sec-Hexyl acetate	50	300	-	-	-	-	-
Hexylene glycol	-	-	-	-	25	125	-
Hydrazine	0.1	0.1	-	-	-	-	X
Hydrogenated terphenyls	0.5	5	-	-	-	-	-
Hydrogen bromide	-	-	-	-	3	10	-
Hydrogen chloride	-	-	-	-	5	7	-
Hydrogen cyanide	-	-	4.7	5			X

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Hydrogen fluoride (as F)	3	-	6	-	-	-	-
Hydrogen peroxide	1	1.4	-	-	-	-	-
Hydrogen selenide (as Se)	0.05	0.2	-	-	-	-	-
Hydrogen sulfide	10	14	15	21	-	-	-
Hydroquinone	-	2	-	-	-	-	-
2-Hydroxypropyl acrylate	0.5	3	-	-	-	-	X
Indene	10	45	-	-	-	-	-
Indium and compounds (as In)	-	0.1	-	-	-	-	-
Iodine	-	-	-	-	0.1	1	-
Iodoform	0.6	10	-	-	-	-	-
Iron oxide dust and fume (as Fe) Total particulate	-	10	-	-	-	-	-
Iron pentacarbonyl (as Fe)	0.1	0.8	0.2	1.6	-	-	-
Iron salts (soluble) (as Fe)	-	1	-	-	-	-	-
Isoamyl acetate	100	525	-	-	-	-	-
Isoamyl alcohol (primary and secondary)	100	360	125	450	-	-	-
Isobutyl acetate	150	700	-	-	-	-	-
Isobutyl alcohol	50	150	-	-	-	-	-
Isooctyl alcohol	50	270	-	-	-	-	X
Isophorone	4	23	-	-	-	-	-
Isophorone diisocyanate	0.005	-	0.02	-	-	-	X
2-Isopropoxyethanol	25	105	-	-	-	-	-
Isopropyl acetate	250	950	310	1185	-	-	-
Isopropyl alcohol	400	980	500	1225	-	-	-
Isopropylamine	5	12	10	24	-	-	-
N-Isopropylaniline	2	10	-	-	-	-	X
Isopropyl ether	500	2100	-	-	-	-	-
Isopropyl glycidyl ether (IGE)	50	240	75	360	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Kaolin							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Ketene	0.5	0.9	1.5	3	-	-	-
Lead inorganic (as Pb) see 1910.1025							
Limestone							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	-	-	-	-	-	-
Lindane	-	0.5	-	-	-	-	X
Lithium hydride	-	0.025	-	-	-	-	-
L.P.G. (Liquefied petroleum gas)	1000	1800	-	-	-	-	-
Magnesite							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Magnesium oxide fume							
Total dust	-	10	-	-	-	-	-
Malathion							
Total dust	-	10	-	-	-	-	X
Maleic anhydride	0.25	1	-	-	-	-	-
Manganese compounds (as Mn)	-	-	-	-	-	5	-
Manganese fume (as Mn)	-	1	-	3	-	-	-
Manganese cyclopentadienyl tricarbonyl (as Mn)	-	0.1	-	-	-	-	X
Manganese tetroxide (as Mn)	-	1	-	-	-	-	-
Marble							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Mercury (aryl and inorganic)(as Hg)	-	-	-	-	-	0.1	X

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Mercury (organo) alkyl compounds (as Hg)	-	0.01	-	0.03	-	-	X
Mercury (vapor) (as Hg)	-	0.05	-	-	-	-	X
Mesityl oxide	15	60	25	100	-	-	-
Methacrylic acid	20	70	-	-	-	-	X
Methanethiol; see Methyl mercaptan							
Methomyl (Lannate)	-	2.5	-	-	-	-	-
Methoxychlor Total dust	-	10	-	-	-	-	-
2-Methoxyethanol; see Methyl cellosolve							
4-Methoxyphenol	-	5	-	-	-	-	-
Methyl acetate	200	610	250	760	-	-	-
Methyl acetylene (Propyne)	1000	1650	-	-	-	-	-
Methyl acetylene-propadiene mixture (MAPP)	1000	1800	1250	2250	-	-	-
Methyl acrylate	10	35	-	-	-	-	X
Methylacrylonitrile	1	3	-	-	-	-	X
Methylal (Dimethoxy-methane)	1000	3100	-	-	-	-	-
Methyl alcohol	200	260	250	325	-	-	X
Methylamine	10	12	-	-	-	-	-
Methyl amyl alcohol; see Methyl isobutyl carbinol							
Methyl n-amyl ketone	100	465	-	-	-	-	-
Methyl bromide	5	20	-	-	-	-	X
Methyl butyl ketone; see 2-Hexanone							
Methyl cellosolve (2-Methoxyethanol)	25	80					X
Methyl cellosolve acetate (2-Methoxyethyl acetate)	25	120					X

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Methyl chloride	50	105	100	210	-	-	-
Methyl chloroform (1,1,1-Trichloroethane)	350	1900	450	2450	-	-	-
Methyl 2-cyanoacrylate	2	8	4	16	-	-	-
Methylcyclohexane	400	1600	-	-	-	-	-
Methylcyclohexanol	50	235	-	-	-	-	-
o-Methylcyclohexanone	50	230	75	345	-	-	X
Methylcyclopentadienyl manganese tricarbonyl (as Mn)	-	0.2	-	-	-	-	X
Methyl demeton	-	0.5	-	-	-	-	X
4,4'-Methylene bis (2-chloroaniline) (MBOCA)	0.02	0.22	-	-	-	-	X
Methylene bis(4-cyclohexylisocyanate)	-	-	-	-	0.01	0.11	
Methylene chloride	See Table Z-2						
Methyl ethyl ketone (MEK); see 2-Butanon							
Methyl ethyl ketone peroxide (MEKP)	-	-	-	-	0.7	5	
Methyl formate	100	250	150	375	-	-	-
Methyl hydrazine (Monomethyl hydrazine)	-	-	-	-	0.2	0.35	X
Methyl iodide	2	10	-	-	-	-	X
Methyl isoamyl ketone	50	240	-	-	-	-	-
Methyl isobutyl carbinol	25	100	40	165	-	-	X
Methyl isobutyl ketone; see Hexone							
Methyl isocyanate	0.02	0.05	-	-	-	-	X
Methyl isopropyl ketone	200	705	-	-	-	-	-
Methyl mercaptan	0.5	1	-	-	-	-	-
Methyl methacrylate	100	410	-	-	-	-	
Methyl parathion	-	0.2	-	-	-	-	X
Methyl propyl ketone; see 2-Pentanone							
Methyl silicate	1	6	-	-	-	-	-
alpha-Methyl styrene	50	240	100	485	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Methylene bisphenyl isocyanate (MDI)	-	-	-	-	0.02	0.2	-
Metribuzin	-	5	-	-	-	-	-
Mica; see Silicates							
Molybdenum (as Mo)							
Soluble compounds	-	5	-	-	-	-	-
Insoluble compounds Total dust	-	10	-	-	-	-	-
Monocrotophos (Azodrin[R])	-	0.25	-	-	-	-	-
Monomethyl aniline	0.5	2	-	-	-	-	X
Morpholine	20	70	30	105	-	-	X
Naphtha (Coal tar)	100	400	-	-	-	-	-
Naphthalene	10	50	15	75	-	-	-
alpha-Naphthylamine; see 1910.1004							
beta-Naphthylamine; see 1910.1009							
Nickel carbonyl (as Ni)	0.001	0.007	-	-	-	-	-
Nickel, metal and insoluble compounds (as Ni)	-	1	-	-	-	-	-
Nickel, soluble compounds (as Ni)	-	0.1	-	-	-	-	-
Nicotine	-	0.5	-	-	-	-	X
Nitric acid	2	5	4	10	-	-	-
Nitric oxide	25	30	-	-	-	-	-
p-Nitroaniline	-	3	-	-	-	-	X
Nitrobenzene	1	5	-	-	-	-	X
p-Nitrochloro-benzene	-	1	-	-	-	-	X
4-Nitrodiphenyl; see 1910.1003							
Nitroethane	100	310	-	-	-	-	-
Nitrogen dioxide	-	-	1	1.8	-	-	-
Nitrogen trifluoride	10	29	-	-	-	-	-
Nitroglycerin[l]	-	-	-	0.1[l]	-	-	X
Nitromethane	100	250	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
1-Nitropropane	25	90	-	-	-	-	-
2-Nitropropane	10	35	-	-	-	-	-
N-Nitrosodimethylamine; see 1910.1016							
Nitrotoluene							
o-isomer							
m-isomer	2	11	-	-	-	-	X
p-isomer							
Nitrotrichloromethane; see Chloropicrin							
Nonane	200	1050	-	-	-	-	-
Octachloro-naphthalene	-	0.1	-	0.3	-	-	X
Octane	300	1450	375	1800	-	-	-
Oil mist, mineral	-	5	-	-	-	-	-
Osmium tetroxide (as Os)	0.0002	0.002	0.0006	0.006	-	-	-
Oxalic acid	-	1	-	2	-	-	-
Oxygen difluoride	-	-	-	-	0.05	0.1	-
Ozone	0.1	0.2	0.3	0.6	-	-	-
Paraffin wax fume	-	2	-	-	-	-	-
Paraquat, respirable dust	-	0.1	-	-	-	-	X
Parathion	-	0.1	-	-	-	-	X
Particulates not otherwise regulated							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Pentaborane	0.005	0.01	0.015	0.03	-	-	-
Pentachloronaphthalene	-	0.5	-	-	-	-	X
Pentachlorophenol	-	0.5	-	-	-	-	X
Pentaerythritol							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Pentane	600	1800	750	2250	-	-	-
2-Pentanone (Methyl propyl ketone)	200	700	250	875	-	-	-
Perchloroethylene (Tetrachloroethylene	25	170	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Perchloromethyl mercaptan	0.1	0.8	-	-	-	-	-
Perchloryl fluoride	3	14	6	28	-	-	-
Perlite							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Petroleum distillates (Naphtha)	400	1600	-	-	-	-	-
Phenol	5	19	-	-	-	-	X
Phenothiazine	-	5	-	-	-	-	X
p-Phenylene diamine	-	0.1	-	-	-	-	X
Phenyl ether, vapor	1	7	-	-	-	-	-
Phenyl ether-biphenyl mixture, vapor	1	7	-	-	-	-	-
Phenylethylene; see Styrene							
Phenyl glycidyl ether (PGE)	1	6	-	-	-	-	-
Phenylhydrazine	5	20	10	45	-	-	X
Phenyl mercaptan	0.5	2	-	-	-	-	-
Phenylphosphine	-	-	-	-	0.05	0.25	-
Phorate	-	0.05	-	0.2	-	-	X
Phosdrin (Mevinphos[R])	0.01	0.1	0.03	0.3	-	-	X
Phosgene (Carbonyl chloride)	0.1	0.4	-	-	-	-	-
Phosphine	0.3	0.4	1	1	-	-	-
Phosphoric acid	-	1	-	3	-	-	-
Phosphorus (yellow)	-	0.1	-	-	-	-	-
Phosphorus oxychloride	0.1	0.6	-	-	-	-	-
Phosphorus pentachloride	-	1	-	-	-	-	-
Phosphorus pentasulfide	-	1	-	3	-	-	-
Phosphorus trichloride	0.2	1.5	0.5	3	-	-	-
Phthalic anhydride	1	6	-	-	-	-	-
m-Phthalodinitrile	-	5	-	-	-	-	-
Picloram							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Picric acid	-	0.1	-	-	-	-	X

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Piperazine dihydrochloride	-	5	-	-	-	-	-
Pindone (2-Pivalyl-1,3-indandione)	-	0.1	-	-	-	-	-
Plaster of Paris							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Platinum (as Pt)							
Metal	-	1	-	-	-	-	-
Soluble salts	-	0.002	-	-	-	-	-
Portland cement							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Potassium hydroxide	-	-	-	-	-	2	-
Propane	1000	1800	-	-	-	-	-
Propargyl alcohol	1	2	-	-	-	-	X
beta-Propriolactone; see 1910.1013							
Propionic acid	10	30	-	-	-	-	-
Propoxur (Baygon)	-	0.5	-	-	-	-	-
n-Propyl acetate	200	840	250	1050	-	-	-
n-Propyl alcohol	200	500	250	625	-	-	-
n-Propyl nitrate	25	105	40	170	-	-	-
Propylene dichloride	75	350	110	510	-	-	-
Propylene glycol dinitrate	0.05	0.3	-	-	-	-	-
Propylene glycol monomethyl ether	100	360	150	540	-	-	-
Propylene imine	2	5	-	-	-	-	X
Propylene oxide	20	50	-	-	-	-	-
Propyne; see Methyl acetylene							
Pyrethrum	-	5	-	-	-	-	-
Pyridine	5	15	-	-	-	-	-
Quinone	0.1	0.4	-	-	-	-	-
Resorcinol	10	45	20	90	-	-	-
Rhodium (as Rh), metal fume and insoluble compounds	-	0.1	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Rhodium (as Rh), soluble compounds	-	0.001	-	-	-	-	-
Ronnel	-	10	-	-	-	-	-
Rosin core solder pyrolysis products, as formaldehyde	-	0.1	-	-	-	-	-
Rotenone	-	5	-	-	-	-	-
Rouge							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Selenium compounds (as Se)	-	0.2	-	-	-	-	-
Selenium hexafluoride (as Se)	0.05	0.4	-	-	-	-	-
Silica, amorphous, precipitated and gel	-	6	-	-	-	-	-
Silica, amorphous, diatomaceous earth, containing less than 1% crystalline silica	-	6	-	-	-		-
Silica, crystalline cristobalite (as quartz), respirable dust	-	0.05	-	-	-	-	-
Silica, crystalline quartz (as quartz), respirable dust	-	0.1	-	-	-	-	-
Silica, crystalline tripoli (as quartz), respirable dust	-	0.1	-	-	-	-	-
Silica, crystalline tridymite (as quartz), respirable dust	-	0.05	-	-	-	-	-
Silica, fused, respirable dust	-	0.1	-	-	-	-	-
Silicates (less than 1% crystalline silica)							
Mica (respirable dust)	-	3	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3] b	STEL[c] ppm[a]	STEL[c] mg/m[3] b	CEILING ppm[a]	CEILING mg/m[3] b	Skin Designation
Soapstone, total dust	-	6	-	-	-	-	-
Soapstone, respirable dust	-	3	-	-	-	-	-
Talc (containing asbestos): use asbestos limit	See 29 CFR 1910.1001						
Talc (containing no asbestos), asbestos), respirable dust	-	2	-	-	-	-	-
Tremolite	See 29 CFR 1910.1101						
Silicon							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Silicon carbide							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Silicon tetrahydride	5	7	-	-	-	-	-
Silver, metal and soluble compounds (as Ag)	-	0.01	-	-	-	-	-
Soapstone; see Silicates							
Sodium azide							
(as HN(3))	-	-	-	-	0.1	-	X
(as NaN(3))	-	-	-	-	-	0.3	X
Sodium bisulfite	-	5	-	-	-	-	-
Sodium fluoroacetate	-	0.05	-	0.15	-	-	X
Sodium hydroxide	-	-	-	-	-	2	-
Sodium metabisulfite	-	5	-	-	-	-	-
Starch							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Stibine	0.1	0.5	-	-	-	-	-
Stoddard solvent	100	525	-	-	-	-	-
Strychnine	-	0.15	-	-	-	-	-
Styrene	50	215	100	425	-	-	-
Subtilisins (Proteolytic enzymes)	-	-	-	0.00006 (60 min.)[g]	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Sucrose							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Sulfur dioxide	2	5	5	10	-	-	-
Sulfur hexafluoride	1000	6000	-	-	-	-	-
Sulfuric acid	-	1	-	-	-	-	-
Sulfur monochloride	-	-	-	-	1	6	-
Sulfur pentafluoride	-	-	-	-	0.01	0.1	-
Sulfur tetrafluoride	-	-	-	-	0.1	0.4	-
Sulfuryl fluoride	5	20	10	40	-	-	-
Sulprofos	-	1	-	-	-	-	-
Systox[R], see Demeton							
2,4,5-T	-	10	-	-	-	-	-
Talc; see Silicates							
Tantalum, metal and oxide dust	-	5	-	-	-	-	-
TEDP (Sulfotep)	-	0.2	-	-	-	-	X
Tellurium and compounds (as Te)	-	0.1	-	-	-	-	-
Tellurium hexafluoride (as Te)	0.02	0.2	-	-	-	-	-
Temephos							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
TEPP	-	0.05	-	-	-	-	X
Terphenyls	-	-	-	-	0.5	5	-
1,1,1,2-Tetrachloro-2,2-difluoroethane	500	4170	-	-	-	-	-
1,1,2,2-Tetrachloro-1,2-difluoroethane	500	4170	-	-	-	-	-
1,1,2,2-Tetrachloroethane	1	7	-	-	-	-	X
Tetrachoroethylene; see Perchloroethylene							
Tetrachloromethane; see Carbon tetrachloride							
Tetrachloronaphthalene	-	2	-	-	-	-	X
Tetraethyl lead (as Pb)	-	0.075	-	-	-	-	X
Tetrahydrofuran	200	590	250	735	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Tetramethyl lead, (as Pb)	-	0.075	-	-	-	-	X
Tetramethyl succinonitrile	0.5	3	-	-	-	-	X
Tetranitromethane	1	8	-	-	-	-	-
Tetrasodium pyrophosphate	-	5	-	-	-	-	-
Tetryl (2,4,6-Trinitrophenyl-methylnitramine)	-	1.5	-	-	-	-	X
Thallium, soluble compounds (as Tl)	-	0.1	-	-	-	-	X
4,4'-Thiobis(6-tert, Butyl-m-cresol)							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Thioglycolic acid	1	4	-	-	-	-	X
Thionyl chloride	-	-	-	-	1	5	-
Thiram	-	5	-	-	-	-	-
Tin, inorganic compounds (except oxides) (as Sn)	-	2	-	-	-	-	-
Tin, organic compounds (as Sn)	-	0.1	-	-	-	-	X
Tin oxide (as Sn)	-	2	-	-	-	-	-
Titanium dioxide							
Total dust	-	10	-	-	-	-	-
Toluene	100	375	150	560	-	-	-
Toluene-2,4-diisocyanate (TDI)	0.005	0.04	0.02	0.15	-	-	-
m-Toluidine	2	9	-	-	-	-	X
o-Toluidine	5	22	-	-	-	-	X
p-Toluidine	2	9	-	-	-	-	X
Toxaphene; see Chlorinated camphene							
Tremolite; see Silicates							
Tributyl phosphate	0.2	2.5	-	-	-	-	-
Trichloroacetic acid	1	7	-	-	-	-	-
1,2,4-Trichlorobenzene	-	-	-	-	5	40	-
1,1,1-Trichloroethane; see Methyl chloroform							
1,1,2-Trichloroethane	10	45	-	-	-	-	X

TABLE Z-1-A, part 2. (contd)

Substance	Final Rule Limits** TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Trichloroethylene	50	270	200	1080	-	-	-
Trichloromethane; see Chloroform							
Trichloronaphthalene	-	5	-	-	-	-	X
1,2,3-Trichloropropane	10	60	-	-	-	-	-
1,1,2-Trichloro-1,2,2-trifluoroethane	1000	7600	1250	9500	-	-	-
Triethylamine	10	40	15	60	-	-	-
Trifluorobromomethane	1000	6100	-	-	-	-	-
Trimellitic anhydride	0.005	0.04	-	-	-	-	-
Trimethylamine	10	24	15	36	-	-	-
Trimethyl benzene	25	125	-	-	-	-	-
Trimethyl phosphite	2	10	-	-	-	-	-
2,4,6-Trinitrophenyl; see Picric acid							
2,4,6-Trinitrophenylmethyl nitramine; see Tetryl							
2,4,6-Trinitrotoluene (TNT)	-	0.5	-	-	-	-	X
Triorthocresyl phosphate	-	0.1	-	-	-	-	X
Triphenyl amine	-	5	-	-	-	-	-
Triphenyl phosphate	-	3	-	-	-	-	-
Tungsten (as W)							
Insoluble compounds	-	5	-	10	-	-	-
Soluble compounds	-	1	-	3	-	-	-
Turpentine	100	560	-	-	-	-	-
Uranium (as U)							
Soluble compunds	-	0.05	-	-	-	-	-
Insoluble compounds	-	0.2	-	0.6	-	-	-
n-Valeraldehyde	50	175	-	-	-	-	-
Vanadium							
Respirable dust (as V(2)O(5))	-	0.05	-	-	-	-	-
Fume (as V(2)O(5))	-	0.05	-	-	-	-	-
Vegetable oil mist							
Total dust	-	15	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Vinyl acetate	10	30	20	60	-	-	-
Vinyl benzene; see Styrene							
Vinyl bromide	5	20	-	-	-	-	-
Vinyl chloride; see 1910.1017							
Vinylcyanide; see Acrylonitrile							
Vinyl cyclohexene dioxide	10	60	-	-	-	-	X
Vinylidene chloride (1,1-Dichloroethylene)	1	4	-	-	-	-	-
Vinyl toluene	100	480	-	-	-	-	-
VM & P Naphtha	300	1350	400	1800	-	-	-
Warfarin	-	0.1	-	-	-	-	-
Welding fumes (total particulate)***	-	5	-	-	-	-	-
Wood dust, all soft and hard woods, except Western red cedar	-	5	-	10	-	-	-
Wood dust, Western red cedar	-	2.5	-	-	-	-	-
Xylenes (o-, m-, p-isomers)	100	435	150	655	-	-	-
m-Xylene alpha, alpha'-diamine	-	-	-	-	-	0.1	X
Xylidine	2	10	-	-	-	-	X
Yttrium	-	1	-	-	-	-	-
Zinc chloride fume	-	1	-	2	-	-	-
Zinc chromate (as CrO(3))	-	-	-	-	-	0.1	-
Zinc oxide fume	-	5	-	10	-	-	-

TABLE Z-1-A, part 2. (contd)

Final Rule Limits**

Substance	TWA ppm[a]	TWA mg/m[3][b]	STEL[c] ppm[a]	STEL[c] mg/m[3][b]	CEILING ppm[a]	CEILING mg/m[3][b]	Skin Designation
Zinc oxide							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Zinc stearate							
Total dust	-	10	-	-	-	-	-
Respirable fraction	-	5	-	-	-	-	-
Zirconium compounds (as Zr)	-	5	-	10	-	-	-

* The transitional PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit.

** Unless otherwise noted, employers in General Industry (i.e., those covered by 29 CFR 1910) may use any combination of controls to achieve these limits until December 31, 1992 as set forth in 29 CFR 1910.1000(f).

*** As determined from breathing-zone air samples.

[a] Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 torr.

[b] Approximate milligrams of substance per cubic meter of air.

[c] Duration is for 15 minutes, unless otherwise noted.

[d] The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsequents, the benzene limits in Table Z-2 apply.

[e] Exposures under 10,000 ppm to be cited de minimus.

[f] The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound measured as the metal, the CAS number for the metal is given - not CAS numbers for the individual compounds.

[g] Compliance with the subtilisins PEL is assessed by sampling with a high volume sampler (600-800 liters per minute) for at least 60 minutes.

[h] The acetone STEL does not apply to the cellulose acetate fiber industry. It is in effect for all other sectors.

[i] The Final Rule Limit of 5 mg/m[3] is not in effect as a result of reconsideration. Calcium hydroxide is covered by the exposure limits for particulates not otherwise regulated of 5 mg/m[3] respirable dust and 15 mg/m[3] total dust.

TABLE Z-1-A, part 2. (contd)

[j] The Final Rule Limit TWA of 5 mg/m[3] is not in effect as a result of reconsideration. The calcium oxide Transitional Limit of 5 mg/m[3] remains in effect and employee exposures shall be kept below that level pursuant to the methods of compliance specified in 29 CFR 1910.1000(e).

[k] The Final Rule Limit STEL of 0.1 mg/m[3] is not in effect as a result of reconsideration for the industrial sector of civilian manufacture and distribution of explosives and propellants for civilian use. The Final rule limits skin designation and the Transitional limits ceiling limit of 1 mg/m[3] remain in effect for this sector until completion of the reconsideration.

[l] The Final Rule Limit STEL of 0.1 mg/m[3] is not in effect as a result of reconsideration for the industrial sector of civilian manufacture and distribution of explosives and propellants for civilian use. The Final rule limits skin designation and the Transitional limits ceiling limit of 2 mg/m[3] remains in effect for this sector until completion of the reconsideration.

NOTE: Pursuant to administrative stays effective September 1, 1989 and published in the FEDERAL REGISTER on September 5, 1989, and extended in part by notices published in the FEDERAL REGISTER on October 6, 1989, December 6, 1989, February 5, 1990, April 6, 1990, May 9, 1990 and November 8, 1990, the September 1, 1989 start-up specified in 29 CFR 1910.1000(f)(2)(i) is stayed as follows:

1. Until decision on the merits of the Eleventh Circuit Court of Appeals in the case of Courtaulds Fibers Inc. v. U.S. Department of Labor, No. 89-7073 and consolidated cases, for the Ceiling for carbon monoxide for blast furnace operations, vessel blowing at basic oxygen furnaces and sinter plants in the steel industry (SIC 33). OSHA will publish in the Federal Register notice of the termination of the carbon monoxide stay.
2. For employees exposed between 2 mg/m[3] and 0.1 mg/m[3] as a STEL for nitroglycerin as of December 15, 1990 in the manufacture of nitroglycerin and nitroglycerin based explosives and propellants for military and space use: until July 1, 1991 for all of those employees per facility, until January 1, 1992 for 1/2 of those employees per facility, until March 1, 1992 for 1/4 of those employees per facility.

   In addition the December 31, 1992 start-up date for feasible engineering controls specified in 29 CFR 1910.1000(f)(2)(ii)(A) for employees exposed between 2 mg/m[3] and 0.1 mg/m[3] as a STEL for nitroglycerin without regard to respirator use on December 15, 1990 in the manufacture of nitroglycerin and nitroglycerin based explosives and propellants for military and space use is stayed until December 31, 1994 for 3/4 of those employees per facility, until December 31, 1996 for 1/2 of those employees per facility and until December 31, 1998 for 1/4 of those employees per facility.

TABLE Z-2.

Material	8-Hour Time Weighted Average	Acceptable Ceiling Concentration	Acceptable Maximum Peak Above the Acceptance Ceiling Concentration for an 8-Hour Shift	
			Concentration	Maximum duration
Benzene [a] (Z37.40-1969)	10 p.p.m.	25 p.p.m.	50 p.p.m.	10 minutes
Beryllium and beryllium compounds (Z37.29-1970)	2 μg./m[3]	5 μg./m[3]	25 μg/m[3]	30 minutes
Cadmium fume (Z37.5-1970)	0.1mg/m[3]	0.3 mg/m[3]	.....	
Cadmium dust (Z37.5-1970)	0.2mg/m[3]	0.6 mg/m[3]	.....	
Carbon disulfide (Z37.3-1968)	20 p.p.m.	30 p.p.m.	100 ppm	30 minutes
Carbon tetrachloride (Z37.17-1967)	10 p.p.m.	25 p.p.m.	200 ppm	5 minutes in any 4 hours
Chromic acid and chromates (Z37.7-1971)	.....	1 mg/10m[3]	.....	
Ethylene dibromide (Z37.31-1970)	20 p.p.m.	30 p.p.m.	50 p.p.m.	5 minutes
Ethylene dichloride (Z37.21-1969)	50 p.p.m.	100 p.p.m.	200 ppm	5 minutes in any 3 hours.
Formaldehyde(2) (Z37.16-1967)	3 p.p.m.	5 p.p.m.	10 p.p.m.	30 minutes
Hydrogen fluoride (Z37.28-1969)	3 p.p.m.	.....	.....	
Hydrogen sulfide (Z37.2-1966)	.....	20 p.p.m.	50 p.p.m.	10 minutes once only if no other measurable exposure occurs.
Fluoride as dust (Z37.28-1969)	2.5 mg/m[3]	.....	.....	

TABLE Z-2. (contd)

Material	8-Hour Time Weighted Average	Acceptable Ceiling Concentration	Acceptable Maximum Peak Above the Acceptance Ceiling Concentration for an 8-Hour Shift	
			Concentration	Maximum duration
Mercury (Z37.8-1971)	.....	1 mg/10m[3]	.....	
Methyl chloride (Z37.18-1969)	100 p.p.m.	200 p.p.m.	300 ppm	5 minutes in any 3 hours.
Methylene chloride (Z37.23-1969)	500 p.p.m.	1,000 ppm	2,000 ppm	5 minutes in any 2 hours.
Organo (alkyl) mercury (Z37.30-1969)	0.01mg/m[3]	0.04mg/m[3]	.....	
Styrene (Z37.15-1969)	100 p.p.m.	200 ppm	600 ppm	5 minutes in any 3 hours.
Tetrachloro-ethylene (Z37.22-1967)	100 p.p.m.	200 ppm	300 ppm	5 minutes in any 3 hours.
Toluene (Z37.12-1967)	200 p.p.m.	300 p.p.m.	500 ppm	10 minutes
Trichloro-ethylene (Z37.19-1967)	100 p.p.m.	200 p.p.m.	300 ppm	5 minutes in any 2 hours.

Note 1. This standard applies to the industry segments exempt from the 1 ppm 8 hour TWA and 5 ppm STEL of the benzene standard at 1910.1028. This standard also applies to any industry for which 1910.1028 is stayed or otherwise not in effect.
Note 2. This standard applies to any industry for which 1910.1048 is stayed or otherwise not in effect.

TABLE Z-3. - MINERAL DUSTS

Substance	Mppcf(e)	Mg/m[3]
Silica:		
Crystalline:		
Quartz (respirable) ...	250f	10mg/m[3]
	%SiO2+5	%SiO2+2
Quartz (total dust) ...	.....	30mg/m[3]
		%S2O2+2
Cristobalite: Use 1/2 the value calculated from the count or mass formulae for quartz ...		
Tridymite: Use 1/2 the value calculated from the formulae for quartz		
Amorphous, including natural atomaceous earth	20	80mg/m[3]
		%SiO2
Silicates (less than 1% crystalline silica):		
Mica	20	
Soapstone	20	
Talc (non-asbestos-form)	20n	
Talc (fibrous). Use asbestos limit		
Tremolite (see talc, fibrous)		
Portland cement	50	
Graphite (natural)	15	
Coal dust (respirable fraction less than 5% SiO2)	.....	2.4mg/m[3] or
For more than 5% SiO2	.....	10mg/m[3]
		%SiO2+2
Inert or Nuisance Dust:		
Respirable fraction	15	5mg/m[3]
Total dust	20	15mg/m[3]

NOTE: Conversion factors -- mppcf x 35.3 = million particles per cubic meter = particles per c.c.

Aerodynamic diameter (unit density sphere)	Percent passing selector
2	90
2.5	75
3.5	50
5.0	25
10	0

The measurements under this note refer to the use of an AEC instrument. The respirable fraction of coal dust is determined with a MRE; the figure corresponding to that of 2.4 Mg/m[3] in the table for coal dust is 4.5 Mg/m[3].

APPENDIX B

DERIVED AIR CONCENTRATIONS FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (from DOE 5480.11, Change 1, 7-20-89)

APPENDIX B

DERIVED AIR CONCENTRATIONS FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (from DOE 5480.11, Change 1, 7-20-89)

The derived air concentrations (DAC) for limiting radiation exposures through inhalation of radionuclides by workers are listed in Table 1. The values are based on either a stochastic (committed effective dose equivalent) dose limit of 5 rem (0.05 Sv) or a nonstochastic (organ) dose limit of 50 rem (0.5 Sv) per year, whichever is more limiting. (Note: the 15 rem [0.15 Sv] dose limit for the lens of the eye does not appear as a critical organ dose limit.)

Table 1 contains five columns of information: (1) radionuclide; (2) inhaled air DAC for lung retention class D (micro Ci/mL); (3) inhaled air DAC for lung retention class W (micro Ci/mL); (4) inhaled air DAC for lung retention class Y (micro Ci/mL); and (5) an indication of whether or not the DAC for each class is controlled by the stochastic (effective dose equivalent) or nonstochastic (tissue) dose. The classes D, W, and Y have been established by the International Commission on Radiological Protection (ICRP) to describe the clearance of inhaled radionuclides from the lung. This classification refers to the approximate length of retention in the pulmonary region. Thus, the range of half-times is less than 10 days for class D (days), from 10 to 100 days for class W (weeks), and greater than 100 days for class Y (years). The DACs in Table 1 are listed by radionuclide, in order of increasing atomic mass, and are based on the assumption that the particle size distribution of the inhaled material is unknown. For this situation, the ICRP recommends that an assumed particle size distribution of 1 micro m be used. For situations where the particle size distribution is known to differ significantly from 1 micro m, appropriate corrections (as described in the DOE report Internal

Dose Conversion Factors for Calculation of Dose to the Public)[a] can be made to both the estimated dose to workers and the DACs.

Alternative absorption factors and lung retention classes for specific compounds are listed by element in Table 2 for cross-referencing with the inhalation DACs in Table 1. The data shown in Table 2 are listed by element in alphabetical order.

The following assumptions and procedures were used in calculating these DAC values for inhalation by workers:

1. The worker is assumed to inhale 2,400 m^3 of air during a 2000-hour work year, as defined by the ICRP in its Publication No. 23.[b]

2. The internal dose factors used in calculating the DAC values were taken from the report Internal Dose Conversion Factors for Calculation of Dose to the Public.[a] These factors are based on the metabolic data and dosimetry models recommended by the ICRP in its Publication No. 30.[c]

The air immersion DAC values shown in Table 3 are based on a stochastic limit of 5 rem (0.05 Sv) per year or a nonstochastic (organ) dose limit of 50 rem (0.5 Sv) per year. Table 3 contains three columns of information: 1) radionuclide; 2) half-life in units of seconds (s), minutes (min), hours (h), days (d), or years (y); and 3) air immersion DAC (micro Ci/mL). The data in Table 3 are listed by radionuclide in order of increasing atomic mass. The air immersion DACs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite atmospheric cloud. The dose conversion factors used to calculate the DAC values for air immersion were taken from the DOE report External Dose-Rate Conversion Factors for Calculation of Dose to the

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(a) U.S. Department of Energy (DOE). 1988. Internal Dose Conversion Factors for Calculation of Dose to the Public. Washington, D.C.

(b) International Commission on Radiological Protection (ICRP). 1975. ICRP Publication 23; Report of the Task Group on Reference Man. Pergamon Press, New York, New York.

(c) International Commission on Radiological Protection (ICRP). 1979-1982. ICRP Publication 30: Limits for Intakes of Radionuclides by Workers. Parts 1 to 3 and supplements 2(3/4) through 8(4), Pergamon Press, New York, New York.

Public.[a] The DAC value for air immersion listed in Table 3 for a given radionuclide is determined either by a limit on annual effective dose equivalent, which provides a limit on stochastic radiation effects, or by a limit on annual dose equivalent to any organ, which provides a limit on nonstochastic radiation effects. For most of the radionuclides listed in Table 3, the DAC value is determined by the limit on annual effective dose equivalent. Thus, the few cases where the DAC value is determined by the limit on annual dose equivalent to skin are indicated in the tables by an appropriate footnote. Again, the DACs listed in Table 3 account only for immersion in a semi-infinite cloud and do not account for inhalation or ingestion exposures. Three classes of radionuclides are included in the air immersion DACs given in Table 3, as described below.

1. Class 1. The first class of radionuclides includes selected noble gases and short-lived activation products that occur in gaseous form. For these radionuclides, inhalation doses are negligible compared to the external dose from immersion in an atmospheric cloud.

2. Class 2. The second class of radionuclides includes those for which a DAC value for inhalation has been calculated (using the ICRP inhalation dose equivalent factors), but for which the DAC value for external exposure to a contaminated atmospheric cloud is more restrictive (i.e., results in a lower DAC value). These radionuclides generally have half-lives of a few hours or less, or are eliminated from the body following inhalation sufficiently rapidly to limit the inhalation dose.

3. Class 3. The third class of radionuclides includes selected isotopes with relatively short half-lives that were not considered in ICRP Publication 30. These radionuclides typically have half-lives that are less than 10 minutes, they do not occur as a decay product of a longer-lived radionuclide, or they lack sufficient decay data to permit internal dose calculations. These radionuclides are also typified by a radioactive emission of highly intense, high-energy photons and rapid removal from the body following inhalation.

The DAC values are given for individual radionuclides. For known mixtures of radionuclides, the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture must not exceed 1.0.

(a) U.S. Department of Energy (DOE). 1988. External Dose-Rate Conversion Factors for Calculation of Dose to the Public. Washington, D.C.

Table 1

Derived Air Concentrations (DAC) for Controlling Radiation Exposures to Workers at DOE Facilities

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
H-3 (Water)2/	2.E-05	2.E-05	2.E-05	St/St/St
H-3 (Elemental)2/	5.E-01	5.E-01	5.E-01	St/St/St
Be-7	3/	9.E-06	8.E-06	/St/St
Be-10		6.E-08	6.E-09	/St/St
C-11 (Org)2/	2.E-04	2.E-04	2.E-04	St/St/St
C-11 (CO)2/	5.E-04	5.E-04	5.E-04	St/St/St
C-11 (CO2)2/	3.E-04	3.E-04	3.E-04	St/St/St
C-14 (Org)2/	1.E-06	1.E-06	1.E-06	St/St/St
C-14 (CO)2/	7.E-04	7.E-04	7.E-04	St/St/St
C-14 (CO2)2/	9.E-05	9.E-05	9.E-05	St/St/St
F-18	3.E-05	4.E-05	3.E-05	St/St/St
Na-22	3.E-07			St/ /
Na-24	2.E-06			St/ /
Mg-28	7.E-07	5.E-07		St/St/
Al-26	3.E-08	3.E-08		St/St/
Si-31	1.E-05	1.E-05	1.E-05	St/St/St
Si-32	1.E-07	5.E-08	2.E-09	St/St/St
P-32	4.E-07	2.E-07		St/St/
P-33	3.E-06	1.E-06		St/St/
S-35	7.E-06	9.E-07		St/St/
S-35 (Gas)		6.E-06		/St/
Cl-36	1.E-06	J.E-07		St/St/
Cl-38	2.E-05	2.E-05		St/St/
Cl-39	2.E-05	2.E-05		St/St/
K-40	2.E-07			St/ /
K-42	2.E-06			St/ /
K-43	4.E-06			St/ /
K-44	3.E-05			St/ /
K-45	5.E-05			St/ /
Ca-41		2.E-06		/E /
Ca-45		3.E-07		/St/
Ca-47		4.E-07		/St/
Sc-43			1.E-05	/ /St
Sc-44m			3.E-07	/ /St
Sc-44			5.E-06	/ /St
Sc-46			1.E-07	/ /St
Sc-47			1.E-06	/ /St
Sc-48			6.E-07	/ /St
Sc-49			2.E-05	/ /St
Ti-44	5.E-09	1.E-08	2.E-09	St/St/St
Ti-45	1.E-05	1.E-05	1.E-05	St/St/St
V-47	4.E-05	4.E-05		St/St/
V-48	4.E-07	3.E-07		St/St/
V-49	1.E-05	7.E-06		BS/St/
Cr-48	5.E-06	3.E-06	3.E-06	St/St/St
Cr-49	3.E-05	4.E-05	4.E-05	St/St/St
Cr-51	2.E-05	1.E-05	8.E-06	St/St/St
Mn-51	2.E-05	2.E-05		St/St/
Mn-52m	4.E-05	4.E-05		St/St/
Mn-52	5.E-07	4.E-07		St/St/
Mn-53	5.E-06	5.E-06		BS/St/
Mn-54	4.E-07	3.E-07		St/St/
Mn-56	6.E-06	9.E-06		St/St/
Fe-52	1.E-06	1.E-06		St/St/
Fe-55	8.E-07	2.E-06		St/St/
Fe-59	1.E-07	2.E-07		St/St/
Fe-60	3.E-09	8.E-09		St/St/
Co-55		1.E-06	1.E-06	/St/St
Co-56		1.E-07	8.E-08	/St/St
Co-57		1.E-06	3.E-07	/St/St
Co-58m		4.E-05	3.E-05	/St/St
Co-58		5.E-07	3.E-07	/St/St
Co-60m		2.E-03	1.E-03	/St/St
Co-60		7.E-08	1.E-08	/St/St
Co-61		3.E-05	2.E-05	/St/St
Co-62m		7.E-05	7.E-05	/St/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Ni-56 (Inorg)	8.E-07	5.E-07		St/St/
Ni-56 (Vapor)		5.E-07		/St/
Ni-57 (Inorg)	2.E-06	1.E-06		St/St/
Ni-57 (Vapor)		3.E-06		/St/
Ni-59 (Inorg)	2.E-06	3.E-06		St/St/
Ni-59 (Vapor)		8.E-07		/St/
Ni-63 (Inorg)	7.E-07	1.E-06		St/St/
Ni-63 (Vapor)		3.E-07		/St/
Nl-65 (Inorg)	1.E-05	1.E-05		St/St/
Ni-65 (Vapor)		7.E-06		/St/
Ni-66 (Inorg)	7.E-07	3.E-07		St/St/
Ni-66 (Vapor)		1.E-06		/St/
Cu-60	4.E-05	5.E-05	4.E-05	St/St/St
Cu-61	1.E-05	2.E-05	1.E-05	St/St/St
Cu-64	1.E-05	1.E-05	9.E-06	St/St/St
Cu-67	3.E-06	2.E-06	2.E-06	St/St/St
Zn-62			1.E-06	/ /St
Zn-63			3.E-05	/ /St
Zn-65			1.E-07	/ /St
Zn-69m			3.E-06	/ /St
Zn-69			6.E-05	/ /St
Zn-71m			7.E-06	/ /St
Zn-72			5.E-07	/ /St
Ga-65	7.E-05	8.E-05		St/St/
Ga-66	1.E-06	1.E-06		St/St/
Ga-67	6.E-06	4.E-06		St/St/
Ga-68	2.E-05	2.E-05		St/St/
Ga-70	7.E-05	8.E-05		St/St/
Ga-72	2.E-06	1.E-06		St/St/
Ga-73	6.E-06	6.E-06		St/St/
Ge-66	1.E-05	8.E-06		St/St/
Ge-67	4.E-05	4.E-05		St/St/
Ge-68	2.E-06	4.E-08		St/St/
Ge-69	6.E-06	3.E-06		St/St/
Ge-71	2.E-04	2.E-05		St/St/
Ge-75	3.E-05	3.E-05		St/St/
Ge-77	4.E-06	2.E-06		St/St/
Ge-78	9.E-06	9.E-06		St/St/
As-69		5.E-05		/St/

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
As-70		2.E-05		/St/
As-71		2.E-06		/St/
As-72		6.E-07		/St/
As-73		7.E-07		/St/
As-74		3.E-07		/St/
As-76		6.E-07		/St/
As-77		2.E-06		/St/
As-78		9.E-06		/St/
Se-70	1.E-05	2.E-05		St/St/
Se-73m	6.E-05	6.E-05		St/St/
Se-73	6.E-06	7.E-06		St/St/
Se-75	3.E-07	3.E-07		St/St/
Se-79	3.E-07	2.E-07		St/St/
Se-81m	3.E-05	3.E-05		St/St/
Se-81	9.E-05	1.E-04		St/St/
Se-83	5.E-05	5.E-05		St/St/
Br-74m	1.E-05	2.E-05		St/St/
Br-74	3.E-05	3.E-05		St/St/
Br-75	2.E-05	2.E-05		St/St/
Br-76	2.E-06	2.E-06		St/St/
Br-77	1.E-05	8.E-06		St/St/
Br-80m	7.E-06	6.E-06		St/St/
Sr-80	8.E-05	9.E-05		St/St/
Br-82	2.E-06	2.E-06		St/St/
Br-83	3.E-05	3.E-05		St/St/
Br-84	2.E-05	3.E-05		St/St/
Rb-79	5.E-05			St/ /
Rb-81m	1.E-04			St/ /
Rb-81	2.E-05			St/ /
Rb-82m	7.E-06			St/ /
Rb-83	4.E-07			St/ /
Rb-84	3.E-07			St/ /
Rb-86	3.E-07			St/ /
Rb-87	6.E-07			St/ /
Rb-88	3.E-05			St/ /
Rb-89	6.E-05			St/ /
Sr-80	5.E-06		5.E-06	St/ /St
Sr-81	3.E-05		3.E-05	St/ /St
Sr-83	3.E-06		2.E-06	St/ /St
Sr-85m	3.E-04		3.E-04	St/ /St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Sr-85	1.E-06		7.E-07	St/ /St
Sr-87m	5.E-05		6.E-05	St/ /St
Sr-89	3.E-07		6.E-08	St/ /St
Sr-90	8.E-09		2.E-09	St/ /St
Sr-91	2.E-06		1.E-06	St/ /St
Sr-92	4.E-06		3.E-06	St/ /St
Y-86m		2.E-05	2.E-05	/St/St
Y-86		1.E-06	1.E-06	/St/St
Y-87		1.E-06	1.E-06	/St/St
Y-88		1.E-07	1.E-07	/St/St
Y-90m		5.E-06	5.E-06	/St/St
Y-90		3.E-07	3.E-07	/St/St
Y-91m		1.E-04	7.E-05	/St/St
Y-91		7.E-08	5.E-08	/St/St
Y-92		3.E-06	3.E-06	/St/St
Y-93		1.E-06	1.E-06	/St/St
Y-94		3.E-05	3.E-05	/St/St
Y-95		6.E-05	6.E-05	/St/St
Zr-86	2.E-06	1.E-06	1.E-06	St/St/St
Zr-88	9.E-08	2.E-07	1.E-07	St/St/St
Zr-89	2.E-06	1.E-06	1.E-06	St/St/St
Zr-93	3.E-09	1.E-08	2.E-08	BS/BS/BS
Zr-95	6.E-08	2.E-07	1.E-07	BS/St/St
Zr-97	8.E-07	6.E-07	5.E-07	St/St/St
Nb-88		1.E-04	9.E-05	/St/St
Nb-89 (66 min)		2.E-05	2.E-05	/St/St
Nb-89 (122 min)		8.E-06	7.E-06	/St/St
Nb-90		1.E-06	1.E-06	/St/St
Nb-93m		5.E-07	7.E-08	/St/St
Nb-94		8.E-08	6.E-09	/St/St
Nb-95m		1.E-06	9.E-07	/St/St
Nb-95		5.E-07	5.E-07	/St/St
Nb-96		1.E-06	1.E-06	/St/St
Nb-97		3.E-05	3.E-05	/St/St
Nb-98		2.E-05	2.E-05	/St/St
Mo-90	3.E-06		2.E-06	St/ /St
Mo-93m	7.E-06		6.E-06	St/ /St
Mo-93	2.E-06		7.E-08	St/ /St
Mo-99	1.E-06		6.E-07	St/ /St
Mo-101	6.E-05		6.E-05	St/ /St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Tc-93m	7.E-05	1.E-04		St/St/
Tc-93	3.E-05	4.E-05		St/St/
Tc-94m	2.E-05	2.E-05		St/St/
Tc-94	8.E-06	1.E-05		St/St/
Tc-96m	1.E-04	1.E-04		St/St/
Tc-96	1.E-06	9.E-07		St/St/
Tc-97m	3.E-06	5.E-07		SW/St/
Tc-97	2.E-05	2.E-06		St/St/
Tc-98	7.E-07	1.E-07		St/St/
Tc-99m	6.E-05	1.E-04		St/St/
Tc-99	2.E-06	3.E-07		SW/St/
Tc-101	1.E-04	2.E-04		St/St/
Tc-104	3.E-05	4.E-05		St/St/
Ru-94	2.E-05	3.E-05	2.E-05	St/St/St
Ru-97	8.E-06	5.E-06	5.E-06	St/St/St
Ru-103	7.E-07	4.E-07	3.E-07	St/St/St
Ru-105	6.E-06	6.E-06	5.E-06	St/St/St
Ru-106	4.E-08	2.E-08	5.E-09	St/St/St
Rh-99m	2.E-05	3.E-05	3.E-05	St/St/St
Rh-99	1.E-06	9.E-07	8.E-07	St/St/St
Rh-100	2.E-06	2.E-06	2.E-06	St/St/St
Rh-101m	5.E-06	3.E-06	3.E-06	St/St/St
Rh-101	2.E-07	3.E-07	7.E-08	St/St/St
Rh-102m	2.E-07	2.E-07	5.E-08	St/St/St
Rh-102	4.E-08	7.E-08	2.E-08	St/St/St
Rh-103m	4.E-04	5.E-04	5.E-04	St/St/St
Rh-105	5.E-06	3.E-06	2.E-06	St/St/St
Rh-106m	1.E-05	1.E-05	1.E-05	St/St/St
Rh-107	1.E-04	1.E-04	1.E-04	St/St/St
Pd-100	6.E-07	5.E-07	6.E-07	St/St/St
Pd-101	1.E-05	1.E-05	1.E-05	St/St/St
Pd-103	3.E-06	2.E-06	J.E-06	St/St/St
Pd-107	9.E-06	3.E-06	2.E-07	K /St/St
Pd-109	3.E-06	2.E-06	2.E-06	St/St/St
Ag-102	8.E-05	9.E-05	8.E-05	St/St/St
Ag-103	4.E-05	6.E-05	5.E-05	St/St/St
Ag-104m	4.E-05	5.E-05	5.E-05	St/St/St
Ag-104	3.E-05	6.E-05	6.E-05	St/St/St
Ag-105	4.E-07	7.E-07	7.E-07	St/St/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Ag-106m	3.E-07	4.E-07	4.E-07	St/St/St
Ag-106	7.E-07	9.E-05	8.E-05	St/St/St
Ag-108m	8.E-08	1.E-07	1.E-08	St/St/St
Ag-110m	6.E-08	8.E-08	4.E-08	St/St/St
Ag-111	7.E-07	4.E-07	4.E-07	L /St/St
Ag-112	3.E-06	4.E-06	4.E-06	St/St/St
Ag-115	4.E-05	4.E-05	3.E-05	St/St/St
Cd-104	3.E-05	5.E-05	5.E-05	St/St/St
Cd-107	2.E-05	2.E-05	2.E-05	St/St/St
Cd-109	1.E-08	5.E-08	5.E-08	K /K /St
Cd-113m	1.E-08	4.E-09	5.E-09	K /K /St
Cd-113	9.E-07	3.E-09	6.E-09	K /K /St
Cd-115m	2.E-06	5.E-08	6.E-08	K /St/St
Cd-115	6.E-05	5.E-07	6.E-07	St/St/St
Cd-117m	5.E-06	7.E-06	6.E-06	St/St/St
Cd-117	5.E-06	7.E-06	6.E-06	St/St/St
In-109	2.E-05	3.E-05		St/St/
In-110 (69 min)	2.E-05	2.E-05		St/St/
In-110 (5 h)	7.E-06	8.E-06		St/St/
In-111	3.E-06	3.E-06		St/St/
In-112	3.E-04	3.E-04		St/St/
In-113m	6.E-05	8.E-05		St/St/
In-114m	3.E-08	4.E-08		St/St/
In-115m	2.E-05	2.E-05		St/St/
In-115	6.E-10	2.E-09		St/St/
In-116m	3.E-05	5.E-05		St/St/
In-117m	1.E-05	2.E-05		St/St/
In-117	7.E-05	9.E-05		St/St/
In-119m	5.E-05	6.E-05		St/St/
Sn-110	5.E-06	5.E-06		St/St/
Sn-111	9.E-05	2.E-04		St/St/
Sn-113	5.E-07	2.E-07		St/St/
Sn-117m	5.E-07	6.E-07		BS/St/
Sn-119m	1.E-06	4.E-07		St/St/
Sn-121m	4.E-07	2.E-07		St/St/
Sn-121	6.E-06	5.E-06		St/St/
Sn-123m	5.E-05	6.E-05		St/St/
Sn-123	3.E-07	7.E-08		St/St/
Sn-125	4.E-07	2.E-07		St/St/
Sn-126	2.E-08	3.E-08		St/St/
Sn-127	8.E-06	8.E-06		St/St/

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Sn-128	1.E-05	1.E-05		St/St/
Sb-115	1.E-04	1.E-04		St/St/
Sb-116m	3.E-05	6.E-05		St/St/
Sb-116	1.E-04	1.E-04		St/St/
Sb-117	9.E-05	1.E-04		St/St/
Sb-118m	8.E-06	9.E-06		St/St/
Sb-119	2.E-05	1.E-05		St/St/
Sb-120 (16 min)	2.E-04	2.E-04		St/St/
Sb-120 (6 d)	9.E-07	6.E-07		St/St/
Sb-122	1.E-06	4.E-07		St/St/
Sb-124m	3.E-04	3.E-04		St/St/
Sb-124	4.E-07	1.E-07		St/St/
Sb-125	1.E-06	2.E-07		St/St/
Sb-126m	8.E-05	8.E-05		St/St/
Sb-126	4.E-07	2.E-07		St/St/
Sb-127	9.E-07	4.E-07		St/St/
Sb-128 (9 h)	2.E-06	1.E-06		St/St/
Sb-126 (10 min)	2.E-04	2.E-04		St/St/
Sb-129	4.E-06	4.E-06		St/St/
Sb-130	3.E-05	3.E-05		St/St/
Sb-13I	1.E-05	1.E-05		T /T /
Te-116	9.E-06	1.E-05		St/St/
Te-121m	8.E-08	2.E-07		BS/St/
Te-121	2.E-06	1.E-06		St/St/
Te-123m	9.E-08	2.E-07		BS/St/
Te-123	8.E-08	2.E-07		BS/05/
Te-125m	2.E-07	3.E-07		BS/St/
Te-127m	1.E-07	1.E-07		BS/St/
Te-127	9.E-06	7.E-06		St/St/
Te-129m	3.E-07	1.E-07		St/St/
Te-129	3.E-05	3.E-05		St/St/
Te-131m	2.E-07	2.E-07		T /T /
Te-131	2.E-06	2.E-06		T /T /
Te-132	9.E-08	9.E-08		T /T /
Te-133m	2.E-06	2.E-06		T /T /
Te-133	9.E-06	9.E-06		T /T /
Te-134	1.E-05	1.E-05		T /T /
I-120m	9.E-06			St/ /
I-120	4.E-06			T / /
I-121	7.E-06			T / /
I-123	3.E-06			T / /

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
I-124	3.E-08			T / /
I-125	3.E-08			T / /
I-126	1.E-08			T / /
I-128	5.E-05			St/ /
I-129	4.E-09			T / /
I-130	3.E-07			T / /
I-131	2.E-08			T / /
I-132m	4.E-06			T / /
I-132	3.E-06			T / /
I-133	1.E-07			T / /
I-134	2.E-05			E / /
I-135	7.E-07			T / /
Cs-125	6.E-05			St/ /
Cs-127	4.E-05			St/ /
Cs-129	1.E-05			St/ /
Cs-130	8.E-05			St/ /
Cs-131	1.E-05			St/ /
Cs-132	2.E-06			St/ /
Cs-134m	6.E-05			St/ /
Cs-134	4.E-08			St/ /
Cs-135m	8.E-05			St/ /
Cs-135	5.E-07			St/ /
Cs-136	3.E-07			St/ /
Cs-137	7.E-08			St/ /
Cs-138	2.E-05			St/ /
Ba-126	6.E-06			St/ /
Ba-128	7.E-07			St/ /
Ba-131m	6.E-04			St/ /
Ba-131	3.E-06			St/ /
Ba-133m	4.E-06			St/ /
Ba-133	3.E-07			St/ /
Ba-135m	5.E-06			St/ /
Ba-139	1.E-05			St/ /
Ba-140	6.E-07			St/ /
Ba-141	3.E-05			St/ /
Ba-142	6.E-05			St/ /
La-131	5.E-05	7.E-05		St/St/
La-132	4.E-06	5.E-06		St/St/
La-135	4.E-05	4.E-05		St/St/
La-137	3.E-08	1.E-07		L /E /
La-138	2.E-09	6.E-09		St/St/

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
La-140	6.E-07	5.E-07		St/St/
La-141	4.E-06	5.E-06		St/St/
La-142	9.E-06	1.E-05		St/St/
La-143	4.E-05	4.E-05		St/St/
Ce-134		3.E-07	3.E-07	/St/St
Ce-135		2.E-06	2.E-06	/St/St
Ce-137m		2.E-06	2.E-06	/St/St
Ce-137		6.E-05	5.E-05	/St/St
Ce-139		3.E-07	3.E-07	/St/St
Ce-141		3.E-07	3.E-07	/St/St
Ce-143		8.E-07	7.E-07	/St/St
Ce-144		1.E-06	6.E-09	/St/St
Pr-136		1.E-04	9.E-05	/St/St
Pr-137		6.E-05	6.E-05	/St/St
Pr-138m		2.E-05	2.E-05	/St/St
Pr-139		5.E-05	5.E-05	/St/St
Pr-142m		7.E-05	6.E-05	/St/St
Pr-142		8.E-07	8.E-07	/St/St
Pr-143		3.E-07	3.E-07	/St/St
Pr-144		5.E-05	5.E-05	/St/St
Pr-145		4.E-06	3.E-06	/St/St
Pr-147		8.E-05	8.E-05	/St/St
Nd-136		2.E-05	2.E-05	/St/St
Nd-138		3.E-06	2.E-06	/St/St
Nd-139m		7.E-06	6.E-06	/St/St
Nd-139		1.E-04	1.E-04	/St/St
Nd-141		3.E-04	3 E-04	/St/St
Nd-147		4.E-07	3.E-07	/St/St
Nd-149		1.E-05	1.E-05	/St/St
Nd-151		8.E-05	8.E-05	/St/St
Pm-141		8.E-05	7.E-05	/St/St
Pm-143		3.E-07	3.E-07	/St/St
Pm-144		5.E-08	5.E-08	/St/St
Pm-145		7.E-08	8.E-08	/BS/St
Pm-146		2.E-08	2.E-08	/St/St
Pm-147		6.E-08	6.E-08	/BS/St
Pm-148m		1.E-07	1.E-07	/St/St
Pm-148		2.E-07	2.E-07	/St/St
Pm-149		8.E-07	8.E-07	/St/St
Pm-150		8.E-06	7.E-06	/St/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Pm-151		2.E-06	1.E-06	/St/St
Sm-141m		4.E-05		/St/
Sm-141		7.E-05		/St/
Sm-142		1.E-05		/St/
Sm-145		2.E-07		/St/
Sm-146		1.E-11		/BS/
Sm-147		2.E-11		/BS/
Sm-151		4.E-08		/BS/
Sm-153		1.E-06		/St/
Sm-155		9.E-05		/St/
Sm-156		4.E-06		/St/
Eu-145		8.E-07		/St/
Eu-146		5.E-07		/St/
Eu-147		7.E-07		/St/
Eu-148		2.E-07		/St/
Eu-149		1.E-06		/St/
Eu-150 (12 h)		3.E-06		/St/
Eu-150 (34 yr)		8.E-09		/St/
Eu-152m		3.E-06		/St/
Eu-152		1.E-08		/St/
Eu-154		8.E-09		/St/
Eu-155		4.E-08		/BS/
Eu-156		2.E-07		/St/
Eu-157		2.E-06		/St/
Eu-158		2.E-05		/St/
Gd-145	7.E-05	7.E-05		St/St/
Gd-146	5.E-08	1.E-07		St/St/
Gd-147	2.E-06	2.E-06		St/St/
Gd-148	3.E-12	1.E-11		BS/BS/
Gd-149	9.E-07	1.E-06		St/St/
Gd-151	2.E-07	5.E-07		BS/St/
Gd-152	4.E-12	2.E-11		BS/BS/
Gd-153	6.E-08	3.E-07		BS/St/
Gd-159	3.E-06	2.E-06		St/St/
Tb-147		1.E-05		/St/
Tb-149		3.E-07		/St/
Tb-150		9.E-06		/St/
Tb-151		4.E-06		/St/
Tb-153		3.E-06		/St/
Tb-154		2.E-06		/St/
Tb-155		3.E-06		/St/
Tb-156m (24 h)		3.E-06		/St/
Tb-156m (5 h)		1.E-05		/St/
Tb-156		6.E-07		/St/
Tb-157		1.E-07		/BS/
Tb-158		8.E-09		/St/
Tb-160		1.E-07		/St/
Tb-161		7.E-07		/St/
Dy-155		1.E-05		/St/
Dy-157		3.E-05		/St/
Dy-159		1.E-06		/St/
Dy-165		2.E-05		/St/
Dy-166		3.E-07		/St/
Ho-155		7.E-05		/St/
Ho-157		6.E-04		/St/
Ho-159		4.E-04		/St/
Ho-161		2.E-04		/St/
Ho-162m		1.E-04		/St/
Ho-162		1.E-03		/St/
Ho-164m		1.E-04		/St/
Ho-164		3.E-04		/St/
Ho-166m		3.E-09		/St/
Ho-166		7.E-07		/St/
Ho-167		2.E-05		/St/
Er-161		3.E-05		/St/
Er-165		8.E-05		/St/
Er-169		1.E-06		/St/
Er-171		4.E-06		/St/
Er-172		6.E-07		/St/
Tm-162		1.E-04		/St/
Tm-166		6.E-06		/St/
Tm-167		8.E-07		/St/
Tm-170		9.E-08		/St/
Tm-171		1.E-07		/BS/
Tm-172		5.E-07		/St/
Tm-173		5.E-06		/St/
Tm-175		1.E-04		/St/
Yb-162		1.E-04	1.E-04	/St/St
Yb-166		8.E-07	8.E-07	/St/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Yb-167		3.E-04	3.E-04	/St/St
Yb-169		3.E-07	3.E-07	/St/St
Yb-175		1.E-06	1.E-06	/St/St
Yb-177		2.E-05	2.E-05	/St/St
Yb-178		2.E-05	1.E-05	/St/St
Lu-169		2.E-06	2.E-06	/St/St
Lu-170		9.E-07	8.E-07	/St/St
Lu-171		8.E-07	8.E-07	/St/St
Lu-172		5.E-07	5.E-07	/St/St
Lu-173		1.E-07	1.E-07	/BS/St
Lu-174m		1.E-07	9.E-08	/BS/St
Lu-174		5.E-08	7.E-08	/BS/St
Lu-176m		1.E-05	1.E-05	/St/St
Lu-176		2.E-09	3.E-09	/BS/St
Lu-177m		5.E-08	3.E-08	/BS/St
Lu-177		9.E-07	9.E-07	/St/St
Lu-178m		8.E-05	7.E-05	/St/St
Lu-178		5.E-05	5.E-05	/St/St
Lu-179		8.E-06	6.E-06	/St/St
Hf-170	2.E-06	2.E-06		St/St/
Hf-172	4.E-09	2.E-08		BS/BS/
Hf-173	5.E-06	5.E-06		St/St/
Hf-175	4.E-07	5.E-07		BS/St/
Hf-177m	2.E-05	4.E-05		St/St/
Hf-178m	6.E-10	2.E-09		BS/BS/
Hf-179m	1.E-07	3.E-07		BS/St/
Hf-180m	9.E-06	1.E-05		St/St/
Hf-181	7.E-08	2.E-07		BS/St/
Hf-182m	4.E-05	6.E-05		St/St/
Hf-182	3.E-10	1.E-09		BS/BS/
Hf-183	2.E-05	2.E-05		St/St/
Hf-184	3.E-06	3.E-06		St/St/
Ta-172		5.E-05	4.E-05	/St/St
Ta-173		8.E-06	7.E-06	/St/St
Ta-174		4.E-05	4.E-05	/St/St
Ta-175		7.E-06	6.E-06	/St/St
Ta-176		5.E-06	5.E-06	/St/St
Ta-177		8.E-06	7.E-06	/St/St
Ta-178		4.E-05	3.E-05	/St/St
Ta-179		2.E-06	4.E-07	/St/St
Ta-180m		3.E-05	2.E-05	/St/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Ta-180		2.E-07	1.E-08	/St/St
Ta-182m		2.E-04	2.E-04	/St/St
Ta-182		1.E-07	6.E-08	/St/St
Ta-183		5.E-07	4.E-07	/St/St
Ta-184		2.E-06	2.E-06	/St/St
Ta-185		3.E-05	3.E-05	/St/St
Ta-186		1.E-04	9.E-05	/St/St
W-176	2.E-05			St/ /
W-177	4.E-05			St/ /
W-178	8.E-06			St/ /
W-179	7.E-04			St/ /
W-181	1.E-05			St/ /
W-185	3.E-06			St/ /
W-187	4.E-06			St/ /
W-188	5.E-07			St/ /
Re-177	1.E-04	2.E-04		St/St/
Re-178	1.E-04	1.E-04		St/St/
Re-181	4.E-06	4.E-06		St/St/
Re-182 (64 h)	1.E-06	9.E-07		St/St/
Re-182 (12 h)	5.E-06	6.E-06		St/St/
Re-184m	1.E-06	2.E-07		St/St/
Re-184	2.E-06	6.E-07		St/St/
Re-186m	7.E-07	6.E-08		SW/St/
Re-186	1.E-06	7.E-07		St/St/
Re-187	3.E-04	4.E-05		SW/St/
Re-188m	6.E-05	6.E-05		St/St/
Re-188	1.E-06	1.E-06		St/St/
Re-189	2.E-06	2.E-06		St/St/
Os-180	2.E-04	2.E-04	2.E-04	St/St/St
Os-181	2.E-05	2.E-05	2.E-05	St/St/St
Os-182	2.E-06	2.E-06	2.E-06	St/St/St
Os-185	2.E-07	3.E-07	3.E-07	St/St/St
Os-189m	1.E-04	9.E-05	7.E-05	St/St/St
Os-191m	1.E-06	9.E-06	7.E-06	St/St/St
Os-191	9.E-07	7.E-07	6.E-07	St/St/St
Os-193	2.E-06	1.E-06	1.E-06	St/St/St
Os-194	2.E-08	2.E-08	3.E-09	St/St/St
Ir-182	6.E-05	6.E-05	5.E-05	St/St/St
Ir-184	1.E-05	1.E-05	1.E-05	St/St/St
Ir-185	5.E-06	5.E-06	4.E-06	St/St/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Ir-186	3.E-06	3.E-06	2.E-06	St/St/St
Ir-187	1.E-05	1.E-05	1.E-05	St/St/St
Ir-188	2.E-06	2.E-06	1.E-06	St/St/St
Ir-189	2.E-06	2.E-06	2.E-06	St/St/St
Ir-190m	8.E-05	9.E-05	8.E-05	St/St/St
Ir-190	4.E-07	4.E-07	4.E-07	St/St/St
Ir-192m	4.E-08	9.E-08	6.E-09	St/St/St
Ir-192	1.E-07	2.E-07	9.E-08	St/St/St
Ir-194m	4.E-08	7.E-08	4.E-08	St/St/St
Ir-194	1.E-06	8.E-07	8.E-07	St/St/St
Ir-195m	1.E-05	1.E-05	9.E-06	St/St/St
Ir-195	2.E-05	2.E-05	2.E-05	St/St/St
Pt-186	2.E-05			St/ /
Pt-188	7.E-07			St/ /
Pt-189	1.E-05			St/ /
Pt-191	3.E-06			St/ /
Pt-193m	2.E-06			St/ /
Pt-193	1.E-05			St/ /
Pt-195m	2.E-06			St/ /
Pt-197m	2.E-05			St/ /
Pt-197	4.E-06			St/ /
Pt-199	6.E-05			St/ /
Pt-200	1.E-06			St/ /
Au-193	1.E-05	8.E-06	8.E-06	St/St/St
Au-194	3.E-06	2.E-06	2.E-06	St/St/St
Au-195	5.E-06	6.E-07	2.E-07	St/St/St
Au-198m	1.E-06	5.E-07	5.E-07	St/St/St
Au-198	2.E-06	7.E-07	7.E-07	St/St/St
Au-199	4.E-06	2.E-06	2.E-06	St/St/St
Au-200m	1.E-06	1.E-06	1.E-06	St/St/St
Au-200	3.E-05	3.E-05	3.E-05	St/St/St
Au-201	9.E-05	1.E-04	9.E-05	St/St/St
Hg-193m (Org)	6.E-06			St/ /
Hg-193m (Inorg)	4.E-06	3.E-06		St/St/
Hg-193m (Vapor)		4.E-06		/St/
Hg-193 (Org)	3.E-05			St/ /
Hg-193 (Inorg)	2.E-05	2.E-05		St/St/
Hg-193 (Vapor)		1.E-05		/St/
Hg-194 (Org)	1.E-08			St/ /
Hg-194 (Inorg)	2.E-08	5.E-08		St/St/
Hg-194 (Vapor)		1.E-08		/St/
Hg-195m (Org)	3.E-06			St/ /
Hg-195m (Inorg)	2.E-06	2.E-06		St/St/
Hg-195m (Vapor)		2.E-06		/St/
Hg-195 (Org)	2.E-05			St/
Hg-195 (Inorg)	1.E-05	1.E-05		St/St/
Hg-195 (Vapor)		1.E-05		/St/
Hg-197m (Org)	4.E-06			St/ /
Hg-197m (Inorg)	3.E-06	2.E-06		St/St/
Hg-197m (Vapor)		2.E-06		/St/
Hg-197 (Org)	6.E-06			St/ /
Hg-197 (Inorg)	5.E-06	4.E-06		St/St/
Hg-197 (Vapor)		3.E-05		/St/
Hg-199m (Org)	7.E-05			St/ /
Hg-199m (Inorg)	6.E-05	7.E-05		St/St/
Hg-199m (Vapor)		3.E-05		/St/
Hg-203 (Org)	3.E-07			St/ /
Hg-203 (Inorg)	5.E-07	5.E-07		St/St/
Hg-203 (Vapor)		3.E-07		/St/
Tl-194m	6.E-05			St/ /
Tl-194	3.E-04			St/ /
Tl-195	5.E-05			St/ /
Tl-197	5.E-05			St/ /
Tl-198m	2.E-05			St/ /
Tl-198	1.E-05			St/ /
Tl-199	3.E-05			St/ /
Tl-200	5.E-06			St/ /
Tl-201	9.E-06			St/ /
Tl-202	2.E-06			St/ /
Tl-204	9.E-07			St/ /
Pb-195m	8.E-05			St/ /
Pb-198	3.E-05			St/ /
Pb-199	3.E-05			St/ /
Pb-200	3.E-06			St/ /
Pb-201	9.E-06			St/ /
Pb-202m	1.E-05			St/ /
Pb-202	2.E-08			St/ /
Pb-203	4.E-06			St/ /
Pb-205	6.E-07			St/ /
Pb-209	2.E-05			St/ /
Pb-210	1.E-10			BS/ /
Pb-211	3.E-07			St/ /
Pb-212	1.E-08			St/ /

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Pb-214	3.E-07			St/ /
Bi-200	3.E-05	4.E-05		St/St/
Bi-201	1.E-05	2.E-05		St/St/
Bi-202	2.E-05	3.E-05		St/St/
Bi-203	3.E-06	2.E-06		St/St/
Bi-205	1.E-06	5.E-07		St/St/
Bi-206	6.E-07	4.E-07		St/St/
Bi-207	7.E-07	2.E-07		St/St/
Bi-210m	2.E-09	3.E-10		K /St/
Bi-210	1.E-07	1.E-08		K /St/
Bi-212	1.E-07	1.E-07		St/St/
Bi-213	1.E-07	2.E-07		St/St/
Bi-214	3.E-07	4.E-07		St/St/
Po-203	3.E-05	4.E-05		St/St/
Po-205	2.E-05	3.E-05		St/St/
Po-207	1.E-05	1.E-05		St/St/
Po-210	3.E-10	3.E-10		E /St/
At-207	1.E-06	9.E-07		St/St/
At-211	3.E-08	2.E-08		St/St/
Rn-220	8.E-09 4/	4/	4/	4/
Rn-222	3.E-08 4/	4/	4/	4/
Fr-222	2.E-07			St/ /
Fr-223	3.E-07			St/ /
Ra-223		3.E-10		/St/
Ra-224		7.E-10		/St/
Ra-225		3.E-10		/St/
Ra-226		3.E-10		/St/
Ra-227		6.E-06		/BS/
Ra-228		5.E-10		/St/
Ac-224	1.E-08	2.E-08	2.E-08	BS/St/St
Ac-225	1.E-10	3.E-10	3.E-10	BS/St/St
Ac-226	1.E-09	2.E-09	2.E-09	BS/St/St
Ac-227	2.E-13	7.E-13	2.E-12	BS/BS/St
Ac-228	4.E-09	2.E-08	2.E-08	BS/BS/St
Th-226		7.E-08	6.E-08	/St/St
Th-227		1.E-10	1.E-10	/St/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Th-228		4.E-12	7.E-12	/BS/St
Th-229		4.E-13	1.E-12	/BS/BS
Th-230		3.E-12	7.E-12	/BS/BS
Th-231		3.E-06	3.E-06	/St/St
Th-232		5.E-13	1.E-12	/BS/BS
Th-234		9.E-08	6.E-08	/St/St
Pa-227		5.E-08	4.E-08	/St/St
Pa-228		5.E-09	5.E-09	/BS/St
Pa-233		2.E-09	1.E-09	/St/St
Pa-231		7.E-13	2.E-12	/BS/BS
Pa-232		9.E-09	2.E-08	/BS/BS
Pa-233		3.E-07	2.E-07	/St/St
Pa-234		3.E-06	3.E-06	/St/St
U-230	2.E-10	1.E-10	1.E-10	BS/St/St
U-231	3.E-06	2.E-06	2.E-06	St/St/St
U-232	9.E-11	2.E-10	3.E-12	BS/St/St
U-233	5.E-I0	3.E-10	2.E-11	BS/St/St
U-234	5.E-10	3.E-10	2.E-11	BS/St/St
U-235	6.E-10	3.E-10	2.E-11	BS/St/St
U-236	6.E-10	3.E-10	2.E-11	BS/St/St
U-237	1.E-06	7.E-07	6.E-07	St/St/St
U-238	6.E-10	3.E-10	2.E-11	BS/St/St
U-239	8.E-05	7.E-05	6.E-05	St/St/St
U-240	2.E-06	1.E-06	1.E-06	St/St/St
Np-232		1.E-06 5/		/BS/
Np-233		1.E-03 5/		/St/
Np-234		1.E-06 5/		/St/
Np-235		5.E-07 5/		/BS/
Np-136 (1.E+05 yr)		1.E-11 5/		/BS/
Np-236 (22 h)		2.E-08 5/		/BS/
Np-237		2.E-12 5/		/BS/
Np-238		4.E-08 5/		/BS/
Np-239		1.E-06 5/		/St/
Np-240		3.E-05 5/		/St/
Pu-234		9.E-08 5/	8.E-08 5/	/St/St
Pu-235		1.E-03 5/	1.E-03 5/	/St/St
Pu-236		7.E-12 5/	1.E-11 5/	/BS/St
Pu-237		1.E-06 5/	1.E-06 5/	/St/St
Pu-238		3.E-12 5/	7.E-12 5/	/BS/BS
Pu-239		2.E-12 5/	6.E-12 5/	/BS/BS

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Pu-240		2.E-12 5/	6.E-12 5/	/BS/BS
Pu-241		1.E-10 5/	3.E-10 5/	/BS/BS
Pu-242		2.E-12 5/	6.E-12 5/	/BS/BS
Pu-243		1.E-05 5/	1.E-05 5/	/St/St
Pu-244		2.E-12 5/	6.E-12 5/	/BS/BS
Pu-245		2.E-06 5/	2.E-06 5/	/St/St
Am-237		1.E-04 5/		/St/
Am-238		1.E-06 5/		/BS/
Am-239		5.E-06 5/		/St/
Am-240		1.E-06 5/		/St/
Am-241		2.E-12 5/		/BS/
Am-242m		2.E-12 5/		/BS/
Am-242		3.E-08 5/		/BS/
Am-243		2.E-12 5/		/BS/
Am-244m		2.E-06 5/		/BS/
Am-244		7.E-08 5/		/BS/
Am-245		3.E-05 5/		/St/
Am-246m		7.E-05 5/		/St/
Am-246		4.E-05 5/		/St/
Cm-238		4.E-07 5/		/St/
Cm-240		2.E-10 5/		/BS/
Cm-241		9.E-09 5/		/BS/
Cm-242		1.E-10 5/		/BS/
Cm-243		3.E-12 5/		/BS/
Cm-244		4.E-12 5/		/BS/
Cm-245		2.E-12 5/		/BS/
Cm-246		2.E-12 5/		/BS/
Cm-247		2.E-12 5/		/BS/
Cm-248		6.E-13 5/		/BS/
Cm-249		6.E-06 5/		/BS/
Bk-245		5.E-07		/St/
Bk-246		1.E-06		/St/
Bk-247		2.E-12		/BS/
Bk-249		9.E-10		/BS/
Bk-250		2.E-07		/BS/
Cf-244		2.E-07 5/	2.E-07 5/	/St/St
Cf-246		4.E-09 5/	4.E-09 5/	/St/St
Cf-248		4.E-11 5/	5.E-11 5/	/BS/St
Cf-249		2.E-12 5/	6.E-12 5/	/BS/BS
Cf-250		5.E-12 5/	1.E-11 5/	/BS/St

Radionuclide	Inhaled Air - Lung Retention Class D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	Stochastic or Organ 1/ (D / W / Y)
Cf-251		2.E-12 5/	5.E-12 5/	/BS/BS
Cf-252		1.E-11 5/	2.E-11 5/	/BS/St
Cf-253		8.E-10 5/	7.E-10 5/	/St/St
Cf-254		9.E-12 5/	7.E-12 5/	/St/St
Es-250		3.E-07		/BS/
Es-251		4.E-07		/BS/
Es-253		6.E-10		/St/
Es-254m		4.E-09		/St/
Es-254		4.E-11		/BS/
Fm-252		6.E-09		/St/
Fm-253		4.E-09		/St/
Fm-254		4.E-08		/St/
Fm-255		9.E-09		/St/
Fm-257		1.E-10		/E /
Md-257		4.E-08		/St/
Md-258		1.E-10		/BS/

1/ A determination of whether the DACs are controlled by stochastic (St) or nonstochastic (organ) dose, or if they both give the same result (E) for each lung retention class is given in this column. The key to the organ notation for nonstochastic dose is: BS Bone surface, K = Kidney, L = Liver, Sin = Stomach wall, and T = Thyroid. A blank Indicates that no calculations are performed for the lung retention class shown.

2/ The ICRP identifies tritiated water and carbon as having immediate uptake and distribution; therefore no solubility classes are designated. For purposes of this table, the DAC values are shown as being constant, independent of solubility class. For tritiated water, the inhalation DAC values allow for an additional 50% absorption through the skin, as described in ICRP Publication No. 30: Limits for Intakes of Radionuclides by Workers. For elemental tritium, the DAC values are based solely on consideration of the dose-equivalent rate to the tissues of the lung from inhaled tritium gas contained within the lung, without absorption in the tissues.

3/ A dash indicates no values given for this data category.

4/ These values are appropriate for protection from radon combined with its short-lived daughters and are based on information given in ICRP Publication 32: Limits for Inhalation of Radon Daughters by Workers and Federal Guidance Report No. 11: Limiting Values of Radionuclide Intake and Air Concentrations, and Dose Conversion Factors for Inhalation, Submersion, and Ingestion (EPA 520/1-88-020). The values given are for 100% equilibrium concentration conditions of the radon daughters with the parent. To allow for an actual measured equilibrium concentration or a demonstrated equilibrium concentration, the values given in this table should be multiplied by the ratio (100%/actual %) or (100%/demonstrated %), respectively. Alternatively, the DAC values for Rn-220 and Rn-222 may be replaced by 1 WL* and 1/3 WL,* respectively, for appropriate limiting of daughter concentrations. Because of the dosimetric considerations for radon, no f1 or lung clearance values are listed.

* A "Working Level" (WL) is any combination of short-lived radon daughters, in one liter of air without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3 E+05 MeV of alpha energy.

5/ For the calculations, f1 values were obtained from ICRP Publication 48: The Metabolism of Plutonium and Related Elements. It is assumed that the effective dose equivalents for inhalation are unchanged even though the f1 values have changed. This is because the contribution to organ dose from inhalation is dependent mainly on transfer from lung to blood when f1 values are small. Also, the gastrointestinal tract dose would be unchanged because the fraction of activity passing through the tract is (1.0 - f1).

Table 2
Alternative AbsorptIon Factors and Lung Retention Classes for Specific Compounds

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Actinium/ Ac	89	Oxides, hydroxides	1.E-t3	Y
		Halides, nitrates	1.E-03	W
		All others	1.E-03	D
Aluminum/ Al	13	Oxides, hydroxides, carbides, halides, nitrates, elemental form	1.E-02	W
		All others	1.E-02	D
Americium/ Am	95	All forms	1.E-03	W
Antimony/ Sb	51	Oxides, hydroxides, halides, sulphides, sulphates, nitrates	1.E-01	D
		All others	1.E-02	W
Arsenic/ As	33	All forms	5.E-01	W
Astatine/ At	85	All (as a halide)	1.E+00	W or D; dependent upon associated element
Barium/ Ba	56	All forms	1.E-01	D
Berkelium/ Bk	97	All forms	5.E-04	W
Beryllium/ Be	4	Oxides, halides, nitrates	5.E-03	Y
		All others	5.E-03	W
Bismuth/ Bi	83	All except nitrates	5.E-02	W
		Nitrates	5.E-02	D
Bromine/ Br	35	Bromides	1.E+00	W or D; dependent upon associated element
Cadmium/ Cd	48	Oxides, hydroxides	5.E-02	Y
		Sulphates, halides	5.E-02	W
		All others	5.E-02	D
Calcium/ Ca	20	All forms	3.E-01	W
Californium/ Cf	98	Oxides, hydroxides	1.E-03	Y
		All others	1.E-03	W
Carbon/ C	6	Oxides 1/		D
		Organic (11C)	1.E+00	W
		Organic (14C)	1.E+00	W
Cerium/ Ce	58	Oxides, hydroxides, fluorides	3.E-04	Y
		All others	3.E-04	W
Cesium/ Cs	55	All forms	1.E+00	D
Chlorine/	17	Chloride	1.E+00	W or D; dependent upon associated element
Chromium/ Cr	24	Oxides, hydroxides	1.E-01	Y
		Halides, nitrates	1.E-01	W
		All others	1.E-01	D
		Ingestion 2/		
		Trivalent	1.E-02	
		Hexavalent	1.E-01	
Cobalt/ Co	27	Oxides, hydroxides, halides, nitrates	5.E-02	Y
		All others	5.E-02	W
		Ingestion only 2/	3.E-01	
Copper/ Cu	29	Oxides, hydroxides	5.E-01	Y
		Sulphites, halides, nitrates	5.E-01	W
		All others	5.E-01	D

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Curium/ Cm	96	All forms	1.E-03	W
Dysprosium/ Dy	66	All forms	3.E-04	W
Einsteinium/ Es	99	All forms	5.E-04	W
Erbium/ Er	68	All forms	3.E-04	W
Europium/ Eu	63	All forms	1.E-03	W
Fermium/ Fm	100	All forms	5.E-04	W
Fluorine/ F	9	Fluoride	1.E+00	Y, W, or D; dependent upon associated element
Francium/ Fr	87	All forms	1.E+00	D
Gadolinium/ Gd	64	Oxides, hydroxides, fluorides	3.E-04	W
		All others	3.E-04	
Gallium/ Ga	31	Oxides, hydroxides, carbides, halides, nitrates,	1.E-03	W
		All others	1.E-03	D
Germanium/ Ge	32	Oxides, sulphides, halides	1.E+00	W
		All others	1.E+00	D
Gold/ Au	79	Oxides, hydroxides	1.E-01	Y
		Halides, nitrates	1.E-01	W
		All others	1.E-01	D
Hafnium/ Hf	72	Oxides, hydroxides, halides, carbides, nitrates	2.E-03	W
		All others	2.E-03	D
Holmiuin/ Ho	67	All forms	3.E-04	W
Hydrogen/ H	1	Water, elemental	1.E+00	
Indium/ In	49	Oxides, hydroxides, halides	2.E-02	W
		All others	2.E-02	D
Iodine/	53	All forms	1.E+00	D
Iridium/ Ir	77	Oxides, hydroxides	1.E-02	Y
		Halides, nitrates, metallic form	1.E-02	W
		All others	1.E-02	D
Iron/ Fe	26	Oxides, hydroxides, halides	1.E-01	W
		All others	1.E-01	D
Lanthanum/ La	57	Oxides, hydroxides	1.E-03	W
		All others	1.E-03	D
Lead/ Pb	82	All forms	2.E-01	D
Lutetium/ Lu	71	Oxides, hydroxides, fluorides	3.E-04	Y
		All others	3.E-04	W
Magnesium/ Mg	12	Oxides, hydroxides, carbides, halides, nitrates	5.E-01	W
		All others	5.E-01	D

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Manganese/ Mn	25	Oxides, hydroxides, halides, nitrates	1.E-01	W
		All others	1.E-01	D
Mendelevium/ Md	101	All forms	5.E-04	W
Mercury/ Hg	80	Oxides, hydroxides, halides, nitrates, sulphites	2.E-02	W
		Sulphates, elemental form	2.E-02	D
		Organic forms	1.E+00	D
		Vapor 1/		D
Molybdenum/ Mo	42	Oxides, hydroxides, MoS2	5.E-02	Y
		All others	8.E-01	D
		Ingestion 2/		
		MoS2	5.E-02	
		All Others	8.E-01	
Neodymium/ Nd	60	Oxides, hydroxides, carbides, fluorides	3.E-04	W
		All others	3.E-04	Y
Neptunium/ Np	93	All forms	1.E-03	W
Nickel/ Ni	28	Oxides, hydroxides	5.E-02	W
		All others (vapor) 1/		D
Niobium/ Nb	41	Oxides, hydroxides	1.E-02	Y
		All others	1.E-02	W
Osmium/ Os	76	Oxides, hydroxides	1.E-02	Y
		Halides, nitrates	1.E-02	W
		All others	1.E-02	D
Palladium/ Pd	46	Oxides, hydroxides	5.E-03	Y
		Nitrates	5.E-03	W
		All others	5.E-03	D
Phosphorus/ P	15	Phosphates	8.E-01	W or D; dependent upon associated element
Platinum/ Pt	78	All forms	1.E-02	D
Plutonium/ Pu	94	Oxides, hydroxides	1.E-05	Y
		Nitrates	1.E-04	W
		All other	1.E-03	W
		[Note: Use same values for ingestion]		
Polonium/ Po	84	Oxides, hydroxides, nitrates	1.E-01	W
		All others	1.E-01	D
Potassium/ K	19	All forms	1.E+00	D
Praseodymium/ Pr	59	Oxides, hydroxides, carbides, fluorides	3.E-04	Y
		All others	3.E-04	W
Promethium/ Pm	61	Oxides, hydroxides carbides, fluorides	3.E-04	Y
		All others	3.E-04	W
Protactinium/ Pa	91	Oxides, hydroxides	1.E-03	Y
		All others	1.E-03	W
Radium/ Ra	88	All forms	2.E-01	W

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Rhenium/ Re	75	Oxides, hydroxides, halides, nitrates	8.E-01	W
		All others	8.E-01	D
Rhodium/ Rh	45	Oxides, hydroxides	5.E-02	Y
		Halides	5.E-02	W
		All others	5.E-02	D
Rubidium/ Rb	37	All forms	1.E+00	D
Ruthenium/ Ru	44	Oxides, hydroxides	5.E-02	Y
		Halides	5.E-02	W
		All others	5.E-02	D
Samarium/ Sm	62	All forms	3.E-04	W
Scandium/ Sc	21	All forms	1.E-04	Y
Selenium/ Se	34	Oxides, hydroxides, carbides	8.E-01	W
		All others	8.E-01	D
		Ingestion only 2/	5.E-02	
Silicon/ Si	14	Ceramic forms	1.E-02	Y
		Oxides, hydroxides, carbides, nitrates	1.E-02	W
		All others	1.E-02	D
Silver/ Ag	47	Oxides, hydroxides	5.E-02	Y
		Nitrates, sulphides	5.E-02	W
		All others, elemental form	5.E-02	D
Sodium/ Na	11	All forms	1.E+00	D
Strontium/ Sr	38	SrTiO3	1.E-02	Y
		All others (soluble)	3.E-01	D
Sulfur/	16	All Inorganic	8.E-01	D
		Elemental Form	8.E-01	W
		Gases	1.E+00	D
		Ingestion 2/		
		All inorganic	1.E-01	
Tantalum/ Ta	73	Oxides, hydroxides, halides, carbides, nitrates, nitrides	1.E-03	Y
		All others	1.E-03	W
Technetium/ Tc	43	Oxides, hydroxides, halides, nitrates	8.E-01	W
		All others	8.E-01	D
Tellurium/ Te	52	Oxides, hydroxides, nitrates	2.E-01	W
		All others	2.E-01	D
Terbium/ Tb	65	All forms	3.E-04	W
Thallium/ Tl	81	All forms	1.E+00	D
Thorium/ Th	90	Oxides, hydroxides	2.E-04	Y
		All others	2.E-04	W
Thulium/ Tm	69	All forms	3.E-04	W
Tin/ Sn	05	Oxides, hydroxides, halides, nitrates, sulphides, Sn3(PO4)4	2.E-02	W
		All others	2.E-02	D
Titanium/ Ti	22	SrTiO3	1.E-02	Y
		Oxides, hydroxides, carbides, halides, nitrates	1.E-02	W
		All others	1.E-02	D

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Tungsten/ W	74	Ingestion 2/		
		Tungstic acid	1.E-02	
		All others	3.E-01	
Uranium/ U	92	UO2, U3O8	1.E-03	Y
		UO3, tetravalent compounds	5.E-02	W
		UF6, uranyl compounds	5.E-02	D
Vanadium/ V	23	Oxides, hydroxides, carbides, halides	1.E-02	W
		All others	1.E-02	D
Ytterbium/ Yb	70	Oxides, hydroxides, fluorides	3.E-04	Y
		All others	3.E-04	W
Yttrium/ Y	39	Oxides, hydroxides	1.E-04	Y
		All others	1.E-04	W
Zinc/ Zn	30	All forms	5.E-01	Y
Zirconium/	40	Carbides	2.E-03	Y
		Oxides, hydroxides, halides, nitrates	1.E-03	W
		All others	1.E-03	D

1/ A dash indicates no data for the value shown.
2/ For ingestion, no lung retention classes are listed.

Table 3
Derived Air Concentrations (DAC) for Workers from External Exposure During Immersion in a Contaminated Atmospheric Cloud

Radionuclide	Half-Life	Air Immersion DAC (uCi/mL)
C-11	20.48 min	4.E-06
N-13	9.97 min	4.E-06
N-16	7.13 s	7.E-07
O-15	122.24 s	4.E-06
F-18 1/	109.74 min	4.E-06
Na-24 1/	15.00 h	9.E-07
Mg-27 2/	9.458 min	5.E-06
Al-28 2/	2.240 min	2.E-06
Cl-38 1/	37.21 min	3.E-06
Ar-37	35.02 d	3.E-00
Ar-39	269 yr	2.E-04 3/
Ar-41	1.827 h	3.E-06
K-43 1/	22.6 h	5.E-06
Ca-49 2/	8.719 min	1.E-06
Sc-44 1/	3.927 h	2.E-06
Sc-46m 2/	18.72 s	5.E-05
Ti-45 1/	3.08 h	5.E-06
Ti-51 2/	5.752 min	1.E-05
V-52 2/	3.75 min	3.E-06
Cr-49 1/	42.09 min	5.E-06
Mn-52m 1/	21.4 min	2.E-06
Mn-56 1/	2.5785 h	2.E-06
Mn-57 2/	1.47 min	6.E-05
Co-60m 1/	10.47 min	1.E-03
Ni-57 1/, 4/	36.08 h	2.E-06
Ni-65 1/, 5/	2.520 h	8.E-06
Cu-61 1/	3.408 h	5.E-06
Cu-62 2/	9.74 min	5.E-06
Ga-66 1/	9.40 h	2.E-06
Ga-68 1/	68.0 min	5.E-06
Ga-72 1/	14.1 h	1.E-06
Se-73 1/	7.15 h	4.E-06
Br-77 1/	57.04 h	1.E-05 6/
Br-80 1/	17.4 min	5.E-05
Br-82 1/	35.30 h	1.E-06
Br-84 1/	31.80 min	2.E-06
Br-85 2/	172 s	5.E-05
Kr-79	35.04 h	2.E-05
Kr-81	2.1E+05 yr	5.E-04
Kr-83m	1.83 h	5.E-02
Kr-85	10.72 yr	1.E-04 3/
Kr-85m	4.48 h	3.E-05
Kr-87	76.3 min	5.E-06
Kr-88	2.84 h	2.E-06
Kr-89	3.16 min	2.E-06
Kr-90	32.32 s	3.E-06
Rb-81 1/	4.58 h	8.E-06
Rb-82 2/	1.25 min	2.E-06
Rb-88 1/	17.8 min	7.E-06
Rb-89 1/	15.44 min	2.E-06
Rb-90 2/	157 s	2.E-06
Rb-90m 2/	258 s	1.E-06
Sr-85m 1/	67.66 min	2.E-05
Sr-87m 1/	2.805 h	6.E-05
Sr-92 1/	1.71 h	3.E-06
Sr-93 2/	7.3 min	2.E-06
Y-86 1/	14.74 h	1.E-06
Y-90m 1/	3.19 h	5.E-06 6/
Y-91m 1/	49.71 min	9.E-06
Nb-90 1/	14.60 h	1.E-07
Nb-94m 2/	6.26 min	9.E-04

Radionuclide	Half-Life	Air Immersion DAC (uCi/mL)
Nb-97 1/	72.1 min	7.E-06
Nb-97m 1/	60 s	6.E-06
Mo-91 2/	15.49 min	4.E-06
Mo-101 1/	14.61 min	3.E-06
Tc-95 1/	20.0 h	5.E-06
Tc-96m 1/	51.5 min	1.E-04
Tc-99m 1/	6.02 h	3.E-05
Tc-101 1/	14.2 min	1.E-05
Ru-105 1/	4.44 h	5.E-06
Rh-105m 2/	45 s	1.E-04
Rh-106 2/	29.92 s	2.E-05
Ag-108 2/	2.37 min	2.E-04
Ag-109m 2/	39.6 s	1.E-03
Ag-110 2/	24.57 s	9.E-05
Cd-111m 2/	48.7 min	1.E-05
Cd-117 1/	2.49 h	4.E-06
Cd-117m 1/	3.36 h	2.E-06
In-113m 1/	1.658 h	2.E-05
In-114 2/	71.9 s	1.E-04
In-116m 1/	54.15 min	2.E-06
In-117 1/	43.8 min	7.E-06
Sb-117 1/	2.80 h	3.E-05
Sb-126m 1/	19.0 min	3.E-06
Sb-129 1/	4.40 h	3.E-06
Te-133 1/	12.45 min	5.E-06
Te-133m 1/	55.4 min	2.E-06
Te-134 1/	41.8 min	5.E-06
I-122 2/	3.62 min	5.E-06
I-128 1/	24.99 min	5.E-05
I-132 1/	2.30 h	2.E-06
I-134 1/	52.6 min	1.E-06
I-135 1/	6.61 h	7.E-07 6/
I-136 2/	83 s	1.E-06

Radionuclide	Half-Life	Air Immersion DAC (μCi/mL)
Xe-122	20.1 h	8.E-05
Xe-123	2.14 h	7.E-06
Xe-125	16.8 h	2.E-05
Xe-127	36.406 d	1.E-05
Xe-129m	8.89 d	2.E-04
Xe-131m	11.84 d	5.E-04
Xe-133	5.245 d	1.E-04
Xe-133m	2.19 d	1.E-04
Xe-135	9.11 h	2.E-05
Xe-135m	15.36 min	1.E-05
Xe-137	3.83 min	2.E-05
Xe-138	14.13 min	4.E-06
Cs-126 2/	1.64 min	4.E-06
Cs-129 1/	32.06 h	1.E-05 6/
Cs-138 1/	32.2 min	2.E-06
Cs-139 2/	9.40 min	1.E-05
Ba-137m 2/	2.552 min	7.E-06
Ba-141 1/	18.27 min	5.E-06
Ba-142 1/	10.70 min	5.E-06
La-142 1/	95.4 min	1.E-06
Pr-144m 2/	7.2 min	9.E-04
Nd-149 1/	1.73 h	1.E-05
Gd-162 2/	9.7 min	1.E-05
Td-162 2/	7.76 min	4.E-06
Dy-157 1/	8.06 h	1.E-05
Re-182m 1/	12.7 h	4.E-06
Os-190m 2/	9.9 min	3.E-06
Ir-190m 1/	3.2 h	8.E-05 6/
Au-195m 2/	30.6 s	2.E-05

Radionuclide	Half-Life	Air Immersion DAC (μCi/mL)
Tl-200 1/	26.1 h	3.E-06
Tl-207 2/	4.77 min	4.E-05 3/
Tl-208 2/	3.053 min	1.E-06
Tl-209 2/	2.20 min	2.E-06
Tl-210 2/	1.30 min	1.E-06
Pb-204m 2/	66.9 min	2.E-06
Bi-211 2/	2.13 min	1.E-04
Po-211 2/	0.516 s	5.E-04
Rn-220	55.61 s	8.E-09 6/
Rn-222	3.824 d	3.E-08 6/
Th-233 2/	22.3 min	1.E-04
Pa-234 1/	6.70 h	2.E-06
Pa-234m 2/	1.17 min	4.E-05 3/
U-239 1/	23.40 min	8.E-05 6/
Np-240 1/	65 min	4.E-06
Np-240m 2/	7.4 min	1.E-05
Am-246 1/	25.0 min	4.E-06

1/ Committed effective dose equivalent from inhalation is calculated in ICRP Publication 30, but the DAC value for external exposure to a contaminated atmospheric cloud is more restrictive than the DAC value for inhalation.

2/ Committed effective dose equivalent from inhalation is not calculated in ICRP Publication 30, but DAC value for external exposure to contaminated cloud should be more restrictive than DAC value for inhalation due to relatively short half-life of radionuclide.

3/ DAC value is determined by limit on annual dose equivalent to skin, rather than limit on annual effective dose equivalent.

4/ DAC value applies to radionuclide in vapor form only; DAC value for inhalation is more restrictive for radionuclide in inorganic form.

5/ DAC value applies to radionuclide in inorganic or vapor form.

6/ DAC value for exposure to contaminated atmospheric cloud is the same as DAC value for inhalation. See footnote 4/ to Table 1 on page 24 of Attachment 1.

APPENDIX C

SURFACE RADIOACTIVITY GUIDES
(from DOE 5480.11, Change 1, 7-20-89)

SURFACE RADIOACTIVITY GUIDES

NUCLIDE 1/	REMOVABLE 2/4/	TOTAL 2/3/ (FIXED PLUS REMOVABLE)
U-nat, U-235, U-238, and associated decay products	1,000 dpm a/100 cm^2	5,000 dpm a/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20 dpm/100 cm^2	300 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200 dpm/100 cm^2	1,000 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. 5/	1,000 dpm B-T/100 cm^2	5,000 dpm B-T/100 cm^2

1/ Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

2/ As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

3/ The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the guide values. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if: (1) from measurements of a representative number n of sections it is determined that $1/n \sum_{i=1}^{n} Si > G$, where Si is the dis/min-100 cm^2 determined from measurement of section i; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds 3G.

4/ The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and Ra-226, Ra-228, Ac-227, Th-228, Th-230, and Pa-231 alpha emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

5/ This category of radionuclides includes mixed fission products, including the SR-90 which is present in them. It does not apply to SR-90 which has been separated from the other fission products or mixtures where the SR-90 has been enriched.

APPENDIX D

DERIVED CONCENTRATION GUIDES FOR AIR AND WATER
(from DOE 5400.5, Change 1, 6-5-90)

APPENDIX D

DERIVED CONCENTRATION GUIDES FOR AIR AND WATER
(from DOE 5400.5, Change 1, 6-5-90)

1. PURPOSE. The Derived Concentration Guide (DCG) values listed in this chapter are provided as reference values for conducting radiological environmental protection programs at operational DOE facilities and sites. Derived Air Concentrations (DAC) guides for controlling occupational intake of radionuclides through inhalation are listed in DOE 5480.11.

2. BASIS. The DCG values are presented for each of three exposure modes: 1) ingestion of water; 2) inhalation of air; and 3) immersion in a gaseous cloud. The DCG values for internal exposure shown in Figure III-1 are based on a committed effective dose equivalent of 100 mrem for the radionuclide taken into the body by ingestion or inhalation during one year. To use the DCGs for comparison with the DOE drinking water systems criterion of 4 mrem/yr (0.04 mSv/yr), use 4 percent of the DCG values for ingestion. Compliance with the 40 CFR Part 61, Subpart H, criterion of 10 mrem/yr (0.10 mSv/yr) effective dose equivalent is demonstrated using the AIRDOS/RADRISK models prescribed by the EPA. Alternative gastrointestinal-tract (GI-tract) absorption factors (f1) and lung retention classes (noted as D, W, or Y in the Task Group Lung Model used to produce the inhalation dose factors reported in ICRP Publication 30) are listed for specific compounds, by element, in Figure III-2 for cross-referencing with the internal DCGs in Figure III-1. The data in Figure III-2 are listed in alphabetical order, by element name. Removal half-times assigned to the compounds with lung retention classes D, W, and Y are 0.5, 50, and 500 days, respectively. The air immersion DCG values shown in Figure III-3 are based on an effective dose equivalent of 100 mrem from exposure during one year. Figure III-1 contains six columns of information: Radionuclide/Chemical Form/Isomer

Half-Life; f1 Value (GI-tract absorption); Ingested Water DCG (μCi/mL); Inhaled Air DCG for Lung Retention Class D (μCi/mL); and Inhaled Air DCG for Lung Retention Class W (μCi/mL); and Inhaled Air DCG for Lung Retention Class Y (μCi/mL). Figure III-2 contains five columns of information: Element/Symbol; Atomic Number; compound; f1 value; and Lung Retention Class. Figure III-3 contains three columns of information: Radionuclide; Half-life in units of seconds (s), minutes (min), hours (h), days (d), or years (yr); and Air Immersion DCG (μCi;mL).

a. Exposure Conditions for Ingestion of Water and Inhalation. Under conditions of continuous exposure, members of the public are assumed to ingest 730 liters of drinking water or to inhale 8,400 cubic meters of air (for exposure of 24 hours per day, 365 days per year), as given for the "reference man" in ICRP Publication 23. Only single modes of exposure were considered in the calculation of the DCGs - that is, they apply to either inhalation or ingestion, not to a combination of both. The dose factors used to calculate the DCG values for internal exposure were taken from the report "Internal Dose Conversion Factors for Calculation of Dose to the Public" (DOE/EH-0071). For ingestion, DCG values are tabulated for all values of f1 for each radionuclide given in ICRP Publication 30, as modified for several transuranic elements by ICRP Publication 48. For inhalation, DCG values are given for all combinations of f1 and lung retention class (D, in, or Y) given by the ICRP, as tabulated in Figure III-2. For radionuclides with multiple f1 listings, where specific data for an airborne or liquid release are lacking, the f1 value that results in the most restrictive DCG for ingested water or inhaled air should be used.

b. Exposure Conditions for Air Immersion. The air immersion DCGs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite atmospheric cloud. The dose conversion factors used to calculate the DCG values for air immersion were taken from the report "External Dose-Rate Conversion Factors for Calculation

of Dose to the Public" (DOE/EH-0070). The DCG value for air immersion listed in Figure III-3 for a given radionuclide is determined either by a limit on annual effective dose equivalent, which provides a limit on stochastic radiation effects, or by a limit on annual dose equivalent to any organ, which provides a limit on non-stochastic radiation effects. For most of the radionuclides listed in Figure III-3, the DCG value is determined by the limit on annual effective dose equivalent. Thus, the few cases where the DCG value is determined by the limit on annual dose equivalent to skin are indicated in the figure by an appropriate footnote. Again, the DCGs listed in Figure III-3 account only for immersion in a semi-infinite cloud and do not account for inhalation or ingestion exposures. Three classes of radionuclides are included in the air immersion DCGs given in Figure III-3, as described below.

(1) Class 1. The first class of radionuclides includes selected noble gases and short-lived activation products that occur in gaseous form. For these radionuclides, inhalation doses are negligible compared to the external dose from immersion in an atmospheric cloud.

(2) Class 2. The second class of radionuclides includes those for which a DCG value for inhalation has been calculated (using the ICRP inhalation dose equivalent factors), but for which the DCG value for external exposure to a contaminated atmospheric cloud is more restrictive (i.e., results in a lower DCG value). These radionuclides generally have half-lives of a few hours or less, or are eliminated from the body following inhalation sufficiently rapidly to limit the inhalation dose.

(3) Class 3. The third class of radionuclides includes selected isotopes with relatively short half-lives that were not considered in ICRP Publication 30. These radionuclides typically have half-lives that are less than 10 minutes, they do not

occur as a decay product of a longer-lived radionuclide, or they lack sufficient decay data to permit internal dose calculations. These radionuclides are also typified by a radioactive emission of highly intense, high-energy photons and rapid removal from the body following inhalation.

c. Application to Mixtures of Radionuclides. The DCG values are given for individual radionuclides. For known mixtures of radionuclides, the sum of the ratios of the observed concentration of each radionuclide to its corresponding DCG must not exceed 1.0.

3. LIMITATIONS. The values given in Figures III-1 and 111-3 account for only three exposure pathways (ingested water or inhaled air or air immersion) and do not include other potentially significant pathways. When more complex environmental pathways are involved, a more complete pathway analysis is required for calculating public radiation doses resulting from the operation of DOE facilities.

Figure III-1
Derived Concentration Guides (DCGs) for Members of the Public from Ingested Water and Inhalation Resulting in 100 mrem/yr

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
H-3 (Water)		2.E-03	/1	1.E-072/2	
H-3 (Elemental)				2.E-02/2	
Be-7	5.E-03	1.E-03		5.E-08	4.E-08
Be-10	5.E-03	3.E-05		4.E-10	3.E-11
C-11 (Org)		1.E-02		1.E-06	
C-11 (CO)			3.E-06		
C-11 (CO2)			1.E-06		
C-14 (Org)		7.E-02		6.E-09	
C-14 (CO)			4.E-06		
C-14 (CO2)			5.E-07		
F-18/3	1.E+00	1.E-03	2.E-07	2.E-07	2.E-07
Na-22	1.E+00	1.E-05	1.E-09		
Na-24/3	1.E+00	1.E-04	1.E-08		
Mg-28	5.E-01	2.E-05	4.E-09	3.E-09	
Al-26	1.E-02	1.E-05	1.E-10	2.E-10	
Si-31	1.E-02	3.E-04	6.E-08	7.E-08	6.E-08
Si-32	1.E-02	8.E-05	6.E-10	3.E-10	1.E-11
P-32	8.E-01	2.E-05	2.E-09	9.E-10	
P-33	8.E-01	2.E-04	2.E-08	6.E-09	
S-35	8.E-01	3.E-04	4.E-08	5.E-09	
	1.E-01	2.E-04			
S-35 (Gas)			3.E-08		
Cl-36/3	1.E+00	5.E-05	6.E-09	6.E-10	
Cl-38	1.E+00	7.E-04	1.E-07	1.E-07	
Cl-39	1.E+00	1.E-03	1.E-07	1.E-07	
K-40	1.E+00	7.E-06	9.E-10		
K-42	1.E+00	1.E-04	1.E-08		
K-43/3	1.E+00	2.E-04	2.E-08		
K-44	1.E+00	9.E-04	2.E-07		
K-45	1.E+00	1.E-03	3.E-07		

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Ca-41	3.E-01	1.E-04		9.E-09	
Ca-45	3.E-01	5.E-05		2.E-09	
Ca-47	3.E-01	2.E-05		2.E-09	
Sc-43	1.E-04	2.E-04			5.E-08
Sc-44m	1.E-04	1.E-05			2.E-09
Sc-44/3	1.E-04	1.E-04			3.E-08
Sc-46	1.E-04	2.E-05			6.E-10
Sc-47	1.E-04	7.E-05			7.E-09
Sc-48	1.E-04	2.E-05			3.E-09
Sc-49	1.E-04	6.E-04			1.E-07
Ti-44	1.E-02	7.E-06	3.E-11	7.E-11	1.E-11
Ti-45/3	1.E-02	2.E-04	6.E-08	8.E-08	7.E-08
V-47	1.E-02	9.E-04	2.E-07	2.E-07	
V-48	1.E-02	2.E-05	3.E-09	2.E-09	
V-49	1.E-02	3.E-03	8.E-08	4.E-08	
Cr-48	1.E-01	2.E-04	3.E-08	2.E-08	2.E-08
	1.E-02	2.E-04			
Cr-49/3	1.E-01	8.E-04	2.E-07	2.E-07	2.E-07
	1.E-02	8.E-04			
Cr-51	1.E-01	1.E-03	1.E-07	6.E-08	5.E-08
	1.E-02	1.E-03			
Mn-51	1.E-01	6.E-04	1.E-07	1.E-07	
Mn-52m/3	1.E-01	9.E-04	2.E-07	2.E-07	
Mn-52	1.E-01	2.E-05	3.E-09	2.E-09	
Mn-53	1.E-01	1.E-03	6.E-08	3.E-08	
Mn-54	1.E-01	5.E-05	2.E-09	2.E-09	
Mn-56/3	1.E-01	1.E-04	4.E-08	5.E-08	
Fe-52	1.E-01	3.E-05	7.E-09	6.E-09	
Fe-55	1.E-01	2.E-04	5.E-09	1.E-08	
Fe-59	1.E-01	2.E-05	8.E-10	1.E-09	
Fe-60	1.E-01	9.E-07	2.E-11	4.E-11	
Co-55	5.E-02	3.E-05		7.E-09	6.E-09
	3.E-01	4.E-05			
Co-56	5.3-02	1.E-05		7.E-10	5.E-10

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Co-56	3.E-01	1.E-05			
Co-57	5.E-02	2.E-04		7.E-09	2.E-09
	3.E-01	1.E-04			
Co-58m	5.E-02	2.E-03		2.E-01	2.E-07
	3.E-01	2.E-03			
Co-58	5.E-02	5.E-05		3.E-09	2.E-09
	3.E-01	4.E-05			
Co-60m/3	5.E-02	4.E-02		9.E-06	6.E-06
	3.E-01	4.E-02			
Co-60	5.E-02	1.E-05		4.E-10	8.E-11
	3.E-01	5.E-06			
Co-61	5.E-02	5.E-04		1.E-07	1.E-07
	3.E-01	6.E-04			
Co-62m	5.E-02	1.E-03		4.E-07	4.E-07
	3.E-01	1.E-03			
Ni-56	5.E-02	4.E-05	5.E-09	3.E-09	
Ni-56 (Vapor)			3.E-09		
Ni-57/3	5.E-02	4.E-05	1.E-08	7.E-09	
Ni-57 (Vapor)			1.E-08		
Ni-59	5.E-02	7.E-04	9.E-09	2.E-08	
Ni-59 (Vapor)			4.E-09		
Ni-63	5.E-02	3.E-04	4.E-09	6.E-09	
Ni-63 (Vapor)			2.E-09		
Ni-65/3	5.E-02	2.E-04	6.E-08	7.E-08	
Ni-65 (Vapor)			4.E-08		
Ni-66	5.E-02	1.E-05	4.E-09	1.E-09	
Ni-66 (Vapor)			7.E-09		
Cu-60	5.E-01	8.E-04	2.E-07	3.E-07	2.E-07
Cu-61/3	5.E-01	3.E-04	7.E-08	1.E-07	8.E-08
Cu-64	5.E-01	3.E-04	7.E-08	5.E-08	5.E-08
Cu-67	5.E-01	1.E-04	2.E-08	1.E-08	1.E-08
Zn-62	5.E-01	4.E-05			7.E-09
Zn-63	5.E-01	7.E-04			2.E-07
Zn-65	5.E-01	9.E-06			6.E-10
Zn-69m	5.E-01	1.E-04			2.E-08
Zn-69	5.E-01	2.E-03			3.E-07
Zn-71m	5.E-01	2.E-04			4.E-08
Zn-72	5.E-01	3.E-05			3.E-09
Ga-65	1.E-03	2.E-03	4.E-07	5.E-07	
Ga-66/3	1.E-03	3.E-05	8.E-09		7.E-09

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Ga-67	1.E-03	2.E-04	3.E-05	2.E-08	
Ga-68/3	1.E-03	4.E-04	1.E-01	1.E-07	
Ga-70	1.E-03	2.E-03	4.E-01	5.E-07	
Ga-72/3	1.E-03	3.E-05	8.E-09	7.E-09	
Ga-73	1.E-03	1.E-04	4.E-08	4.E-08	
Ge-66	1.E+00	7.E-04	6.E-08	5.E-05	
Ge-67	1.E+00	1.E-03	2.E-07	2.E-07	
Ge-68	1.E+00	1.E-04	9.E-09	2.E-10	
Ge-69	1.E+00	4.E-04	4.E-05	2.E-08	
Ge-71	1.E+00	1.E-02	1.E-06	1.E-07	
Ge-75	1.E+00	2.E-03	2.E-07	2.E-07	
Ge-77	1.E+00	2.E-04	2.E-05	1.E-08	
Ge-78	1.E+00	7.E-04	5.E-08	5.E-08	
As-69	5.E-01	1.E-03		3.E-07	
As-70	5.E-01	4.E-04		1.E-07	
As-71	5.E-01	1.E-04		1.E-08	
As-72	5.E-01	2.E-05		3.E-09	
As-73	5.E-01	2.E-04		4.E-09	
As-74	5.E-01	4.E-05		2.E-09	
As-76	5.E-01	3.E-05		4.E-09	
As-77	5.E-01	1.E-04		1.E-08	
As-78	5.E-01	2.E-04		5.E-08	
Se-70	8.E-01	5.E-04	9.E-08	1.E-07	
	5.E-02	3.E-04			
Se-73m	8.E-01	2.E-03	4.E-07	3.E-07	
	5.E-02	9.E-04			
Se-73/3	8.E-01	2.E-04	3.E-08	4.E-08	
	5.E-02	9.E-05			
Se-75	8.E-01	2.E-05	2.E-09	1.E-09	
	5.E-02	8.E-05			
Se-79	8.E-01	2.E-05	2.E-09	1.E-09	
	5.E-02	1.E-04			
Se-81m	8.E-01	1.E-03	2.E-07	2.E-07	
	5.E-02	7.E-04			
Se-81	8.E-01	2.E-03	5.E-07	6.E-07	
	5.E-02	2.E-03			
Se-83	8.E-01	1.E-03	3.E-07	3.E-07	
	5.E-02	9.E-04			
Br-74m	1.E+00	6.E-04	9.E-08	1.E-07	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Br-74	1.E+00	1.E-03	2.E-07	2.E-07	
Br-75	1.E+00	1.E-03	1.E-07	1.E-07	
Br-76	1.E+00	1.E-04	1.E-08	1.E-08	
Br-77/3	1.E+00	4.E-04	6.E-08	5.E-08	
Br-80m	1.E+00	6.E-04	4.E-08	3.E-08	
Br-80/3	1.E+00	2.E-03	4.E-07	5.E-07	
Br-82/3	1.E+00	8.E-05	1.E-08	9.E-09	
Br-83	1.E+00	2.E-03	2.E-07	1.E-07	
Br-84/3	1.E+00	9.E-04	1.E-07	2.E-07	
Rb-79	1.E+00	2.E-03	3.E-07		
Rb-81m	1.E+00	1.E-03	8.E-07		
Rb-81/3	1.E+00	1.E-03	1.E-07		
Rb-82m	1.E+00	3.E-04	4.E-08		
Rb-83	1.E+00	2.E-05	2.E-09		
Rb-84	1.E+00	1.E-05	2.E-09		
Rb-86	1.E+00	1.E-05	2.E-09		
Rb-87	1.E+00	3.E-05	4.E-09		
Rb-88/3	1.E+00	8.E-04	1.E-07		
Rb-89/3	1.E+00	2.E-03	3.E-07		
Sr-80	3.E-01	3.E-02	5.E-06		
	1.E-02	3.E-02			6.E-06
Sr-81	3.E-01	1.E-04	2.E-07		
	1.E-02	6.E-04			2.E-07
Sr-83	3.E-01	8.E-05	2.E-08		
	1.E-02	6.E-05			8.E-09
Sr-85m/3	3.E-01	6.E-03	1.E-06		
	1.E-02	6.E-03			2.E-06
Sr-85	3.E-01	7.E-05	6.E-09		
	1.E-02	1.E-04			4.E-09
Sr-87m/3	3.E-01	1.E-03	3.E-07		
	1.E-02	1.E-03			4.E-07
Sr-89	3.E-01	2.E-05	2.E-09		
	1.E-02	2.E-05			3.E-10
Sr-90	3.E-01	1.E-06	5.E-11		
	1.E-02	1.E-05			9.E-12
Sr-91	3.E-01	6.E-05	1.E-08		
	1.E-02	5.E-05			8.E-09
Sr-92/3	3.E-01	9.E-05	2.E-08		
	1.E-02	7.E-05			2.E-08
Y-86m	1.E-04	6.E-04		1.E-07	1.E-07
Y-86/3	1.E-04	3.E-05		8.E-09	7.E-09
Y-87	1.E-04	6.E-05		8.E-09	7.E-09
Y-88	1.E-04	3.E-05		6.E-10	6.E-10
Y-90m/3	1.E-04	2.E-04		3.E-08	3.E-08
Y-90	1.E-04	1.E-05		2.E-09	1.E-09
Y-91m/3	1.E-04	4.E-03		6.E-07	4.E-07
Y-91	1.E-04	2.E-05		4.E-10	3.E-10
Y-92	1.E-04	7.E-05		2.E-08	2.E-08
Y-93	1.E-04	3.E-05		7.E-09	6.E-09
Y-94	1.E-04	8.E-04		2.E-07	2.E-07
Y-95	1.E-04	1.E-03		4.E-07	3.E-07
Zr-86	2.E-03	4.E-05	9.E-09	6.E-09	6.E-09
Zr-88	2.E-03	1.E-04	5.E-10	1.E-09	7.E-10
Zr-89	2.E-03	4.E-05	8.E-09	6.E-09	6.E-09
Zr-93	2.E-03	9.E-05	4.E-11	1.E-10	2.E-10
Zr-95	2.E-03	4.E-05	6.E-10	9.E-10	7.E-10
Zr-97	2.E-03	2.E-05	5.E-09	3.E-09	3.E-09
Nb-88	1.E-02	2.E-03		5.E-07	5.E-07
Nb-89 (66 min)	1.E-02	3.E-04		1.E-07	9.E-08
Nb-89 (122min)	1.E-02	1.E-04		4.E-08	4.E-08
Nb-90	1.E-02	3.E-05		6.E-09	6.E-09
Nb-93m	1.E-02	3.E-04		3.E-09	4.E-10
Nb-94	1.E-02	3.E-05		5.E-10	4.E-11
Nb-95m	1.E-02	7.E-05		6.E-09	5.E-09
Nb-95	1.E-02	6.E-05		3.E-09	3.E-09
Nb-96	1.E-02	3.E-05		6.E-09	6.E-09
Nb-97/3	1.E-02	6.E-04		2.E-07	2.E-07
Nb-98	1.E-02	4.E-04		1.E-07	1.E-07
Mo-90	8.E-01	1.E-04	2.E-08		
	5.E-02	6.E-05			1.E-08
Mo-93m	8.E-01	3.E-04	4.E-08		
	5.E-02	1.E-04			3.E-08
Mo-93	8.E-01	1.E-04	1.E-08		
	5.E-02	6.E-04			4.E-10
Mo-99	8.E-01	5.E-05	6.E-09		
	5.E-02	3.E-05			3.E-09
Mo-101/3	8.E-01	2.E-03	3.E-07		
	5.E-02	1.E-03			4.E-07
Tc-93m	8.E-01	2.E-03	4.E-07	7.E-07	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Tc-93	8.E-01	8.E-04	2.E-07	2.E-07	
Tc-94m	8.E-01	5.E-04	1.E-07	1.E-07	
Tc-94	8.E-01	2.E-04	4.E-08	6.E-08	
Tc-96m/3	8.E-01	4.E-03	7.E-07	6.E-07	
Tc-96	8.E-01	5.E-05	7.E-09	5.E-09	
Tc-97m	8.E-01	1.E-04	2.E-08	3.E-09	
Tc-97	8.E-01	9.E-04	1.E-07	1.E-08	
Tc-98	8.E-01	3.E-05	4.E-09	7.E-10	
Tc-99m/3	8.E-01	2.E-03	4.E-07	6.E-07	
Tc-99	8.E-01	1.E-04	1.E-08	2.E-09	
Tc-101/3	8.E-01	4.E-03	8.E-07	9.E-07	
Tc-104	8.E-01	8.E-04	2.E-07	2.E-07	
Ru-94	5.E-02	4.E-04	1.E-07	1.E-07	1.E-07
Ru-97	5.E-02	2.E-04	4.E-08	3.E-08	3.E-08
Ru-103	5.E-02	5.E-05	4.E-09	2.E-09	2.E-09
Ru-105/3	5.E-02	1.E-04	3.E-08	3.E-08	3.E-08
Ru-106	5.E-02	6.E-06	2.E-10	1.E-10	3.E-11
Rh-99m	5.E-02	5.E-04	1.E-07	2.E-07	2.E-07
Rh-99	5.E-02	7.E-05	7.E-09	5.E-09	5.E-09
Rh-100	5.E-02	4.E-05	1.E-08	9.E-09	9.E-09
Rh-101m	5.E-02	2.E-04	3.E-08	2.E-08	2.E-08
Rh-101	5.E-02	6.E-05	1.E-09	2.E-09	4.E-10
Rh-102m	5.E-02	4.E-05	1.E-09	9.E-10	3.E-10
Rh-102	5.E-02	2.E-05	2.E-10	4.E-10	1.E-10
Rh-103m	5.E-02	1.E-02	3.E-06	3.E-06	3.E-06
Rh-105	5.E-02	1.E-04	3.E-08	1.E-08	1.E-08
Rh-106m	5.E-02	2.E-04	6.E-08	9.E-08	8.E-08
Rh-107	5.E-02	3.E-03	6.E-07	6.E-07	6.E-07
Pd-100	5.E-03	4.E-05	3.E-09	3.E-09	3.E-09
Pd-101	5.E-03	4.E-04	7.E-08	8.E-08	7.E-08
Pd-103	5.E-03	2.E-04	1.E-08	1.E-08	8.E-09
Pd-107	5.E-03	1.E-03	5.E-08	2.E-08	9.E-10
Pd-109	5.E-03	6.E-05	1.E-08	1.E-08	1.E-08
Ag-102	5.E-02	2.E-03	4.E-07	5.E-07	5.E-07
Ag-103	5.E-02	1.E-03	2.E-07	3.E-07	3.E-07
Ag-104m	5.E-02	9.E-04	2.E-07	3.E-07	3.E-07
Ag-104	5.E-02	6.E-04	2.E-07	4.E-07	4.E-07
Ag-105	5.E-02	7.E-05	3.E-09	4.E-09	4.E-09
Ag-106m	5.E-02	2.E-05	2.E-09	2.E-09	2.E-09
Ag-106	5.E-02	2.E-03	4.E-07	5.E-07	5.E-07
Ag-108m	5.E-02	2.E-05	4.E-10	6.E-10	6.E-11
Ag-110m	5.E-02	1.E-05	3.E-10	4.E-10	2.E-10
Ag-111	5.E-02	3.E-05	4.E-09	2.E-09	2.E-09
Ag-112	5.E-02	9.E-05	2.E-08	2.E-08	2.E-08
Ag-115	5.E-02	9.E-04	2.E-07	2.E-07	2.E-07
Cd-104	5.E-02	6.E-04	2.E-07	3.E-07	3.E-07
Cd-107	5.E-02	6.E-04	1.E-07	1.E-07	1.E-07
Cd-109	5.E-02	1.E-05	1.E-10	3.E-10	3.E-10
Cd-113m	5.E-02	9.E-07	8.E-12	3.E-11	3.E-11
Cd-113	5.E.02	8.E-07	8.E-12	3.E-11	3.E-11
Cd-115m	5.E-02	9.E-06	2.E-10	3.E-10	3.E-10
Cd-115	5.E-02	3.E-05	3.E-09	3.E-09	3.E-09
Cd-117m/3	5.E-02	1.E-04	3.E-08	4.E-08	3.E-08
Cd-117/3	5.E-02	1.E-04	3.E-08	4.E-08	3.E-08
In-109	2.E-02	5.E-04	1.E-07	2.E-07	
In-110 (69min)	2.E-02	4.E-04	1.E-07	1.E-07	
In-110 (5 h)	2.E-02	1.E-04	4.E-08	5.E-08	
In-111	2.E-02	1.E-04	2.E-08	2.E-08	
In-112	2.E-02	6.E-03	1.E-06	2.E-06	
In-113m/3	2.E-02	1.E-03	3.E-07	5.E-07	
In-114m	2.E-02	9.E-06	2.E-10	2.E-10	
In-115m	2.E-02	4.E-04	1.E-07	1.E-07	
In-115	2.E-02	1.E-06	3.E-12	1.E-11	
In-116m/3	2.E-02	1.E-04	2.E-07	3.E-07	
In-117m	2.E-02	3.E-04	8.E-08	1.E-07	
In-117/3	2.E-02	2.E-03	4.E-07	5.E-07	
In-119m	2.E-02	1.E-03	3.E-07	3.E-07	
Sn-110	2.E-02	9.E-05	3.E-08	3.E-08	
Sn-111	2.E-02	2.E-03	5.E-07	6.E-07	
Sn-113	2.E-02	5.E-05	3.E-09	1.E-09	
Sn-117m	2.E-02	5.E-05	5.E-09	3.E-09	
Sn-119m	2.E-02	1.E-04	6.E-09	2.E-09	
Sn-121m	2.E-02	1.E-04	2.E-09	1.E-09	
Sn-121	2.E-02	2.E-04	4.E-08	3.E-08	
Sn-123m	2.E-02	1.E-03	3.E-07	3.E-07	
Sn-123	2.E-02	2.E-05	1.E-09	4.E-10	
$n-125	2.E-02	1.E-05	2.E-09	8.E-10	
Sn-126	2.E-02	8.E-06	1.E-10	2.E-10	
Sn-127	2.E-02	2.E-04	5.E-08	4.E-08	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Sn-128	2.E-02	3.E-04	6.E-08	9.E-08	
Sb-115	1.E-01	2.E-03	6.E-07		
	1.E-02	2.E-03		7.E-07	
Sb-116m	1.E-01	6.E-04	2.E-07		
	1.E-02	6.E-04		3.E-07	
Sb-116	1.E-01	2.E-03	7.E-07		
	1.E-02	2.E-03		8.E-07	
Sb-117/3	1.E-01	2.E-03	5.E-07		
	1.E-02	2.E-03		7.E-07	
Sb-118m	1.E-01	2.E-04	5.E-08		
	1.E-02	1.E-04		5.E-08	
Sb-119	1.E-01	4.E-04	1.E-07		
	1.E-02	4.E-04		6.E-08	
Sb-120 (16min)	1.E-01	5.E-03	1.E-06		
	1.E-02	5.E-03		1.E-06	
Sb-120 (6 d)	1.E-01	3.E-05	5.E-09		
	1.E-02	3.E-05		3.E-09	
Sb-122	1.E-01	2.E-05	5.E-09		
	1.E-02	2.E-05		3.E-09	
Sb-124m	1.E-01	7.E-03	2.E-06		
	1.E-02	7.E-03		1.E-06	
Sb-124	1.E-01	2.E-05	2.E-09		
	1.E-02	1.E-05		6.E-10	
Sb-125	1.E-01	6.E-05	6.E-09		
	1.E-02	5.E-05		1.E-09	
Sb-126m/3	1.E-01	2.E-03	4.E-07		
	1.E-02	2.E-03		5.E-07	
Sb-126	1.E-01	2.E-05	3.E-09		
	1.E-02	1.E-05		1.E-09	
Sb-127	1.E-01	2.E-05	5.E-09		
	1.E-02	2.E-05		2.E-09	
Sb-128 (9 h)	1.E-01	3.E-05	1.E-08		
	1.E-02	3.E-05		8.E-09	
Sb-128 (10min)	1.E-01	3.E-03	9.E-07		
	1.E-02	3.E-03		1.E-06	
Sb-129/3	1.E-01	5.E-05	2.E-08		
	1.E-02	8.E-05		2.E-08	
Sb-130	1.E-01	5.E-04	1.E-07		
	1.E-02	5.E-04		2.E-07	
Sb-131	1.E-01	5.E-04	9.E-08		
	1.E-02	5.E-04		1.E-07	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Te-116	2.E-01	2.E-04	5.E-08	7.E-08	
Te-121m	2.E-01	2.E-05	9.E-10	1.E-09	
Te-121	2.E-01	9.E-05	1.E-08	7.E-09	
Te-123m	2.E-01	3.E-05	1.E-09	1.E-09	
Te-123	2.E-01	3.E-05	1.E-09	3.E-09	
Te-125m	2.E-01	4.E-05	2.E-09	2.E-09	
Te-127m	2.E-01	2.E-05	1.E-09	6.E-10	
Te-127	2.E-01	2.E-04	5.E-08	4.E-08	
Te-129m	2.E-01	1.E-05	1.E-09	6.E-10	
Te-129	2.E-01	7.E-04	2.E-07	2.E-07	
Te-131m	2.E-01	9.E-06	3.E-09	2.E-09	
Te-131	2.E-01	7.E-04	1.E-07	1.E-07	
Te-132	2.E-01	2.E-05	2.E-09	2.E-09	
Te-133m/3	2.E-01	2.E-04	3.E-08	3.E-08	
Te-133/3	2.E-01	9.E-04	1.E-07	1.E-07	
Te-134/3	2.E-01	7.E-04	1.E-07	1.E-07	
I-120m	1.E+00	4.E-04	5.E-08		
I-120	1.E+00	2.E-04	3.E-08		
I-121	1.E+00	8.E-04	1.E-07		
I-123	1.E+00	3.E-04	4.E-08		
I-124	1.E+00	4.E-06	6.E-10		
I-125	1.E+00	4.E-06	5.E-10		
I-126	1.E+00	2.E-06	3.E-10		
I-128/3	1.E+00	2.E-03	3.E-07		
I-129	1.E+00	5.E-07	7.E-11		
I-130	1.E+00	3.E-05	5.E-09		
I-131	1.E+00	3.E-06	4.E-10		
I-132m	1.E+00	3.E-04	5.E-08		
I-132/3	1.E+00	2.E-04	4.E-08		
I-133	1.E+00	1.E-05	2.E-09		
I-134/3	1.E+00	7.E-04	1.E-07		
I-135/3	1.E+00	7.E-05	1.E-08		
Cs-125	1.E+00	2.E-03	3.E-07		
Cs-127	1.E+00	2.E-03	2.E-07		
Cs-129/3	1.E+00	6.E-04	8.E-08		
Cs-130	1.E+00	3.E-03	4.E-07		
Cs-131	1.E+00	6.E-04	7.E-08		
Cs-132	1.E+00	7.E-05	1.E-08		
Cs-134m	1.E+00	3.E-03	3.E-07		
Cs-134	1.E+00	2.E-06	2.E-10		
Cs-135m	1.E+00	3.E-03	5.E-07		

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Cs-135	1.E+00	2.E-05	3.E-09		
Cs-136	1.E+00	1.E-05	2.E-09		
Cs-137	1.E+00	3.E-06	4.E-10		
Cs-138/3	1.E+00	9.E-04	1.E-07		
Ba-126	1.E-01	2.E-04	4.E-08		
Ba-128	1.E-01	1.E-05	4.E-09		
Ba-131m	1.E-01	1.E-02	3.E-06		
Ba-131	1.E-01	8.E-05	2.E-08		
Ba-133m	1.E-01	7.E-05	2.E-08		
Ba-133	1.E-01	4.E-05	2.E-09		
Ba-135m	1.E-01	9.E-05	3.E-05		
Ba-139	1.E-01	3.E-04	7.E-08		
Ba-140	1.E-01	2.E-05	3.E-09		
Ba-141/3	1.E-01	7.E-04	2.E-07		
Ba-142/3	1.E-01	1.E-03	3.E-07		
La-131	1.E-03	1.E-03	3.E-07	4.E-07	
La-132	1.E-03	9.E-05	2.E-05	3.E-08	
La-135	1.E-03	1.E-03	3.E-07	2.E-07	
La-137	1.E-03	3.E-04	2.E-10	6.E-10	
La-138	1.E-03	2.E-05	8.E-12	3.E-11	
La-140	1.E-03	2.E-05	3.E-09	3.E-09	
La-141	1.E-03	1.E-04	2.E-08	3.E-08	
La-142	1.E-03	2.E-04	5.E-08	8.E-08	
La-143	1.E-03	1.E-03	2.E-07	2.E-07	
Ce-134	3.E-04	2.E-05		2.E-09	2.E-09
Ce-135	3.E-04	4.E-05		9.E-09	8.E-09
Ce-137m	3.E-04	7.E-05		1.E-08	9.E-09
Ce-137	3.E-04	1.E-03		3.E-07	3.E-07
Ce-139	3.E-04	1.E-04		2.E-09	2.E-09
Ce-141	3.E-04	5.3-05		2.E-09	1.E-09
Ce-143	3.E-04	3.E-05		4.E-09	4.E-09
Ce-144	3.E-04	7.E-06		6.E-11	3.E-11
Pr-136	3.E-04	2.E-03		6.E-07	5.E-07
Pr-137	3.E-04	1.E-03		4.E-07	3.E-07
Pr-138m	3.E-04	3.E-04		1.E-07	1.E-07
Pr-139	3.E-04	1.E-03		3.E-07	3.E-07
Pr-142m	3.E-04	2.E-03		4.E-07	3.E-07
Pr-142	3.E-04	3.E-05		5.E-09	4.E-09
Pr-143	3.E-04	3.E-05		2.E-09	2.E-09

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Pr-144	3.E-04	1.E-03		3.E-07	3.E-07
Pr-145	3.E.04	9.E-05		2.E-08	2.E-08
Pr-147	3.E-04	2.E-03		5.E-07	4.E-07
Nd-136	3.E-04	4.E-04		1.E-07	1.E-07
Nd-138	3.E-04	5.E-05		2.E-08	1.E-08
Nd-139m	3.E-04	1.E-04		4.E-08	3.E-08
Nd-139	3.E-04	2.E-03		8.E-07	7.E-07
Nd-141	3.E-04	4.E-03		2.E-06	1.E-06
Nd-147	3.E-04	4.E-05		2.E-09	2.E-09
Nd-149/3	3.E-04	3.E-04		6.E-08	6.E-08
Nd-151	3.E-04	2.E-03		5.E-07	4.E-07
Pm-141	3.E-04	2.E-03		4.E-07	4.E-07
Pm-143	3.E-04	1.E-04		1.E-09	2.E-09
Pm-144	3.E-04	3.E-05		3.E-10	3.E-10
Pm-145	3.E-04	3.E-04		5.E-10	4.E-10
Pm-146	3.E-04	4.E-05		1.E-10	1.E-10
Pm-147	3.E-04	1.E-04		5.E-10	3.E-10
Pm-148m	3.E-04	2.E-05		7.E-10	7.E-10
Pm-148	3.E-04	1.E-05		1.E-09	1.E-09
Pm-149	3.E-04	4.E-05		4.E-08	4.E-09
Pm-150	3.E-04	1.E-04		4.E-08	4.E-08
Pm-151	3.E-04	5.E-05		8.E-09	7.E-09
Sm-141m	3.E-04	8.E-04		2.E-07	
Sm-141	3.E-04	2.E-03		4.E-07	
Sm-142	3.E-04	2.E-04		6.E-08	
Sm-145	3.E-04	2.E-04		1.E-09	
Sm-146	3.E-04	7.E-07		2.E-13	
Sm-147	3.E-04	8.E-07		2.E-13	
Sm-151	3.E-04	4.E-04		4.E-10	
Sm-153	3.E-04	5.E-05		7.E-09	
Sm-155	3.E-04	2.E-03		5.E-07	
Sm-156	3.E-04	1.E-04		2.E-08	
Eu-145	1.E-03	4.E-05		5.E.09	
Eu-146	1.E-03	3.E-05		3.E-09	
Eu-147	1.E-03	8.E-05		4.E-09	
Eu-148	1.E-03	3.E-05		8.E-10	
Eu-149	1.E-03	3.E-04		7.E-09	
Eu-150 (12 h)	1.E-03	9.E-05		2.E-08	
Eu-150 (34 yr)	1.E-03	2.E-05		4.E-11	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Eu-152m	1.E-03	7.E-05		2.E-08	
Eu-152	1.E-03	2.E-05		5.E-11	
Eu-154	1.E-03	2.E-05		5.E-11	
Eu-155	1.E-03	1.E-04		3.E-10	
Eu-156	1.E-03	2.E-05		1.E-09	
Eu-157	1.E-03	6.E-05		1.E-08	
Eu-158	1.E-03	5.E-04		1.E-07	
Gd-145	3.E-04	1.E-03	4.E-07	4.E-07	
Gd-146	3.E-04	4.E-05	3.E-10	7.E-10	
Gd-147	3.E-04	5.E-05	1.E-08	8.E-09	
Gd-148	3.E-04	7.E-07	4.E-14	1.E-13	
Gd-149	3.E-04	8.E-05	5.E-09	6.E-09	
Gd-151	3.E-04	2.E-04	1.E-09	3.E-09	
Gd-152	3.E-04	9.E-07	5.E-14	2.E-13	
Gd-153	3.E-04	1.E-04	6.E-10	1.E-09	
Gd-159	3.E-04	7.E-05	2.E-08	1.E-08	
Tb-147	3.E-04	2.E-04		7.E-08	
Tb-149	3.E-04	1.E-04		2.E-09	
Tb-150	3.E-04	1.E-04		5.E-08	
Tb-151	3.E-04	1.E-04		2.E-08	
Tb-153	3.E-04	1.E-04		2.E-08	
Tb-154	3.E-04	5.E-05		1.E-08	
Tb-155	3.E-04	2.E-04		2.E-08	
Tb-156m (24 h)	3.E-04	2.E-04		2.E-08	
Tb-156m (5 h)	3.E-04	4.E-04		6.E-08	
Tb-156	3.E-04	3.E-05		3.E-09	
Tb-157	3.E-04	1.E-03		1.E-09	
Tb-158	3.E-04	3.E-05		5.E-11	
Tb-160	3.E-04	2.E-05		5.E-10	
Tb-161	3.E-04	5.E-05		4.E-09	
Dy-155	3.E-04	2.E-04		6.E-08	
Dy-157/3	3.E-04	5.E-04		2.E-07	
Dy-159	3.E-04	3.E-04		6.E-09	
Dy-165	3.E-04	4.E-04		1.E-07	
Dy-166	3.E-04	2.E-05		2.E-09	
Ho-155	3.E-04	1.E-03		4.E-07	
Ho-157	3.E-04	7.E-03		3.E-06	
Ho-159	3.E-04	6.E-03		2.E-06	
Ho-161	3.E-04	3.E-03		1.E-06	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Ho-162m	3.E-04	2.E-03		6.E-07	
Ho-162	3.E-04	2.E-02		6.E-06	
Ho-164m	3.E-04	3.E-03		7.E-07	
Ho-164	3.E-04	6.E-03		1.E-06	
Ho-166m	3.E-04	2.E-05		2.E-11	
Ho-166	3.E-04	2.E-05		4.E-09	
Ho-167	3.E-04	4.E-04		1.E-07	
Er-161	3.E-04	4.E-04		2.E-07	
Er-165	3.E-04	2.E-03		4.E-07	
Er-169	3.E-04	1.E-04		6.E-09	
Er-171	3.E-04	1.E-04		2.E-08	
Er-172	3.E-04	4.E-05		3.E-09	
Tm-162	3.E-04	2.E-03		7.E-07	
Tm-166	3.E-04	1.E-04		3.E-08	
Tm-167	3.E-04	7.E-05		5.E-09	
Tm-170	3.E-04	3.E-05		5.E-10	
Tm-171	3.E-04	4.E-04		1.E-09	
Tm-172	3.E-04	2.E-05		3.E-09	
Tm-173	3.E-04	1.E-04		3.E-08	
Tm-175	3.E-04	3.E-03		6.E-07	
Yb-161	3.E-04	2.E-03		7.E-07	7.E-07
Yb-166	3.E-04	4.E-05		5.E-09	4.E-09
Yb-167	3.E-04	8.E-03		2.E-06	2.E-06
Yb-169	3.E-04	5.E-05		2.E-09	2.E-09
Yb-175	3.E-04	9.E-05		8.E-09	8.E-09
Yb-177	3.E-04	4.E-04		1.E-07	1.E-07
Yb-178	3.E-04	4.E-04		1.E-07	9.E-08
Lu-169	3.E-04	7.E-05		1.E-08	1.E-08
Lu-170	3.E-04	3.E-05		5.E-09	5.E-09
Lu-171	3.E-04	5.E-05		4.E-09	5.E-09
Lu-172	3.E-04	3.E-05		3.E-09	3.E-09
Lu-173	3.E-04	1.E-04		1.E-09	6.E-10
Lu-174m	3.E-04	8.E-05		8.E-10	5.E-10
Lu-174	3.E-04	1.E-04		6.E-10	4.E-10
Lu-176m	3.E-04	2.E-04		6.E-08	5.E-08
Lu-176	3.E-04	2.E-05		3.E-11	2.E-11
Lu-177m	3.E-04	2.E-05		3.E-10	2.E-10
Lu-177	3.E-04	7.E-05		5.E-09	5.E-09
Lu-178m	3.E-04	2.E-03		4.E-07	4.E-07

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Lu-178	3.E-04	1.E-03		3.E-07	3.E-07
Lu-179	3.E-04	2.E-04		4.E-08	4.E-08
Hf-170	2.E-03	7.E-05	1.E-08	1.E-08	
Hf-172	2.E-03	3.E-05	4.E-11	1.E-10	
Hf-173	2.E-03	1.E-04	3.E-08	3.E-08	
Hf-175	2.E-03	8.E-05	2.E-09	3.E-09	
Hf-177m	2.E-03	5.E-04	1.E-07	2.E-07	
Hf-178m	2.E-03	7.E-06	6.E-12	2.E-11	
Hf-179m	2.E-03	3.E-05	1.E-09	1.E-09	
Hf-180m	2.E-03	2.E-04	5.E-08	6.E-08	
Hf-181	2.E-03	3.E-05	9.E-10	1.E-09	
Hf-182m	2.E-03	1.E-03	2.E-07	3.E-07	
Hf-182	2.E-03	1.E-05	4.E-12	2.E-11	
Hf-183	2.E-03	6.E-04	1.E-07	1.E-07	
Hf-184	2.E-03	7.E-05	2.E-08	2.E-08	
Ta-172	1.E-03	1.E-03		3.E-07	2.E-07
Ta-173	1.E-03	2.E-04		5.E-08	4.E-08
Ta-174	1.E-03	7.E-04		2.E-07	2.E-07
Ta-175	1.E-03	2.E-04		4.E-08	3.E-08
Ta-176	1.E-03	1.E-04		3.E-08	3.E-08
Ta-177	1.E-03	3.E-04		5.E-08	4.E-08
Ta-178	1.E-03	5.E-04		2.E-07	2.E-07
Ta-179	1.E-03	6.E-04		1.E-08	2.E-09
Ta-180m	1.E-03	6.E-04		2.E-07	1.E-07
Ta-180	1.E-03	4.E-05		1.E-09	6.E-11
Ta-182m	1.E-03	6.E-03		1.E-06	1.E-06
Ta-182	1.E-03	2.E-05		7.E-10	3.E-10
Ta-183	1.E-03	3.E-05		3.E-09	2.E-09
Ta-184	1.E-03	5.E-05		1.E-08	1.E-08
Ta-185	1.E-03	7.E-04		2.E-07	2.E-07
Ta-186	1.E-03	2.E-03		5.E-07	5.E-07
W-176	1.E-02	3.E-04			
	3.E-01	4.E-04	1.E-07		
W-177	1.E-02	6.E-04			
	3.E-01	7.E-04	2.E-07		
W-178	1.E-02	1.E-04			
	3.E-01	2.E-04	5.E-08		
W-179	1.E-02	2.E-02			
	3.E-01	2.E-02	4.E-06		
W-181	1.E-02	4.E-04			

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
W-181	3.E-01	5.E-04	8.E-08		
W-185	1.E-02	7.E-05			
	3.E-01	1.E-04	2.E-08		
W-187	1.E-02	5.E-02			
	3.E-01	7.E-05	2.E-08		
W-188	1.E-02	2.E-05			
	3.E-01	2.E-05	3.E-09		
Re-177	8.E-01	3.E-03	6.E-07	8.E-07	
Re-178	8.E-01	3.E-03	6.E-07	7.E-07	
Re-181	8.E-01	1.E-04	2.E-08	2.E-08	
Re-182 (64 h)	8.E-01	4.E-05	6.E-09	5.E-09	
Re-182(12 h)/3	8.E-01	2.E-04	3.E-08	4.E-08	
Re-184m	8.E-01	6.E-05	7.E-09	1.E-09	
Re-184	8.E-01	6.E-05	8.E-09	3.E-09	
Re-186m	8.E-01	4.E-05	5.E-09	4.E-10	
Re-186	8.E-01	5.E-05	7.E-09	4.E-09	
Re-187	8.E-01	2.E-02	2.E-06	2.E-07	
Re-188m	8.E-01	2.E-03	3.E-07	3.E-07	
Re-188	8.E-01	5.E-05	7.E-09	6.E-09	
Re-189	8.E-01	9.E-05	1.E-08	1.E-08	
Os-180	1.E-02	3.E-03	9.E-07	1.E-06	1.E-06
Os-181	1.E-02	4.E-04	1.E-07	1.E-07	1.E-07
Os-182	1.E-02	6.E-05	1.E-08	1.E-08	9.E-09
Os-185	1.E-02	7.E-05	1.E-09	2.E-09	2.E-09
Os-189m	1.E-02	2.E-03	2.E-07	5.E-07	4.E-07
Os-191m	1.E-02	4.f-04	7.E-08	5.E-08	4.E-08
Os-191	1.E-02	7.E-05	5.E-09	4.E-09	3.E-09
Os-193	1.E-02	4.E-05	1.E-08	7.E-09	6.E-09
Os-194	1.E-02	2.E-05	1.E-10	1.E-10	2.E-11
Ir-182	1.E-02	1.E-03	3.E-07	4.E-07	3.E-07
Ir-184	1.E-02	2.E-04	6.E-08	7.E-08	6.E-08
Ir-185	1.E-02	1.E-04	3.E-08	3.E-08	2.E-08
Ir-186	1.E-02	6.E-05	2.E-08	1.E-08	1.E-08
Ir-187	1.E-02	3.E-04	7.R-08	7.E-08	6.E-08
Ir-188	1.E-02	5.E-05	1.E-08	8.E-09	8.E-09
Ir-189	1.E-02	1.E-04	1.E-08	9.E-09	9.E-09
Ir-190m/3	1.E-02	5.E-03	5.E-07	5.E-07	5.E-07
Ir-190	1.E-02	3.E-05	2.E-09	2.E-09	2.E-09
Ir-192m	1.E-02	9.E-05	2.E-10	2.E-10	4.E-11
Ir-192	1.E-02	3.E-05	6.E-10	9.E-10	5.E-10

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Ir-194m	1.E-02	2.E-05	2.E-10	4.E-10	2.E-10
Ir-194	1.E-02	3.E-05	7.E-09	5.E-09	4.E-09
Ir-195m	1.E-02	2.E-04	6.f-08	7.E-08	5.E-05
Ir-195	1.E-02	4.E-04	1.E-07	1.E-07	1.E-07
Pt-186	1.E-02	4.E-04	9.E-08		
Pt-188	1.E-02	4.E-05	4.E-09		
Pt-189	1.E-02	3.E-04	7.E-08		
Pt-191	1.E-02	1.E-04	2.E-08		
Pt-193m	1.E-02	8.E-05	1.E-08		
Pt-193	1.E-02	1.E-03	6.E-08		
Pt-195m	1.E-02	6.E-05	1.E-08		
Pt-197m	1.E-02	4.E-04	1.E-07		
Pt-197	1.E-02	9.E-05	2.E-08		
Pt-199	1.E-02	1.E-03	3.E-07		
Pt-200	1.E-02	3.E-05	8.E-09		
Au-193	1.E-01	2.E-04	3.E-08	4.E-08	4.E-08
Au-194	1.E-01	7.E-05	9.E-09	3.E-09	1.E-08
Au-195	1.E-01	1.E-04	1.E-08	3.E-09	1.E-09
Au-198m	1.E-01	2.E-05	3.E-09	2.E-09	2.E-09
Au-198	1.E-01	6.E-05	4.E-09	6.E-09	7.E-09
Au-199	1.E-01	8.E-05	8.E-09	8.E-09	8.E-09
Au-200m	1.E-01	3.E-05	4.E-09	5.E-09	6.E-09
Au-200	1.E-01	7.E-04	9.E-08	1.E-07	2.E-07
Au-201	1.E-01	2.E-03	3.E-07	5.E-07	5.E-07
Hg-193m (Org)	1.E+00	3.E-04	3.E-08		
	4.E-01	1.E-04			
Hg-193m	2.E-02	9.E-05	2.E-08	2.E-08	
Hg-193m (Vapor)			2.E-08		
Hg-193 (Org)	1.E+00	1.E-03	2.E-07		
	4.E-01	5.E-04			
Hg-193	2.E-02	4.E-04	1.E-07	1.E-07	
Hg-193 (Vapor)			7.E-08		
Hg-194 (Org)	1.E+00	5.E-07	7.E-11		
	4.E-01	1.E-06			
Hg-194	2.E-02	2.E-05	1.E-10	3.E-10	
Hg-194 (Vapor)			7.E-11		
Hg-195m (Org)	1.E+00	1.E-04	1.E-08		
	4.E-01	8.E-05			
Hg-195m	2.E-02	6.E-05	1.E-08	9.E-09	
Hg-195m (Vapor)			9.E-09		

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Hg-195 (Org)	1.E+00	1.E-03	1.E-07		
	4.E-01	5.E-04			
Hg-195	2.E-02	4.E-04	8.E-08	8.E-08	
Hg-195 (Vapor)			7.E-08		
Hg-197m (Org)	1.E+00	2.E-04	2.E-08		
	4.E-01	1.E-04			
Hg-197m	2.E-02	8.E-05	2.E-08	1.E-08	
Hg-197m (Vapor)			1.f-08		
kg-197 (Org)	1.E+00	3.E-04	3.E-08		
	4.E-01	2.E-04			
Hg-197	2.E-02	1.E-04	3.E-08	2.E-08	
Hg-197 (Vapor)			2.E-07		
Hg-199m (Org)	1.E+00	3.E-03	4.E-07		
	4.E-01	2.E-03			
Hg-199m	2.E-02	2.E-03	4.E-07	4.E-07	
Hg-199m (Vapor)			2.E-07		
Hg-203 (Org)	1.E+00	1.E-05	2.E-09		
	4.E-01	2.E-05			
Hg-203	2.E-02	7.E-05	3.E-09	3.E-09	
Hg-203 (Vapor)			2.E-09		
Tl-194m	1.E+00	2.E-03	4.E-07		
Tl-194	1.E+00	7.E-03	1.E-06		
Tl-195	1.E+00	2.E-03	3.E-07		
Tl-197	1.E+00	2.E-03	3.E-07		
Tl-198m	1.E+00	8.E-04	1.E-07		
Tl-198	1.E+00	5.E-04	7.E-08		
Tl-199	1.E+00	2.E-03	2.E-07		
Tl-200/3	1.E+00	2.E-04	3.E-08		
Tl-201	1.E+00	5.E-04	5.E-08		
Tl-202	1.E+00	9.E-05	1.E-08		
Tl-204	1.E+00	4.E-05	5.E-09		
Pb-195m	2.E-01	2.E-03	5.E-07		
Pb-198	2.E-01	9.E-04	2.E-07		
Pb-199	2.E-01	6.E-04	2.E-07		
Pb-200	2.E-01	9.E-05	1.E-08		
Pb-201	2.E-01	2.E-04	5.E-08		
Pb-202m	2.E-01	2.E-04	7.E-08		
Pb-202	2.E-01	4.E-06	1.E-10		
Pb-203	2.E-01	1.E-04	2.E-08		
Pb-205	2.E-01	9.E-05	3.E-09		
Pb-209	2.E-01	7.E-04	1.E-07		

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Pb-210	2.E-01	3.E-08	9.E-13		
Pb-211	2.E-01	3.E-04	1.E-09		
Pb-212	2.E-01	3.E-06	8.E-11		
Pb-214	2.E-01	2.E-04	2.E-09		
Bi-200	5.E-02	8.E-04	2.E-07	2.E-07	
Bi-201	5.E-02	3.E-04	7.E-08	9.E-08	
Bi-202	5.E-02	4.E-04	1.E-07	2.E-07	
Bi-203	5.E-02	7.E-05	2.E-08	1.E-08	
Bi-205	5.E-02	4.E-05	6.E-09	3.E-09	
Bi-206	5.E-02	2.E-05	3.E-09	2.E-09	
Bi-207	5.E-02	3.E-05	4.E-09	8.E-10	
Bi-210m	5.E-02	2.E-06	1.E-11	2.E-12	
Bi-210	5.E-02	2.E-05	9.E-10	6.E-11	
Bi-211	5.E-02	1.E-04	6.E-10	7.E-10	
Bi-213	5.E-02	2.E-04	7.E-10	8.E-10	
Bi-214	5.E-02	6.E-04	2.E-09	2.E-09	
Po-203	1.E-01	7.E-04	2.E-07	2.E-07	
Po-205	1.E-01	6.E-04	9.E-08	2.E-07	
Po-207	1.E-01	2.E-04	6.E-08	7.E-08	
Po-210	1.E-01	8.E-08	1.E-12	1.E-12	
At-207	1.E+00	2.E-04	6.E-09	5.E-09	
At-211	1.E+00	3.E-06	2.E-10	1.E-10	
Rn-210		/4	/4	/4	/4
Rn-211		/5	/5	/5	/5
Fr-222	1.E+00	6.E-05	1.E-09		
Fr-223	1.E+00	2.E-05	2.E-09		
Ra-223	2.E-01	3.E-07		2.E-12	
Ra-224	2.E-01	4.E-07		4.E-12	
Ra-225	2.E-01	4.E-07		2.E-12	
Ra-226	2.E-01	1.E-07		1.E-12	
Ra-227	2.E-01	6.E-04		4.E-08	
Ra-228	2.E-01	1.E-07		3.E-12	
Ac-224	1.E-03	5.E-05	9.E-11	1.E-10	1.E-10
Ac-225	1.E-03	1.E-06	1.E-12	2.E-12	1.E-12
Ac-226	1.E-03	3.E-06	9.E-12	1.E-11	1.E-11
Ac-227	1.E-03	1.E-08	2.E-15	7.E-15	1.E-14
Ac-228	1.E-03	6.E-05	4.E-11	1.E-10	1.E-10

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Th-226	2.E-04	1.E-04		4.E-10	3.E-10
Th-227	2.E-04	4.E-06		8.E-13	7.E-13
Th-228	2.E-04	4.E-07		5.E-14	4.E-14
Th-229	2.E-04	4.E-08		6.E-15	7.E-15
Th-230	2.E-04	3.E-07		4.E-14	5.E-14
Th-231	2.E-04	1.E-04		1.E-08	2.E-08
Th-232	2.E-04	5.E-08		7.E-15	1.E-14
Th-234	2.E-04	1.E-05		5.E-10	4.E-10
Th-Natural	2.E-04	5.E-08		7.E-15	1.E-14
Pa-227	1.E-03	1.E-04		3.E-10	2.E-10
Pa-228	1.E-03	3.E-05		5.E-11	3.E-11
Pa-230	1.E-03	2.E-05		1.E-11	8.E-12
Pa-231	1.E-03	1.E-08		9.E-15	1.E-14
Pa-232	1.E-03	4.E-05		1.E-10	2.E-10
Pa-233	1.E-03	4.E-05		2.E-09	1.E-09
Pa-234/3	1.E-03	7.E-05		2.E-08	2.E-08
U-230	5.E-02	2.E-07	1.E-12	8.E-13	
	2.E-03	1.E-06			6.E-13
U-231	5.E-02	1.E-04	2.E-08	1.E-08	
	2.E-03	1.E-04			1.E-08
U-232	5.E-02	1.E-07	1.E-12	9.E-33	
	2.E-03	2.E-06			2.E-04
U-233	5.E-02	5.E-07	4.E-12	2.E-12	
	2.E-03	5.E-06			9.E-14
U-234	5.E-02	5.E-07	4.E-12	2.E-12	
	2.E-03	5.E-06			9.E-14
U-235	5.E-02	6.E-07	5.E-12	2.E-12	
	2.E-03	5.E-06			1.E-13
U-236	5.E-02	5.E-07	5.E-12	2.E-12	
	2.E-03	6.E-06			1.E-13
U-237	5.E-02	5.E-05	6.E-09	4.E-09	
	2.E-03	5.E-05			4.E-09
U-238	5.E-02	6.E-07	5.E-12	2.E-12	
	2.E-03	6.E-06			1.E-13
U-239/3	5.E-02	2.E-03	4.E-07	4.E-07	
	2.E-03	2.E-03			4.E-07
U-240	5.E-02	3.E-05	9.E-09	7.E-09	
	2.E-03	3.E-05			6.E-09
U-Natural	5.E-02	6.E-07	5.E-12	2.E-12	
	2.E-03	6.E-06			1.E-13
Np-232	1.E-03/6	6.E-03/7		1.E-08/8	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Np-233	1.E-03/6	2.E-02/7		8.E-06/8	
Np-234	1.E-03/6	8.E-05/7		6.E-09/8	
Np-235	1.E-03/6	6.E-04/7		3.E-09/8	
Np-236(1.E+05yr)	1.E-03/6	2.E-07/7		1.E-13/8	
Np-236 (22 h)	1.E-03/6	1.E-04/7		2.E-10/8	
Np-237	1.E-03/6	3.E-08/7		2.E-14/8	
Np-238	1.E-03/6	4.E-05/7		4.E-10/8	
Np-239	1.E-03/6	5.E-05/7		5.E-09/8	
Np-240/3	1.E-03/6	7.E-04/7		2.E-07/8	
Pu-234	1.E-03/6	1.E-04/7		5.E-10/8	
	1.E-05/6	2.E-04/7			4.E-10/8
Pu-235	1.E-03/6	1.E-02/7		7.E-06/8	
	1.E-05/6	2.E-02/7			6.E-06/8
Pu-236	1.E-03/6	1.E-07/7		8.E-14/8	
	1.E-05/6	5.E-06/7			9.E-14/8
Pu-237	1.E-03/6	1.E-04/7		8.E-09/8	
	1.E-05/6	3.E-04/7			7.E-09/8
Pu-238	1.E-03/6	4.E-08/7		3.E-14/8	
	1.E-05/6	3.E-06/7			4.E-14/8
Pu-239	1.E-03/6	3.E-08/7		2.E-14/8	
	1.E-05/6	2.E-06/7			4.E-14/8
Pu-240	1.E-03/6	3.E-08/7		2.E-14/8	
	1.E-05/6	2.E-06/7			4.E-14/8
Pu-241	1.E-03/6	2.E-06/7		1.E-12/8	
	1.E-05/6	1.E-04/7			2.E-12/8
Pu-242	1.E-03/6	3.E-08/7		2.E-14/8	
	1.E-05/6	2.E-06/7			4.E-14/8
Pu-243	1.E-03/6	4.E-04/7		8.E-14/8	
	1.E-05/6	4.E-04/7			9.E-08/8
Pu-244	1.E-03/6	3.E-08/7		2.E-14/8	
	1.E-05/6	2.E-06/7			4.E-14/8
	1.E-03/6	6.E-05/7		1.E-08/8	
Pu-245	1.E-05/6	6.E-05/7			1.E-08/8
Am-237	1.E-03/6	2.E-03/7		7.E-07/8	
Am-238	1.E-03/6	8.E-04/7		1.E-08/8	
Am-239	1.E-03/6	1.E-04/7		3.E-08/8	
Am-240	1.E-03/6	5.E-05/7		6.E-09/8	
Am-241	1.E-03/6	3.E-08/7		2.E-14/8	
Am-242m	1.E-03/6	3.E-08/7		2.E-14/8	
Am-242	1.E-03/6	1.E-04/7		2.E-10/8	
Am-243	1.E-03/6	3.E-08/7		2.E-14/8	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Am-244m	1.E-03/6	2.E-03/7		1.E-08/8	
Am-244	1.E-03/6	7.E-05/7		7.E-10/8	
Am-245	1.E-03/6	8.E-04/7		2.E-07/8	
Am-246m	1.E-03/6	2.E-03/7		4.E-07/8	
Am-246/3	1.E-03/6	9.E-04/7		2.E-07/8	
Cm-238	1.E-03/6	4.E-04/7		3.E-09/8	
Cm-240	1.E-03/6	2.E-06/7		1.E-12/8	
Cm-241	1.E-03/6	3.E-05/7		7.E-11/8	
Cm-242	1.E-03/6	1.E-06/7		7.E-13/8	
Cm-243	1.E-03/6	5.E-08/7		3.E-14/8	
Cm-244	1.E-03/6	6.E-08/7		4.E-14/8	
Cm-245	1.E-03/6	3.E-08/7		2.E-14/8	
Cm-246	1.E-03/6	3.E-08/7		2.E-14/8	
Cm-247	1.E-03/6	3.E-08/7		2.E-14/8	
Cm-248	1.E-03/6	8.E-09/7		6.E-15/8	
Cm-249	1.E-03/6	1.E-03/7		5.E-08/8	
Bk-245	5.E-04	6.E-05		3.E-09	
Bk-246	5.E-04	7.E-05		7.E-09	
Bk-247	5.E-04	6.E-08		2.E-14	
Bk-249	5.E-04	2.E-05		9.E-12	
Bk-250	5.E-04	3.E-04		2.E-09	
Cf-244	1.E-03/6	9.E-04/7		1.E-09/8	1.E-09/8
Cf-246	1.E-03/6	1.E-05/7		2.E-11/8	2.E-11/8
Cf-248	1.E-03/6	5.E-07/7		3.E-13/8	3.E-13/8
Cf-249	1.E-03/6	3.E-08/7		2.E-14/8	3.E-14/8
Cf-250	1.E-03/6	7.E-08/7		5.E-14/8	6.E-14/8
Cf-251	1.E-03/6	3.E-08/7		2.E-14/8	3.E-14/8
Cf-252	1.E-03/6	1.E-07/7		1.E-13/8	9.E-14/8
Cf-253	1.E-03/6	1.E-05/7		5.E-12/8	4.E-12/8
Cf-254	5.E-04/6	5.E-08/7		5.E-14/8	4.E-14/8
Es-250	5.E-04	1.E-03		3.E-09	
Es-251	5.E-04	2.E-04		3.E-09	
Es-253	5.E-04	6.E-06		4.E-12	
Es-254m	5.E-04	9.E-06		3.E-11	
Es-254	5.E-04	9.E-07		3.E-13	
Fm-252	5.E-04	1.E-05		3.E-11	
Fm-253	5.E-04	4.E-05		2.E-11	
Fm-254	5.E-04	8.E-05		2.E-10	

Radionuclide	f1 Value	Ingested Water DCG (μCi/mL)	Inhaled Air DCG (μCi/mL) D	W	Y
Fm-255	5.E-04	1.E-05		5.E-11	
Fm-257	5.E-04	2.E-06		6.E-13	
Md-257	5.E-04	3.E-04		2.E-10	
Md-258	5.E-04	2.E-06		8.E-13	

/1 A dash indicates no values given for this data category.

/2 The inhalation DCG values allow for an additional 50% absorption through the skin, as described in ICRP Publication No. 30: "Limits for Intakes of Radionuclides by Workers." for elemental tritium, the lung dose equivalent is used as the basis for the DCG value shown.

/3 For the radionuclide shown, the DCG for external exposure from immersion in a contaminated plume (listed in figure III-2) is more restrictive.

/4 DCGs for Rn-220 are being assessed by DOE. Until the review has been completed and new values issued, the value of 3.E-09 micro Ci/mL given in figure III-3 shall be used.

/5 DCGs for Rn-222 are being assessed by DOE. Until the review has been completed and new values issued, the value of 3.E-09 micro Ci/mL given in Figure III-3 shall be used for Rn-222 releases from DOE facilities. In addition, the requirements of Chapter IV, Sections 4b, 6b, and 6d, shall be used when they are applicable.

/6 ICRP Publication No. 48: "The Metabolism of Plutonium and Related Elements."

/7 Based on the listed f1 value. It is assumed that individual organ doses, except for the gastrointestinal tract, change in proportion to f1 for all organs, including the "Remainder." Gastrointestinal doses are unchanged because very little material is absorbed in the upper portions of the tract.

/8 It is assumed that the effective dose equivalents are unchanged even though the f1 values have changed. This is because the contribution to organ dose from inhalation is dependent mainly on transfer from lung to blood when f1 values are small. Also the gastrointestinal tract dose would be unchanged because the fraction of activity passing through the tract is (1.0 - f1).

Figure III-2
Alternative Absorption factors and Lung Retention Classes
for Specific Compounds

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Actinium/ Ac	89	Oxides, hydroxides	1.E-03	Y
		Halides, nitrates	1.E-03	W
		All others	1.E-03	D
Aluminum/ Al	13	Oxides, hydroxides, carbides, halides, nitrates, elemental form	1.E-02	W
		All Others	1.E-02	D
Americium/ Am	95	All forms	1.E-03	W
Antimony/ Sb	51	Oxides, hydroxides, halides, sulphides, sulphates, nitrates	1.E-01	D
		All others	1.E-02	W
Arsenic/ As	33	All Forms	5.E-01	W
Astatine/ At	85	All (as a halide)	1.E+00	W or D; dependent upon associated element
Barium/ Ba	56	All Forms	1.E-01	D
Berkelium/ Bk	97	All Forms	5.E-04	W
Beryllium/ Be	4	Oxides, halides, nitrates	5.E-03	Y
		All others	5.E-03	W
Bismuth/ Bi	83	All except nitrates	5.E-02	W
		Nitrates	5.E-02	D
Bromine/ Br	35	Bromides	1.E+00	W or D; dependent upon associated element
Cadmium/ Cd	48	Oxides, hydroxides	5.E-02	Y
		Sulphates, halides	5.E-02	W
		All others	5.E-02	D
Calcium/ Ca	20	All Forms	3.E-01	W
Californium/ Cf	98	Oxides, hydroxides	1.E-03	Y
		All others	1.E-03	W
Carbon/ C	6	Oxides	/1	D
		Organic (11C)	1.E-02	W
		Organic (14C)	7.E-05	W
Cerium/ Ce	58	Oxides, hydroxides, fluorides	3.E-04	Y
		All others	3.E-04	W
Cesium/ Cs	55	All Forms	1.E+00	D
Chlorine/ Cl	17	Chloride	1.E+00	W or D; dependent upon associated element
Chromium/ Cr	24	Oxides, hydroxides	1.E-01	Y
		Halides, nitrates	1.E-01	W
		All Others	1.E-01	D
		Ingestion/2		
		Trivalent 1	1.E-02	
		Hexavalent	1.E-01	
Cobalt/ Co	27	Oxides, hydroxides, halides, nitrates	5.E-02	Y
		All others	5.E-01	W
		Ingestion only	3.E-01	

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Copper/ Cu	29	Oxides, hydroxides	5.E-01	Y
		Sulphites, halides, nitrates	5.E-01	W
		All others	5.E-01	D
Curium/ Cm	96	All forms	1.E-03	W
Dysprosium/ Dy	66	All forms	3.E-04	W
Einsteinium/ Es	99	All Forms	5.E-04	W
Erbium/ Er	68	All forms	3.E-04	W
Europium/ Eu	63	All forms	1.E-03	W
Fermium/ Fm	100	All forms	5.E-04	W
Fluorine/	9	Fluoride	1.E+00	Y, W, or D; dependent upon associated element
Francium/ Fr	87	All Forms	1.E+00	D
Gadolinium/ Gd	64	Oxides, hydroxides, fluorides	3.E-04	W
		All others	3.E-04	
Gallium/ Ga	31	Oxides, hydroxides, carbides, halides, nitrates,	1.E-03	W
		All others	1.E-03	D
Germanium/ Ge	32	Oxides, sulphides, halides	1.E+00	W
		All others	1.E+00	D
Gold/ Au	79	Oxides, hydroxides	1.E-01	Y
		Halides, nitrates	1.E-01	W
		All others	1.E-01	D
Hafnium/ Hf	72	Oxides, hydroxides, halides, carbides, nitrates	1.E-03	W
		All others	1.E-03	D
Holmium/ Ho	67	All Forms	3.E-04	W
Hydrogen/ H	1	Water (3H)	1.E+00	
Indium/ In	49	Oxides, hydroxides, halides	2.E-02	W
		All others	2.E-02	D
Iodine/ I	53	All forms	1.E+00	D
Iridium/ Ir	77	Oxides, hydroxides	1.E-02	Y
		Halides, nitrates, metallic form	1.E-02	W
		All others	1.E-02	D
Iron/ Fe	26	Oxides, hydroxides, halides	1.E-01	W
		All others	1.E-01	D
Lanthanum/ La	57	Oxides, hydroxides	1.E-03	W
		All others	1.E-03	D
Lead/ Pb	81	All forms	2.E-01	D
Lutetium/ Lu	71	Oxides, hydroxides, fluorides	3.E-04	Y
		All others	3.E-04	W

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Magnesium/ Mg	12	Oxides, hydroxides, carbides, halides, nitrates	5.E-01	W
		All others	5.E-01	D
Manganese/ Mn	25	Oxides, hydroxides, halides, nitrates	1.E-01	W
		All others	1.E-01	D
Mendelevium/ Md	101	All forms	5.E-04	W
Mercury/ Hg	80	Oxides, hydroxides, halides, nitrates, sulphites	2.E-02	W
		Sulphates, elemental form	2.E-02	D
		Organic Forms	1.E+00	D
		Vapor		D
Molybdenum/ Mo	42	Oxides, hydroxides, MoS2	5.E-02	Y
		All others	8.E-01	D
		Ingestion/2		
		MoS2	5.E-02	
		All others	8.E-01	
Neodymium/ Nd	60	Oxides, hydroxides, carbides, fluorides	3.E-04	Y
		All others	3.E-04	W
Neptunium/ Np	93	All forms	1.E-03	W
Nickel/ Ni	28	Oxides, hydroxides	5.E-01	W
		All others (vapor)		D
Niobium/ Nb	41	Oxides, hydroxides	1.E-02	Y
		All others	1.E-02	W
Osmium/ Os	76	Oxides, hydroxides	1.E-02	Y
		Halides, nitrates	1.E-02	W
		All others	1.E-02	D
Palladium/ Pd	46	Oxides, hydroxides	5.E-03	Y
		Nitrates	5.E-03	W
		All others	5.E-03	D
Phosphorus/ P	15	Phosphates	8.E-01	W or D; dependent upon associated element
Platinum/ Pt	78	All forms	1.E-02	D
Plutonium/ Pu	94	Oxides, hydroxides	1.E-05	Y
		Nitrates		W
		All others	1.E-04	W
		[Note: Use same values for ingestion]	1.E-03	
Polonium/ Po	84	Oxides, hydroxides, nitrates	1.E-01	W
		All others	1.E-01	D
Potassium/ K	19	All forms	1.E+00	D
Praesodymium/ Pr	59	Oxides, hydroxides, carbides, fluorides	3.E-04	Y
		All others	3.E-04	W
Promethium/ Pm	61	Oxides, hydroxides, carbides, fluorides	3.E-04	Y
		All others	3.E-04	W
Protactinium/ Pa	91	Oxides, hydroxides	1.E-03	
		All others	1.E-03	W
Radium/ Ra	88	All forms	2.E-01	W

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Rhenium/ Re	75	Oxides, hydroxides, halides, nitrates	8.E-01	W
		All others	8.E-01	D
Rhodium/ Rh	45	Oxides, hydroxides	5.E-02	Y
		Halides	5.E-02	W
		All others	5.E-02	D
Rubidium/ Rb	37	All forms	1.E+00	D
Ruthenium/ Ru	44	Oxides, hydroxides	5.E-02	Y
		Halides	5.E-02	W
		All others	5.E-02	D
Samarium/ Sm	62	All forms	3.E-04	W
Scandium/ Sc	21	All forms	1.E-04	Y
Selenium/ Se	34	Oxides, hydroxides, carbides	8.E-01	W
		All others	8.E-01	D
		Ingestion only	5.E-02	
Silicon/ Si	14	Ceramic forms	1.E-02	Y
		Oxides, hydroxides, carbides, nitrates	1.E-02	W
		All others	1.E-02	D
Silver/ Ag	47	Oxides, hydroxides	5.E-02	Y
		Nitrates, sulphides	5.E-02	W
		All others, elemental form	5.E-02	D
Sodium/ Na	11	All Forms	1.E+00	D
Strontium/ Sr	38	SrTiO3	1.E-02	Y
		All others(soluble)	3.E-01	D
Sulfur/ S	16	Sulphates, sulphides	1.E-01	W or D; dependent upon associated element
		All inorganic	8.E-01	
		Elemental form	1.E-01	W
		Gases	1.E+00	D
Tantalum/ Ta	73	Oxides, hydroxides, halides, carbides, nitrates, nitrides	1.E-03	Y
		All others	1.E-03	W
Technetium/ Tc	43	Oxides, hydroxides, halides, nitrates	8.E-01	W
		All others	8.E-01	D
Tellurium/ Te	52	Oxides, hydroxides, nitrates	2.E-01	W
		All others	2.E-01	D
Terbium/ Tb	65	All forms	3.E-04	W
Thallium/ Tl	81	All forms	1.E+00	D
Thorium/ Th	90	Oxides, hydroxides	2.E-04	Y
		All others	2.E-04	W
Thulium/ Tm	69	All forms	3.E-04	W
Tin/ Sn	50	Oxides, hydroxides, halides, nitrates, sulphides, Sn3(PO4)4	2.E-02	W
		All others	2.E-02	D
Titanium/ Ti	22	SrTiO3	1.E-02	Y
		Oxides, hydroxides, carbides, halides, nitrates	1.E-02	W
		All others	1.E-02	D

Element/ Symbol	Atomic Number	Compound	f1	Lung Retention Class
Tungsten/ W	74	Ingestion/2		
		Tungstic acid	1.E-02	
		All others	3.E-01	
Uranium/ U	92	UO2, U3O8	2.E-03	Y
		UO3, tetravalent compounds	5.E-02	W
		UF6, uranyl compounds	5.E-02	D
Vanadium/ V	23	Oxides, hydroxides, carbides, halides	1.E-02	W
		All others	1.E-02	D
Ytterbium/ Yb	70	Oxides, hydroxides, fluorides	3.E-04	Y
		All others	3.E-04	W
Yttrium/ Y	39	Oxides, hydroxides	1.E-04	Y
		All others	1.E-04	W
Zinc/ Zn	30	All forms	5.E-01	Y
Zirconium/ Zr	40	Carbides	2.E-03	Y
		Oxides, hydroxides, halides, nitrates	2.E-03	W
		All others	2.E-03	D

/1 A dash indicates no data For the value shown.
/2 For ingestion, no lung retention classes are listed.

Figure III-3
Derived Concentration Guides (DCGs) For Members of the Public from External Exposure During Immersion in a Contaminated Atmospheric Cloud

Radionuclide	Half-Life	Air Immersion DCG (micro Ci/mL)
C-11	20.48 min	2.E-08
N-13	9.97 min	2.E-08
N-16	7.13 s	3.E-09
O-15	122.24 s	2.E-08
F-18/1	109.74 min	2.E-08
Na-24/1	15.00 h	4.E-09
Mg-27/2	9.458 min	2.E-08
Al-28/2	2.240 min	1.E-08
Cl-38/1	37.21 min	1.E-08
Ar-37	35.02 d	1.E-02
Ar-39	269 yr	4.E-06/3
Ar-41	1.827 h	1.E-08
K-43/1	22.6 h	2.E-08
Ca-49/2	8.719 min	5.E-09
Sc-44/1	3.927 h	9.E-09
Sc-46m/2	18.72 s	2.E-07
Ti-45/1	3.08 h	2.E-08
Ti-51/2	5.752 min	5.E-08
V-52/2	3.75 min	1.E-08
Cr-49/1	42.09 min	2.E-08
Mn-52m/1	21.4 min	8.E-09
Mn-56/1	2.5785 h	1.E-08
Mn-57/2	1.47 min	2.E-07
Co-60m/1	10.47 min	4.E-06
Ni-57/1, /4	36.08 h	1.E-08
Ni-65/1, /5	2.520 h	3.E-08
Cu-61/1	3.408 h	2.E-08
Cu-62/2	9.74 min	2.E-08
Ga-66/1	9.40 h	7.E-09
Ga-68/1	68.0 min	2.E-08
Ga-72/1	14.1 h	7.E-09
Se-73/1	7.15 h	2.E-08
Br-77/1	57.04 h	6.E-08/6
Br-80/1	17.4 min	2.E-07
Br-82/1	35.30 h	7.E-09
Br-84/1	31.80 min	1.E-08
Br-85/2	172 s	2.E-07
Kr-79	35.04 h	8.E-08
Kr-81	2.1E+05 yr	2.E-06
Kr-83m	1.83 h	2.E-04
Kr-85	10.72 yr	3.E-06/3
Kr-85m	4.48 h	1.E-07
Kr-87	76.3 min	2.E-08
Kr-88	2.84 h	9.E-09
Kr-89	3.16 min	1.E-08
Kr-90	32.32 s	1.E-08
Rb-81/1	4.58 h	3.E-08
Rb-82/2	1.25 min	2.E-08
Rb-88/1	17.8 min	3.E-08
Rb-89/1	15.44 min	9.E-09
Rb-90/2	157 s	8.E-09
Rb-90m/2	258 s	5.E-09
Sr-85m/1	67.66 min	9.E-08
Sr-87m/1	2.805 h	6.E-08
Sr-92/1	2.71 h	1.E-08
Sr-93/2	7.3 min	8.E-09
Y-86/1	14.74 h	5.E-09
Y-90m/1	3.19 h	3.E-08/6
Y-91m/1	49.71 min	4.E-08
Nb-90/1	14.60 h	4.E-09

Radionuclide	Half-Life	Air Immersion DCG (micro Ci/mL)
Nb-94m/2	6.26 min	4.E-06
Nb-97/1	72.1 min	3.E-08
Nb-97m/1	60 s	3.E-08
Mo-91/2	15.49 min	2.E-08
Mo-101/1	14.61 min	1.E-08
Tc-95/1	20.0 h	2.E-08
Tc-96m/1	51.5 min	5.E-07
Tc-99m/1	6.02 h	1.E-07
Tc-101/1	14.2 min	6.E-08
Ru-105/1	4.44 h	2.E-08
Rh-105m/2	45 s	7.E-07
Rh-106/2	29.92 s	8.E-08
Ag-108/2	2.37 min	7.E-07
Ag-109m/2	39.6 s	4.E-06
Ag-110/2	24.57 s	4.E-07
Cd-111m/2	48.7 min	7.E-08
Cd-117/1	2.49 h	2.E-08
Cd-117m/1	3.36 h	9.E-09
In-113m/1	1.658 h	8.E-08
In-114/2	71.9 s	5.E-07
In-116m/1	54.15 min	8.E-09
In-117/1	43.8 min	3.E-08
Sb-117/1	2.80 h	1.E-07
Sb-126m/1	19.0 min	1.E-08
Sb-129/1	4.40 h	1.E-08
Te-133/1	12.45 min	2.E-08
Te-133m/1	55.4 min	8.E-09
Te-134/1	41.8 min	2.E-08
I-122/2	3.62 min	2.E-08
I-128/1	24.99 min	2.E-07
I-132/1	2.30 h	8.E-09
I-134/1	52.6 min	7.E-09
I-I35/1	6.61 h	1.E-08/6
I-136/2	83 s	7.E-09

Radionuclide	Half-Life	Air Immersion DCG (micro Ci/mL)
Xe-122	20.1 h	3.E-07
Xe-123	2.14 h	3.E-08
Xe-125	16.8 h	8.E-08
Xe-127	36.406 d	7.E-08
Xe-129m	8.89 d	8.E-07
Xe-131m	11.84 d	2.E-06
Xe-133	5.245 d	5.E-07
Xe-133m	2.19 d	6.E-07
Xe-135	9.11 h	8.E-08
Xe-135m	15.36 min	5.E-08
Xe-137	3.83 min	9.E-08
Xe-138	14.13 min	2.E-08
Cs-126/2	1.64 min	2.E-08
Cs-129/1	32.06 h	8.E-08/6
Cs-138/1	32.2 min	8.E-09
Cs-139/2	9.40 min	5.E-08
Ba-137m/2	2.552 min	3.E-08
Ba-141/1	18.27 min	2.E-08
Ba-142/1	10.70 min	2.E-08
La-142/1	95.4 min	6.E-09
Pr-144m/2	7.2 min	4.E-06
Nd-149/1	1.73 h	5.E-08
Gd-162/2	9.7 min	5.E-08
Td-162/2	7.76 min	2.E-08
Dy-157/1	8.06 h	6.E-08
Re-182m/1	12.7 h	2.E-08
Os-190m/1	9.9 min	1.E-08
Ir-190m/1	3.2 h	5.E-07/6
Au-195m/2	30.6 s	1.E-07

Radionuclide	Half-Life	Air Immersion DCG (micro Ci/mL)
Tl-200/1	26.1 h	1.E-08
Tl-207/2	4.77 min	1.E-06/3
Tl-208/2	3.053 min	5.E-09
Tl-209/2	2.20 min	9.E-09
Tl-210/2	1.30 min	7.E-09
Pb-204m/2	66.9 min	9.E-09
Bi-211/2	2.13 min	4.E-07
Po-211/2	0.516 s	2.E-06
Rn-220/7	55.61 s	3.E-09
Rn-222/7	3.82 d	3.E-09
Th-233/2	22.3 min	5.E-07
Pa-234/1	6.70 h	1.E-08
Pa-234m/2	1.17 min	8.E-07/3
U-239/1	23.40 min	4.E-07/6
Np-240/1	65 min	2.E-08
Np-240m/2	7.4 min	6.E-08
Am-246/1	25.0 min	2.E-08

/1 Committed effective dose equivalent from inhalation is calculated in ICRP Publication 30, but the DCG value for external exposure to a contaminated atmospheric cloud is more restrictive than the DCG value for inhalation.

/2 Committed effective dose equivalent from inhalation is not calculated in ICRP Publication 30, but DCG value for external exposure to contaminated cloud should be more restrictive than DCG value For inhalation due to relatively short half-life of radionuclide.

/3 DCG value is determined by limit on annual dose equivalent to skin, rather than limit on annual effective dose equivalent.

/4 DCG value applies to radionuclide in vapor form only; DCG value for inhalation is more restrictive for radionuclide in inorganic Form.

/5 DCG value applies to radionuclide in inorganic or vapor form.

/6 DCG value for exposure to contaminated atmospheric cloud is the same as DCG value for inhalation.

/7 The value shown for radon gas is a result of unit conversion from 3 pCi/L to 3 micro Ci/mL.