U.S. Department of Energy
Washington, D.C.

ORDER

DOE 5480.1A

8-13-81

SUBJECT: ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION PROGRAM FOR DOE OPERATIONS

1. PURPOSE. This Order establishes the Environmental Protection, Safety, and Health Protection Program for Department of Energy (DOE) operations.

2. CANCELLATION. DOE 5480.1, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION PROGRAM FOR DOE OPERATIONS, of 5-5-80. Its chapters are not cancelled; see Table of Contents.

3. SCOPE. The policy and requirements outlined in this Order apply to all DOE operations including all DOE contractor operations where, under the contractual arrangements for the work to be performed, DOE has authority to establish and enforce environmental protection, safety, and health protection program requirements. The extent to which requirements apply is specified in the various supplementary chapters of this Order.

4. REFERENCES.

   a. DOE Procurement Regulations (DOE PRs), Part 9-50, which provide the clauses to be used in contracts where DOE elects to enforce environmental protection, safety, and health protection requirements.

   b. E.O. 12196, "Occupational Safety and Health Programs for Federal Employees," which establishes the requirement for Federal agencies to provide occupational safety and health programs for their employees.

   c. 29 CFR 1960, SAFETY AND HEALTH PROVISIONS FOR FEDERAL EMPLOYEES, which provides the regulations and guidelines for the implementation of E.O. 12196.

   d. DOE 5482.1A, ENVIRONMENTAL, SAFETY, AND HEALTH APPRAISAL PROGRAM, which presents the Department's policy and requirements for appraisal of environmental protection, safety, and health protection programs.

   e. DOE 5481.1A, SAFETY ANALYSIS AND REVIEW SYSTEM, which establishes uniform requirements for the preparation and review of safety analyses.

   f. DOE 5700.6A, QUALITY ASSURANCE, which sets forth principles and assigns responsibilities for establishing, implementing, and maintaining programs of plans and actions to assure quality achievement in DOE programs.

DISTRIBUTION:
All Departmental Elements
Federal Energy Regulatory Commission (info)

INITIATED BY:
Assistant Secretary, Environmental Protection, Safety, and Emergency Preparedness

g. DOE 1324.2, RECORDS DISPOSITION, which prescribes requirements for the retention and disposition of records.

h. DOE 5483.1, OCCUPATIONAL SAFETY AND HEALTH PROGRAM FOR GOVERNMENT-OWNED CONTRACTOR-OPERATED (GOCO) FACILITIES, which provides guidance and establishes procedures for the GOCO safety and health program.

i. DOE 5484.1, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION REPORTING REQUIREMENTS, which establishes the requirements and procedures for reporting and investigating matters of environmental protection, safety, and health protection significance to DOE operations.

j. DOE 5484.2, UNUSUAL OCCURRENCE REPORTING SYSTEM, which establishes a system for reporting unusual occurrences having programmatic significance.

k. DOE 6430. , FACILITIES GENERAL DESIGN CRITERIA, implemented while in coordination by Assistant Secretary, Management and Administration memorandum of 6-10-81.

l. DOE 3790.1, OCCUPATIONAL SAFETY AND HEALTH PROGRAM FOR FEDERAL EMPLOYEES, which establishes the policy for the implementation and administration of the occupational, safety, and health program for Federal Employees.

m. DOE 5610.3, PROGRAM TO PREVENT ACCIDENTAL OR UNAUTHORIZED NUCLEAR EXPLOSIVE DETONATIONS, which establishes safety policies and procedures applicable to activities involving nuclear explosives.

n. Pending the development and promulgation of supplemental chapters to this Order, the references listed in Attachment 2 may be used as guideline procedures and standards in the discharge of the Department's environmental protection, safety, and health protection responsibilities under the Occupational Safety and Health Act of 1970; Executive Order 12088; the Atomic Energy Act of 1954, as amended; and the Energy Reorganization Act of 1974, as amended.

5. DEFINITIONS.

a. Environmental Protection, Safety, and Health Protection Program refers to those DOE requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations that are concerned with: controlling air, water, and soil pollution; limiting to acceptably low levels risks to the well-being of both operating personnel and the general public; and protecting property adequately against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, the following: environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facilities safety, nuclear safety, and quality assurance.

b. Federal Employee Occupational Safety and Health Program refers to the program mandated by E.O. 12196, and implemented by 29 CFR 1960, and DOE 3790.1.

c. DOE Operations are those activities funded by DOE for which DOE has responsibility for environmental protection, safety, and health protection.

d. Line Organization includes the program secretarial officer, the program office, and the field organization responsible for the management of a given DOE operation.

e. DOE Contractor includes any DOE prime contractor or subcontractor subject to the contractual provisions of DOE PR-50.704.2 or other contractual provisions where DOE has elected to enforce environmental protection, safety, quality assurance, and health protection requirements by specific negotiated contract provisions.

f. Program Secretarial Officer is an outlay program manager and includes the Assistant Secretaries for Conservation and Renewable Energy, Fossil Energy, Nuclear Energy, Defense Program, Environmental Protection, Safety and Emergency Preparedness, and the Director of Energy Research.

g. Standard means a specified set of rules or conditions concerned with the classification of components; delineation of procedures; definition of terms; specifications of materials, performance, design, or operations; or measurements of quality in describing materials, products, systems, services or practices. Standards may be specified by DOE as prescribed (i.e., required) or recommended.

h. Prescribed Standards are those standards adopted by DOE that define the minimum requirements that DOE and its contractors must comply with to the extent they apply to the activities being conducted.

i. Recommended Standards are those guides or standards adopted by DOE that DOE and its contractors should consider for guidance, as applicable, in addition to the prescribed standards.

j. An Exemption is a release from the requirements of this Order, or any other DOE Orders.

k. An Exception is an interim release from a standard of the type specified under the Occupational Safety and Health Act.

l. A Temporary Variance is a short-term release from a standard of the type specified under the Occupational Safety and Health Act.

m. A Permanent Variance is a release from a standard of the type specified under the Occupational Safety and Health Act.

n. Quality Assurance are all those planned and systematic actions necessary to provide adequate confidence that a facility, structure, system, or component will perform satisfactorily in service.

o. An Implementation Plan is a concise description of the approach, resources, and time period planned for implementing Orders that require such plans on a site wide basis including a description of the execution of environmental protection, safety, and health responsibilities and authorities by the field organization, and any proposed exemptions to parts of such DOE Orders.

p. An Assessment is an examination and evaluation by a Program Secretarial Officer of those portions of its internal environmental protection, safety, and health program, program plan implementation, and operations retained under its control.

6. POLICY. It is the policy of the DOE to:

a. Assure protection of the environment, the safety and health of the public, and Government property against accidental loss and damage.

b. Provide safe and healthful workplaces and conditions of employment for all employees of DOE and DOE contractors.

c. Assure compliance with applicable statutory requirements affecting Federal facilities and operations.

d. Assure that research, development, demonstration, and production activities are performed in a controlled manner; that components, systems, and processes are designed, developed, constructed, tested, operated, and maintained according to sound engineering standards, quality practices, and technical specifications; and that resulting technology data are valid and retrievable.

7. RESPONSIBILITIES AND AUTHORITIES

a. Line Management. DOE Headquarters primary responsibility and authority is in program development, planning, and policy. Program execution is the responsibility of the DOE field structure which also provides input to program formulation and policy. The program secretarial officers and operations office managers all report to the Under Secretary for overall direction, administration, and institutional matters. The program Secretarial Officers have the primary responsibility for development of assigned programs. The field organization managers are responsible to the respective program Secretarial Officers for execution of these programs. Environmental protection, safety, and health protection is an integral part of the programs. Accordingly, line management responsibility for these functions of the assigned programs and

facilities flows from the Under Secretary to the program Secretarial Officers to the field organization managers.

b. Program Secretarial Officers are assigned primary responsibility for assuring implementation of the DOE environmental protection, safety, and health protection program. This responsibility includes assuring that DOE and Federal environmental protection, safety, quality assurance, and health protection policies, directives, and orders are adhered to continuously and vigorously in all DOE operations. They are also responsible for implementation of the Federal Employee Occupational Safety and Health Program. They shall:

(1) Provide clear and explicit delegations of authority and responsibilities.

(2) Assure that appropriate program elements, as identified in Attachment 1, are included in program plans and proposals for design, construction, operation, modification, and decommissioning of DOE operations.

(3) Take necessary management actions, including the assurance that budget proposals for their assigned functions provide adequately for protection requirements.

(4) Assure that applicable requirements are identified and provided to the contracting officers for inclusion in contracts.

(5) Perform program reviews and assessments to assure compliance of their program organizations and field organizations with DOE Orders. In the execution of this responsibility maximum use should be made of the appraisals and other reviews performed by the Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness (EP-1) and the Assistant Secretary, Management and Administration (MA-1).

(6) Provide program direction to the field consistent with DOE prescribed requirements relating to environmental protection, safety, and health protection.

(7) Review and approve summary type implementation plans for DOE Orders submitted by field organizations.

(8) Provide the Deputy Assistant Secretary for Environmental Safety and Health, EP-30, an opportunity to review and comment on field office prepared implementation plans for DOE Orders. Must consider comments received from EP-1 before giving final approval.

(9) For DOE program activities not assigned to a field organization for implementation, assume the responsibilities assigned to Heads of Field Organizations in 7(c) below.

(10) Take such action as may be appropriate to assure safety, including directing the field office manager to curtail and suspend their operations when, in their opinion, such operation would result in an undue environmental protection, safety, or health protection risk.

(11) Ensure that documents generated under this Order are reviewed for classification where appropriate.

c. Heads of Field Organizations, consistent with other actions stated in this Order, DOE 5481.1A, DOE 3790.1, and as deemed necessary to assure safety of operation of facilities and operations under their jurisdiction, shall:

(1) Execute programs and assure that contractors and their subcontractors execute programs and policies which utilize appropriate program elements, as identified in Attachment 1, for siting, design, construction, operation, maintenance, modification, deactivation, decontamination, and decommissioning of DOE facilities and activities.

(2) Require preparation of, and approve, safety analyses and facility operations safety requirements and changes thereto, consistent with DOE 5481.1A and with appropriate chapters of this Order.

(3) Take such action as may be appropriate to assure safety, including curtailment and suspension of operations when, in their opinion, such operation would result in an undue environmental protection, safety, or health protection risk.

(4) Give due consideration in the selection of contractors to the ability of offerors to meet environmental protection, safety, and health protection requirements. Assure that applicable safety requirements are included in contracts.

(5) Appraise the programs of subordinate field activities in accordance with DOE 5482.1A and initiate remedial actions as appropriate.

(6) Execute programs and assure that contractors and their subcontractors execute programs and policies in a manner that shall include compliance with prescribed requirements relating to environmental protection, safety, and health protection.

(7) Prepare implementation plans for this Order and other DOE Orders where required.

(7) Prepare implementation plans for this Order and other DOE Orders where required.

(a) These plans will include:

1 The execution of safety responsibilities and authorities by the field office and their contractors; and

2 The proposed generic exemptions to parts of DOE Orders because of site specific conditions.

(b) The field office implementation plans will be reviewed and approved by the cognizant program Secretarial Officers before implementation. This requirement in no way prohibits field office managers from initiating actions of necessity in exercising responsibility for environmental, safety, and health activities. Specific exemptions to the standards identified in Chapter I of this Order or the requirements of this Order or other environmental protection, safety, and health Orders which are dependent on specific facility designs would not be a part of the field office prepared implementation plans, but shall be identified in the facility design documentation and safety analysis which will be reviewed and approved in the normal process of facility design and operation and assessed as part of the environmental, safety, quality assurance, and health appraisal programs.

Note: These procedures for exemptions do not apply to Federal Regulations listed in Chapter I of this Order or any National Environmental Protection Act Environmental Impact Statement or Environmental Assessment documents.

(8) Establish and maintain liaison with regional, State, or local officials as appropriate, and advise the responsible program Secretarial Officer of any environmental protection, safety, and health protection requirements issued by these officials that will affect their operations. Concurrently advise EP-1 of all requirements issued that will affect any DOE operation.

(9) Grant exceptions to, and process requests for, variances from occupational safety and health standards in accordance with DOE 5483.1.

(10) Establish procedures to assure that required information is recorded and reported as prescribed by this Order.

(11) Authorize operation of a new or significantly modified facility after determining that its operation will not create undue environmental, safety or health risks.

(12) The Manager, Pittsburgh Naval Reactors Office, and the Manager Schenectady Naval Reactors Office, together with their branch field offices located at DOE Naval reactor prototype sites, report to the Deputy Assistant Secretary for Naval Reactors because of their unique responsibility solely involved with the Naval Reactors Programs. In this regard, the Deputy Assistant Secretary for Naval Reactors will continue to carry out responsibilities for approving implementation of DOE requirements in the areas of reactor safety, criticality control, and radiation protection defined herein and in other DOE Orders for field organization managers.

(13) Assure that documents generated under this Order are reviewed for classification where appropriate.

d. Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness (EP-1) is responsible for providing an independent overview of the environmental protection, safety, and health protection program as it applies to the Department's operations and is directly responsible to the Secretary for this function. In carrying out this function, the EP-1:

(1) Develops policies, standards, guides, requirements, and procedures covering environmental protection, safety, and health protection programs for DOE operations, including those on notification, investigation, and reporting of occurrences having environmental protection, safety, or health protection significance.

(2) Provides technical advice and assistance concerning environmental protection, safety, and health protection programs to line organizations.

(3) Provides a central point for coordination within DOE and with other agencies and other groups in the development of environmental protection, safety, and health protection standards and requirements and resolution of environmental, safety or health operational issues applicable to DOE operations, including review of proposed standards and requirements for their application to and potential impact on DOE activities, and participation in the development and review of general design criteria.

(4) Reviews field office implementation plans for DOE Orders for consistency and the advisability of site specific exemptions, and advises the cognizant Program Secretarial Officer on the adequacy of the proposed implementation plans. Advises the Under Secretary if, in the opinion of EP-1, the approved implementation plan is significantly deficient and the issue cannot be resolved with the cognizant program Secretarial Officer.

(5) Conducts appraisals in accordance with DOE 5482.1A.

(6) Identifies needs for research and development to support environmental protection, safety, and health protection programs and recommends appropriate actions.

(7) Provides a central point for the collection, retention, evaluation and dissemination of information having environmental protection, safety, and health protection significance.

(8) Renders interpretations of this Order and its chapters.

(9) Provides overview assurance that safety analyses are prepared and reviewed in accordance with DOE 5481.1A.

(10) Reviews and recommends appropriate actions on reports and documents having significant environmental protection, safety, or health protection implications.

(11) Delegates to the Deputy Assistant Secretary for Environmental Safety and Health (EP-30), the authority to carry out responsibilities (1) through (10) above, except as set forth in paragraphs 7e and 7f.

(12) Approves requests for variances from occupational safety and health standards in accordance with DOE 5483.1.

e. Assistant Secretary, Management and Administration (MA-1) is responsible for providing an overview of the Federal Employee Occupational Safety and Health Program as it applies to the Department's operations and is directly responsible to the Secretary of this function. In carrying out this function, MA-1 shall:

(1) Be responsible for developing policies guides, requirements and procedures for the DOE Federal Employees Occupational Safety and Health Program (including the provision of medical services). These efforts are to be consistent with E.O. 12196, Department of Labor policies, and applicable DOE requirements, standards, guides, and Orders.

(2) Act as the Department's designated safety and health official for dealings with the Department of Labor on Federal employee safety and health matters.

(3) Carry out all of the environmental protection, safety, and health protection responsibilities appropriate to line management responsibility for the operation of Headquarters facilities.

(4) Provide advice to program Secretarial Officers and Heads of Field Organizations on employment standards and safety and health training of Federal employees and concurs in all Departmentwide safety and

health training programs for Federal employees. Acts for the Department in gaining concurrence from the Office of Personnel Management on all proposed revisions to employment standards of Federal employees.

f. Deputy Assistant Secretary for Naval Reactors shall be responsible for conducting management appraisals, implementing DOE environmental protection, safety and health protection requirements, and establishing independent overviews of reactor safety, criticality control and radiation protection in the Naval Reactors program. These appraisals, implementation actions, and overviews are excluded from EP-1 responsibility and authority.

William S. Heffelfinger
Assistant Secretary
Management and Administration

ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION PROGRAM ELEMENTS

The following elements establish the general framework for the environmental protection, safety, and health protection program.

1. Statutory Basis.

   a. Assurance that applicable Federal, State, and local environmental protection, safety, and health protection statutes, Executive orders, and regulations are met.

   b. Fulfillment of Federal requirements such as those of the Clean Water Act, the Endangered Species Act, the Toxic Substances Control Act, and the Energy Supply and Environmental Coordination Act.

2. Policy and Implementation.

   a. Establishment and interpretation of environmental protection, safety, and health protection program policy and requirements.

   b. Development, adoption, and application of codes, standards, and guides.

   c. Assignment of responsibilities to DOE elements.

   d. Execution of appropriate environmental protection, safety, and health protection contractual requirements.

   e. Funding support by line organizations to support environmental protection, safety, and health protection needs.

   f. Provision of safety and health services for Federal employees.

   g. Establishment and maintenance of an emergency response capability.

   h. Support of training programs.

   i. Support of operational environmental protection, safety, and health protection research.

3. Hazard and Risk Assessment and Systems Safety.

   a. Application of systems safety principles to DOE activities.

   b. Implementation of quality and reliability assurance programs.

c. Analysis of activities to identify hazards and assess risks.

d. Analysis of the adequacy of risk-limiting mechanisms.

e. Documented acceptance of residual risks by the appropriate level of management.

f. Conduct of hazardous operations under written procedures appropriate for the level of hazard involved.

g. Investigation of accidents and incidents to determine causal factors and provide feedback to improve performance.

4. Internal Audit and Appraisal.

a. Implementation of an internal audit program at the first level of operations.

b. Implementation of an independent appraisal mechanism at the various levels of the DOE or contractor system.

5. Information and Reporting.

a. Collection, evaluation, and dissemination of environmental protection, safety, and health protection information.

b. Public reporting of DOE performance data.

GUIDELINES

Pending the issuances of additional supplementary chapters to this Order, the following may be used as guideline procedures and standards in the discharge of the Department's environmental protection, safety, and health protection program:

ERDAM 0511, RADIOACTIVE WASTE MANAGEMENT, of 9-19-73, which provides for minimizing radioactive exposure and associated risk to man and environment. (To be replaced by a proposed Order 5820. , MANAGEMENT OF RADIOACTIVE WASTE.)

Attachment 1 to the Directive was revised by DOE O 5480.1, Changes 1 through 4; and DOE O 5480.1A. Attachment 2 to this Directive was revised by DOE O 5480.1, Changes 2 through 4. The Table of Contents was added by DOE O 5480.1, Change 1; and was revised by DOE O 5480.1, Changes 2 through 4; and DOE O 5480.1A.

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Chapter IV, "Nuclear Criticality Safety," was added by DOE O 5480.1, Change 1; and deleted/replaced by Chapter V via ORO O 5480.1, Change 5.

Chapter V added by DOE O 5480.1, Change 1; and replaced by DOE O 5480.1, Change 5 version.

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Chapter VI added by DOE O 5480.1, Change 1; and revised/replaced by DOE O 5480.1, Change 5.

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Chapter VII added by DOE O 5480.1, Change 1.

CHAPTER VIII - CONTRACTOR OCCUPATIONAL MEDICAL PROGRAM (of 5-22-81)

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CHAPTER IX - CONSTRUCTION SAFETY AND HEALTH PROGRAM (of 12-18-80)

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CHAPTER I

ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION STANDARDS

1. PURPOSE. This chapter sets forth the environmental protection, safety, and health protection standards applicable to all operations of the Department of Energy, hereafter referred to as the Department.

2. GENERAL REQUIREMENTS.

   a. Provisions of this chapter shall be followed during facility design, construction, operation, modification, and decommissioning. Existing facilities need not be changed arbitrarily to comply with the specified standards except as required by law. As part of the normal facility design effort for each new facility the applicable codes, standards, and guides to be used in the design and operation are to be identified and documented.

   b. This chapter covers the prescribed standards to be used by the Department and its contractors. In addition, DOE and its contractors shall comply with all legally applicable Federal and State standards. Where a Department contractor is also a Nuclear Regulatory Commission licensee, the contract relationship will not exempt the contractor from compliance with Nuclear Regulatory Commission regulations and the terms of the license. Where Department of Energy contractors are tenants on a military installation and a Host-Tenant Agreement has been executed, the standards established by the host shall be observed unless the Department prescribed standards provide for greater protection, in which case Department standards shall be observed. Facilities covered by this chapter include those owned, leased or otherwise controlled by the Department or leased by contractors for use in work, and include those of either a permanent or temporary nature (e.g., trailers, rented spaces, field sites).

   c. In addition to the prescribed and recommended standards set forth by this chapter, the user should also consult the other chapters of this Order. The sources for the standards and a glossary of abbreviations are contained in Attachment 1.

   d. If there are conflicts between prescribed standards in this chapter, or between this chapter and other chapters of this Order, the standards providing the greater protection shall govern.

   e. Those DOE-owned reactor plants which are prototype reactor plants for design and development of Naval reactor plants, and which are concommitantly used for training of operators for Naval nuclear propulsion plants, have certain unique requirements because of their military application. All of these plants and supporting laboratory facilities are under the cognizance of the Deputy Assistant Secretary for Naval

Reactors who jointly serves as the Director of the Naval Nuclear Program. Accordingly, the Deputy Assistant Secretary for Naval Reactors is responsible for assuring that adequate standards are applied for emergency preparedness, environmental protection, nuclear safety, and health protection for Naval reactor prototype plants and supporting laboratory facilities owned by DOE."

3. RESPONSIBILITIES AND AUTHORITIES.

a. Program Secretarial Officers shall:

(1) Assure compliance with the standards of this chapter on a site-wide basis by organizations under their jurisdiction by review and approval of the summary type implementation plans for DOE Orders submitted by field organizations.

(2) Prescribe, as appropriate, additional or more stringent standards for individual facilities after appropriate consultation with field organization management and other affected Program Secretarial Offices.

b. Heads of Field Organizations and the Assistant Secretary, Management and Administration shall:

(1) Apply the prescribed standards contained herein.

(2) Assure that the level of performance of health and safety are maintained consistent with the intent of these standards, for those activities under their direction.

(3) Prescribe, as appropriate, additional or more stringent standards, based on the determination that such standards are essential to safety and proper performance of their function.

(4) Grant exemptions as set forth in paragraph 4, where such action will best serve the interest of DOE, providing that the safety of employees, the public, and Government and private property can be maintained.

(5) Identify needs to Deputy Assistant Secretary for Environmental Safety and Health (EP-30) for new standards to address environment, safety, and health concerns.

c. Assistant Secretary, Environmental Protection, Safety, and Emergency Preparedness (EP-1) shall:

(1) Review nationally recognized health and safety requirements, guides, codes, and standards and prescribe those applicable to DOE activities,

following appropriate review and comment by affected Departmental elements.

(2) Determine the need for and develop or promote the development of new or revised standards applicable to environmental safety and health.

(3) Act as liaison with voluntary standards bodies and other Federal agencies on ES&H standards to reflect DOE needs and requirements.

(4) Develop and maintain appropriate mechanisms for maintaining the standards listing comprehensive, up-to-date, and revising the standards listing, as necessary.

4. PROCEDURE FOR GRANTING EXEMPTIONS.

a. Heads of Field Organizations are authorized to grant exemptions from the prescribed standards of this chapter for specific facilities or activities, except as noted in subparagraph 4b. Specific exemptions to the prescribed standards identified in this chapter, which are dependent on specific facility designs, shall be identified in the facility design documentation and safety analysis, which will be reviewed and approved in the normal process of facility design and operation and assessed as part of the Environmental, Safety, Quality Assurance, and Health Appraisal Programs.

b. Exemptions from standards established pursuant to the Federal regulations listed herein, unless allowed by the procedure identified in subparagraph 4c, are to be submitted with suitable justification to EP-1.

c. Those Department contractor operations subject to DOE 5483.1, OCCUPATIONAL SAFETY AND HEALTH PROGRAM FOR GOVERNMENT-OWNED CONTRACTOR-OPERATED FACILITIES, must follow the procedures of that Order to obtain variances from the Occupational Safety and Health Administration standards listed herein. Those Department operations directly subject to the Occupational Safety and Health Administration's regulations must follow the procedures of 29 CFR 1960, Subpart C, or 29 CFR 1905, as appropriate, to obtain relief from standards listed herein (which are also listed in 29 CFR 1910, 1915-1918, and 1926). Requests are to be forwarded to the appropriate Department of Energy official as defined in DOE 5483.1 or DOE 3790.1.

5. EMERGENCY PREPAREDNESS. The following standards, in addition to those listed in the other chapters, shall be used as applicable.

a. Prescribed Standards. To be identified.

b. Recommended Standards. "Immediate Evacuation Signal for Use in Industrial Installations Where Radiation Exposure May Occur," ANSI N2.3-1979 (ANSI).

6. ENVIRONMENTAL PROTECTION. The following standards, in addition to those listed in the other chapters, shall be used as applicable.

a. Prescribed Standards.

(1) Executive Order 12088 "Federal Compliance with Pollution Control Standards."

(2) The following standards, regulations, and guidelines promulgated pursuant to Federal environmental legislation:

(a) Air.

1 New Source Performance Standards (40 CFR 60).

2 National Hazardous Air Pollutant Standards (40 CFR 61).

3 Regulations Designating Air Quality Control Regions (40 CFR 81).

(b) Water.

1 Discharge of Oil (40 CFR 110).

2 Oil Pollution Prevention (40 CFR 112).

3 National Oil and Hazardous Substances Contingency Plan (40 CFR 1510).

4 Water Quality Standards Approved by the Federal Government (40 CFR 120).

5 National Pollutant Discharge Elimination System (40 CFR 122).

6 Policies and Procedures for the National Pollutant Discharge Elimination System (40 CFR 125).

7 General Pretreatment Regulations for Existing and New Sources of Pollution (40 CFR 403).

8 Secondary Treatment Information (40 CFR 133).

9 Transportation for Dumping, and Dumping of Material into Ocean Waters (40 CFR 220-230).

10 Cooling Water Intake Structures (40 CFR 401.14) (General Provisions for Effluent Guidelines and Standards - 40 CFR 401).

(c) Drinking Water.

1 National Interim Primary Drinking Water Regulations (40 CFR 141).

2 National Interim Primary Drinking Water Regulations Implementation (40 CFR 142).

(d) Solid Waste.

1 Guidelines for the Thermal Processing of Solid Wastes and for the Land Disposal of Solid Wastes (40 CFR 240 and 241).

2 Solid Waste Storage and Collection (40 CFR 243).

(e) Radiation. "Performance Testing and Procedural Specifications for Thermoluminescense Dosimetry (Environmental Applications)," ANSI N 545-1975 (ANSI).

(f) Pesticides.

1 Executive Order 11870, "Environmental Safeguards on Activities for Animal Damage Control on Federal Lands."

2 Regulations for Enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act (40 CFR 162).

3 Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticide Containers (40 CFR 165).

4 Exemption of Federal and State Agencies for Use of Pesticides Under Emergency Conditions (40 CFR 166).

5 Worker Protection Standards for Agricultural Pesticides (40 CFR 170)

6 Certification of Pesticide Applicators (40 CFR 171).

b. Recommended Standards.

(1) Standard Methods for the Examination of Water and Wastewater (AWWA).

(2) Guide for Use of Insecticides, Handbook 290 (USDA).

(3) Manual of Septic Tank Practice, Publication No. 526 (USPHS).

(4) Sanitary Landfill Design and Operation Publication No. SW-65ts. (EPA).

(5) Interim Guide of Good Practice for Incineration at Federal Facilities, Publication No. AP-46 (USPHS).

(6) Incinerator Guidelines, Publication No. 2012 (USPHS).

(7) Air Pollution Engineering Manual, Publication No. AP-40 (USPHS).

(8) Compilation of Air Pollutant Emission Factors (EPA).

7. FIRE PROTECTION. The following standards, in addition to those listed in the other chapters, shall be used as applicable.

a. Prescribed Standards.

(1) National Fire Codes (NFPA).

(2) Standard for Fire Protection of AEC Electronic Computer Data Processing Systems, WASH 1245-1. (Compliance with this standard satisfies the requirements for NFPA-75).

(3) Product Directories of Underwriters Laboratories together with the periodic supplements (UL).

(4) Factory Mutual Approval Guide (FM).

(5) TP20-11 General Fire Fighting Guidance for Nuclear Weapons (this document is confidential restricted data).

(6) Standard on Fire Protection for portable structures, DOE/EV-0043, August 1979.

b. Recommended Standards.

(1) Handbook of Fire Protection (NFPA).

(2) Loss Prevention Data Sheets (FM).

8. HEALTH PROTECTION. The following standards, in addition to those listed in the other chapters, shall be used as applicable.

a. Radiation Protection.

(1) Prescribed Standards.

(a) Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X and Gamma Radiation, ANSI N13.5-1972 (ANSI).

(b) Radiation Symbol, ANSI N2.1-1969 (ANSI).

(c) Radiological Safety in the Design and Operation of Particle Accelerators, ANSI N43.1-1978 (ANSI).

(d) Specification and Performance of On-site Instrumentation for Continuously Monitoring Radioactivity in Effluents, ANSI N13.10-1974 (ANSI).

(e) Personnel Neutron Dosimeters (Neutron Energies Less Than 20 MeV), ANSI N319-1976 (ANSI).

(f) Performance Criteria for Instrumentation Used for Inplant Plutonium Monitoring, ANSI N317-1978 (ANSI).

(g) "Inspection and Test Specifications for Direct and Indirect Reading Quartz Fiber Pocket Dosimeters," ANSI N322-1975. (ANSI).

(h) A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA), DOE/EV/1830-TS, April 1980 (to be used until issued as formal standard).

(2) Recommended Standards.

(a) Applicable (FRC) Reports (#1-1960, #2-1962, #5-1964, #7-1965, #8 (Revised) (EPA).

(b) Handbooks, NCRP Recommendations (NBS).

(c) Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities, ANSI N13.1-1969 (ANSI).

(d) Criteria for Film Badge Performance, ANSI 13.7-1972 (ANSI).

(e) Radiation Protection Instrumentation Test and Calibration, ANSI N323-1978 (ANSI).

(f) Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications, ANSI N545-1975 (ANSI).

(g) Standards for Protection Against Radiation (10 CFR 20).

(h) Radiation Protection Standards Reports (ICRP).

(i) Reports (ICRU)

1 Report 20, 1971, Radiation Protection Instrumentation and Its Application.

2 Report 19, 1968, Radiation Quantities and Units.

3 Report 14, 1969, Radiation Dosimetry.

(j) Safety Series (IAEA).

(k) Electronic Product Radiation Control, Subpart 3 of P.L. 90-602, as amended on 10-18-68.

(l) Technical Considerations in Emergency Instrumentation Preparedness, BNWL-1742, 1974 (DOE).

1 Phase II-C - Emergency Radiological and Meteorological Instrumentation for Fuel Reprocessing Facilities, BNWL-1857, 1976.

2 Phase II-D - Evaluation Testing and Calibration Methodology for Emergency Radiological Instrumentation, BNWL -1991, 1976.

3 Phase II-B - Emergency Radiological and Meteorological Instrumentation for Mixed Fuel Fabrication Facilities, BNWL-1742, 1974.

4 Phase II-A - Emergency Radiological and Meteorological Instrumentation Criteria for Reactors, BNWL-1635, 1972.

b. Occupational Medicine.

(1) Prescribed Standards. To be identified.

(2) Recommended Standards.

(a) Scope, Objectives, and Functions of Occupational Health Programs, OOCH-213 (AMA).

(b) Occupational Health Services for Employees, U.S. Department of Health, Education, and Welfare. Public Health Service Publication No. 1041 (May 1963)(USPHS).

(c) An Administrative Guide for Federal Occupational Health Units, HEW, Public Health Service Publication No. 1325-A (March 1966), (USPHS).

(d) Epidemiology in Occupational Disease and Injury, OOCH-290 (AMA).

(e) Medical Aspects of Radiation Accidents Handbook, Eugene Saenger, M.D., Editor (GPO).

c. Industrial Hygiene.

(1) Prescribed Standards.

(a) Current Threshold Limit Values (ACGIH).

(b) Practices for Respiratory Protection, ANSI Z88.2-1980 (ANSI).

(2) Recommended Standards.

(a) Hygienic Guide Series (AIHA).

(b) Heating and Cooling for Man in Industry (AIHA).

(c) Respirator Manual, LA-6370-M (DOE).

(d) Industrial Ventilation Manual (ACGIH).

(e) Industrial Noise Manual (AIHA).

(f) Guide for Conservation of Hearing and Noise (AAOO).

(g) NIOSH Criteria Documents (NIOSH).

d. Public Health and Sanitation.

(1) Prescribed Standards.

(a) Food.

1 Food Service Sanitation Manual, DHEW Publication No. 78-2081 (FDA).

2 The Vending of Food and Beverages, USPHS Publication No. 546 (1965).

(b) Water.

1 National Interim Primary Drinking Water Regulations, Publication No. EPA-570/9-76-003 (EPA).

2 Manual for Evaluating Public Drinking Water Supplies, Publication No. 1820 (EPA).

3 Manual of Individual Water Supply Systems, Publication No. 430 9/73-003 (EPA).

4 Quality Standards for Bottled Water (21 CFR 11).

5 Sanitary Standard for Manufactured Ice, USPHS 1183 (1964).

6 GSA Handbooks on Performance Standards for Cleaning Public Buildings (GSA).

9. OCCUPATIONAL SAFETY. The following standards, in addition to those listed in the other chapters, shall be used as applicable.

a. General Safety.

(1) Prescribed Standards.

(a) Forest Service Safety Standards (USDA).

(b) Boiler and Pressure Vessel Code; Sections I-XI (ASME).

(c) Occupational Safety and Health Standards, 29 CFR 1910.

(d) Safety and Health Regulations for Construction, 29 CFR 1926.

(e) Safety and Health Regulations for Ship Repairing, 29 CFR 1915.

(f) Safety and Health Regulations for Shipbuilding, 29 CFR 1916.

(g) Safety and Health Regulations for Shipbreaking, 29 CFR 1917.

(h) Safety and Health Regulations for Longshoring, 29 CFR 1918.

(i) Department of Defense Explosive Safety Board Standards (Ordnance Operations).

(j) Department of Navy Standards (for Naval Reactors program applications) (NAV).

(2) Recommended Standards.

(a) Chemical Rocket Propellant Hazards, JANNAF Propulsion Committee, Volume I - General Safety Engineering Design Criteria, NTIS-AD 889763, May 1970. Volume II - Solid Rocket Propellant Processing, Handling, Storage, and Transportation, NTIS-AD

870258, May 1970. Volume III - Liquid Propellant Handling, Storage, and Transportation, N.T.I.S.-AD 870259, May 1970. (Quantity distance tables are expected-OSHA/NFPA QD tables apply where appropriate).

(b) Manual Sheets (MCA).

(c) Chemical Safety Data Sheets (MCA).

(d) Accident Prevention Manual for Industrial Operations (NSC).

(e) Supervisor's Safety Manual (NSC).

(f) Handbook of Laboratory Safety (CRC).

(g) Handbook of Rigging, W.E. Rossnagel, McGraw-Hill Book Co., Inc., publishers. (McGraw).

(h) Data Sheet Series (NSC).

(i) Matheson Gas Data Book (MPD).

(j) Handling Hazardous Materials, NASA SP-5032 (NASA).

(k) Testing Materials Standards (those applicable to safety) (ASTM).

(l) Handbook of Compressed Gases (CGA).

(m) Service Station Safety, Accident Prevention Manual 5 (API).

(n) Operating Personnel Training Program on Oxygen Deficient Atmospheres, UC-240-002, September 1978.

b. Construction Safety.

(1) Prescribed Standards.

(a) Pipeline Safety Standards (49 CFR 192).

(b) Safety and Health Regulations for Construction (29 CFR 1926).

(2) Recommended Standards.

(a) Manual of Accident Prevention in Construction (AGCA).

(b) Guidelines for Minimizing Soil Erosion and Water and Air Pollution During Construction, Soil Conservation Service Engineering Memorandum 66, 6-19-68 (USDA).

c. Crane Safety.

(1) Prescribed Standards.

(a) ANSI Series B 30.

(b) Crane Manufactures Association of America, Specification No. 70 (CMAA).

(2) Recommended Standard.

(a) Requirements for Hoisting and Rigging of Special Components and Equipment, RDT F8-6 (DOE).

(b) DOE Hoisting and Rigging Manual, May 1980.

d. Drilling Safety.

(1) Prescribed Standards.

(a) Petroleum Safety Orders, Administrative Code, Title 8, Chapter 4, Subchapter 14, State of California (except the requirement of paragraph (b) Section 6640, of article 41 of the 1959 orders is permanently waived-API PR 9B applies). (CALIF)

(b) Applicable Division of Production Specifications and Recommended Practices on Oil Field Equipment (API).

(c) Safe Practices in Drilling Operations, Third Edition, 1967, RP 2010 (API).

(2) Recommended Standards.

(a) Rotary Drilling Handbook on Accident Prevention and Safe Operating Practices (IAODC).

(b) Applicable Division of Production Bulletins (API).

e. Electrical Safety.

(1) Prescribed Standards.

(a) National Electrical Code, ANSI/NFPA No. 70-1978.

(b) National Electrical Safety Code (ANSI-C2-1977).

(e) Evaluation of Explosive Storage Safety Criteria, May 1970, AD 871 194 (NTIS).

g. Firearm Safety.

(1) Prescribed Standards.

(a) GSA Handbook HB, Federal Protective Service Uniformed Force Operations, PBS P5930.17.

(b) Pistols and Revolvers, FM 23-35, 7-60 (AMC).

(c) Safety with Firearms Handbook (NRA).

(2) Recommended Standards.

(a) Education and Training Security Police, Training Course AMCP 621-1 (AMC).

(b) Military Police Preservation of Order Activities, AMCR 190-3, 12-71 (AMC).

h. Mine and Tunnel Safety.

(1) Prescribed Standards.

(a) P.L. 91-173 88 Stat. 742-804 as amended by P.L. 95-164, Federal Mine Safety and Health Act of 1977.

(b) Tunnel Safety Orders, Administrative Code, Title 8, Chapter 4, Subchapter 20, State of California (CALIF).

(c) Mine Safety Orders, Administrative Code, Title 8, Chapter 4, Subchapter 12, State of California (CALIF).

(2) Recommended Standard. Tunneling: Recommended Safety Rules, Bulletin 644, Bureau of Mines. (BUMINES)

10. NUCLEAR SAFETY. The following standards, in addition to those listed in the other chapters, shall be used as applicable.

a. Reactor Safety.

(1) Prescribed Standards.

(a) Criteria for Protection Systems for Nuclear Power Generating Stations, ANSI/IEEE 279-1971.

(b) Boiler and Pressure Vessel Code, ASME.

(c) Selection, Qualification, and Training of Personnel for Nuclear Power Plants, ANS 3.1, October 1980 (for Category A reactors).

(2) Recommended Standards.

(a) Applicable Nuclear Energy (RDT) Standards (See index of NE (RDT) Standards) (DOE).

(b) Licensing of Production and Utilization Facilities, 10 CFR 50 and appendices, including regulatory guides issued to describe methods of implementing these regulations.

(c) Operators' Licenses, 10 CFR 55.

(d) Reactor Site Criteria, 10 CFR 100.

(e) Safe Operation of Critical Assemblies and Research Reactors, 1971 Edition, Safety Series No. 35 (IAEA).

(f) Safe Operation of Nuclear Power Plants, Safety Series 31 (IAEA).

(g) IEEE Standards.

(h) ANS Series 15 Standards.

(i) Design Guide; Critical Facilities, BNL-50831-I.

(j) Design Guide; Light and Heavy Water Cooled Reactors, BNL-50831-II.

(k) Design Guide; Pool Type Reactors, BNL-50831-III.

(l) Design Guide; Liquid Metal Reactors, BNL-50831-IV.

(m) Design Guide; Transient Reactors, BNL-50831-V.

(n) Design Guide; Air Cooled Graphite Reactors, BNL-50831-VI.

b. Nuclear Facility Safety.

(1) Prescribed Standards.

(a) Criticality Accident Alarm System, ANSI/ANS-8.3-1979 (ANSI).

(b) Safety Standards for Operations with Fissionable Materials Outside Reactors, ANSI N16.1-1975 (ANSI).

(c) Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Materials, (ANSI/ANS 8.5-1979) (ANSI).

(2) Recommended Standards.

(a) Nuclear Safety Guide, TID-7016 (DOE).

(b) Critical Dimensions of Systems Containing uranium-235, plutonium-239, and uranium-233, TID-7028 (DOE).

(c) Critical and Safe Masses and Dimensions of Lattices of U and UO2 in Water, DuPont-1014 (DUPONT).

(d) United Kingdom Atomic Energy Authority Handbook of Criticality Data, AHSB(S), Handbook 1 (1st Revision).

(e) Criticality Handbook, ARH-600, (3 volumes).

(f) ANSI N16 Series Standards.

(g) Licensing of Production and Utilization Facilities, (10 CFR 50).

(h) Special Nuclear Material (10 CFR 70).

(i) Rules of General Applicability to Licensing of Byproduct Material (10 CFR 30).

(j) Licensing of Source Material (10 CFR 40).

(k) Operators' Licenses (10 CFR 55).

(l) Appropriate Portions of Reactor Site Criteria (10 CFR 100).

(m) Nuclear Air Cleaning Handbook ERDA 76-21, (DOE).

11. TRANSPORTATION SAFETY. The following standards, in addition to those listed in the other chapters, shall be used as applicable.

a. Aircraft Safety.

(1) Prescribed Standards. Federal Aviation Regulations (DOT).

(2) Recommended Standard. Aviation Ground Operation Safety Handbook (NSC).

(5) Ventilation System for Small Craft, Booklet 395, U.S. Coast Guard (DOT).

d. Transportation of Radioactive Material.

(1) Prescribed Standards.

(a) Department of Transportation Hazardous Materials Regulations (49 CFR 100-179).

(b) Packaging of Radioactive Materials for Transport (10 CFR 71).

(2) Recommended Standards.

(a) Cask Designers Guide ORNL-NSIC-68, 1970 (DOE).

(b) Structural Analysis of Shipping Casks, ORNL-TM-1312, Volumes I through X (DOE).

(c) Packaging of Uranium Hexafluoride for Transport, ANSI N14.1-1971 (ANSI).

e. Railroad Safety. Prescribed Standard. Federal Railroad Administration, (49 CFR 211-240).

SOURCES OF STANDARDS

1. AAOO — American Academy of Ophthalmology and Otolaryngology
15 Second Street, SW.
Rochester, Minnesota 55901

2. AASHTO — American Association of State Highway and Transportation Officials
444 North Capitol Street, NW.
Washington. D.C. 20001

3. ACGIH — American Conference of Governmental Industrial Hygienists
2205 South Road
Cincinnati, Ohio 45238

4. AGCA — Associated General Contractors of America, Inc.
1957 E Street, N.W.
Washington, D.C. 20006

5. AIHA — American Industrial Hygiene Association
475 Wolf Ledges Parkway
Akron, Ohio 44311

6. AMC — United States Department of the Army
Headquarters, U.S. Army Material Development and Readiness Command
Pentagon
Washington, D.C. 20310

7. ANSI — American National Standards Institute
1430 Broadway
New York, New York 10018

8. API — American Petroleum Institute
2101 L Street N.W.
Washington, D.C. 20037

9. ASME — American Society of Mechanical Engineers, Inc.
345 East 47th Street
New York, New York 10017

10. ASTM — American Society for Testing and Materials
1916 Race Street
Philadelphia, Pennsylvania 19103

11.	AWWA	American Water Works Association, Inc. 666 Quincy Street Denver, Colorado 80235
12.	BUMINES	Publications Section U.S. Bureau of Mines 4800 Forbes Avenue Pittsburgh, Pennsylvania 15213
13.	CALIF	State of California General Services Publications P.O. Box 1015 North Highland, California 95660
14.	CGA	Compressed Gas Association, Inc. 500 Fifth Avenue New York, New York 10036
15.	CMAA	Crane Manufacturers Association of America, Inc. 1326 Freeport Road Pittsburgh, Pennsylvania 15238
16.	CRC	C. R. C. Press, Inc. 2000 N.W. 24th Street Boco Raton, Florida 33431
17.	DOD	Department of Defense The Pentagon Washington, D.C. 20301
18.	DNA	Field Command Defense Nuclear Agency Albuquerque, New Mexico
19.	DOT	Department of Transportation 400 7th Street, S.W. Washington, D.C. 20590
20.	DOT	Coast Guard Department of Transportation 400 7th Street, SW. Washington, D.C. 20590
21.	DUPONT	E.I. duPont de Nemours and Company Petrochemicals Department Wilmington, Delaware 19898

22. EPA — Environmental Protection Agency
401 M Street, SW.
Washington, D.C. 20460

23. FDA — Food and Drug Administration
5600 Fishers Lane
Rockville, Maryland 20857

24. FEMA — Federal Emergency Management Agency
Administrative Services Division
Printing and Publications Branch
Room 404
Washington, D.C. 20472

25. FM — Factory Mutual Engineering Division
1151 Boston-Providence Turnpike
Norwood, Massachusetts 02062

26. GPO — Superintendent of Documents
United States Government Printing Office
Washington, D.C. 20402

27. GSA — General Services Administration
General Services Building
18 and F Street, NW.
Washington, D.C. 20405

28. IAEA — UNIPUB
P.O. Box 433, Murray Hill Station
New York, New York 10016

29. ICRP — International Committee on Radiation Protection
4201 Lexington Avenue
New York, New York 10017

30. ICRU — International Commission on Radiation Units
and Measurements
7910 Woodmont Avenue
Washington, D.C. 20014

31. IEEE — Institute of Electrical and Electronic
Engineers, Inc.
345 East 47th Street
New York, New York 10017

32. IME — Institute of Makers of Explosives
420 Lexington Avenue
New York, New York 10017

33. IRI — Industrial Risk Insurers
85 Woodland Street
Hartford, Connecticut 06102

34. ISO — International Standards Organization
c/o American National Standards Institute
1430 Broadway
New York, New York 10018

35. ITE — Institute of Transportation Engineers, Inc.
Suite 905, 1815 North Fort Myer Drive
Arlington, Virginia 22209

36. MCA — Chemical Manufacturers Association
1825 Connecticut Avenue, NW.
Washington, D.C. 20009

37. MCGRAW — McGraw-Hill Book Company, Inc.
1221 Avenue of Americas
New York, New York 10020

38. MPD — G. D. Searle and Company
Will Ross, Inc./Matties or Products Division
P.O. Box 85
East Rutherford, New Jersey 07073

39. NASA — National Aeronautics and Space Administration
400 Maryland Avenue, SW.
Washington, D.C. 20546

40. NAV — Commanding Officer
(Code 512) Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, Pennsylvania 19120

41. NBS — National Bureau of Standards
Department of Commerce
Washington, D.C. 20234

42. NCRP — National Council on Radiation Protection and Measurement
7910 Woodmont Avenue, Suite 1016
Bethesda, Maryland 20014

43. NCUTLO — National Committee on Uniform Traffic Laws and Ordinances
1776 Massachusetts Avenue, NW.
Washington, D.C. 20036

44. NFPA — National Fire Protection Association
470 Atlantic Avenue
Boston, Massachusetts 02210

45. NIOSH — Publications
NIOSH (MSR6)
4676 Columbia Parkway
Cincinnati, Ohio 45226

46. NRA — National Rifle Association
1600 Rhode Island Avenue, NW.
Washington, D.C. 20036

47. NSC — National Safety Council
444 North Michigan Avenue
Chicago, Illinois 60611

48. NTIS — National Technical Information Service
Department of Commerce
Springfield, Virginia 22151

49. NWU — Traffic Institute
Northwestern University
405 Church Street
Evanston, Illinois 60201

50. OMB — Office of Management and Budget
Old Executive Office Building
17th and Pennsylvania Avenue, NW.
Washington, D.C. 20503

51 OSHA — OSHA Publications Office
U.S. Department of Labor
Room S1212
3rd Street and Constitution Avenue, NW.
Washington, D.C. 20210

52. UL — Underwriters' Laboratories, Inc.
207 East Ohio Street
Chicago, Illinois 60611

53. USDA — Department of Agriculture
Washington, D.C. 20250

54. USPHS — Public Health Service
Office of Public Affairs
100 Independence Avenue, SW.
Room 7406
Washington, D.C. 20201

CHAPTER III

SAFETY REQUIREMENTS FOR THE PACKAGING OF FISSILE AND OTHER RADIOACTIVE MATERIALS

1. PURPOSE. The purpose of this chapter is to establish requirements for the packaging of fissile and other radioactive materials.

2. SCOPE. This chapter applies to all Headquarters divisions, offices, field organizations, and contractors who are involved with the shipment of radioactive material and who are exempt from the licensing requirements of the Code of Federal Regulations, Title 10, Part 71. (Reference the Code of Federal Regulations, Title 10, Part 70.11, which exempts the Department of Energy and its contractors from the regulations of the Nuclear Regulatory Commission.)

3. REFERENCES.

   a. Code of Federal Regulations, Title 10, Part 71, "Packaging of Radioactive Material for Transport."

   b. Department of Transportation Regulations.

      (1) Code of Federal Regulations, Title 49, Parts 100-189, "Hazardous Materials Regulations."

      (2) Code of Federal Regulations, Title 46, Part 146, "Transportation or Storage of Military Explosives on Board Vessels."

   c. International Atomic Energy Agency Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Material," 1973 Revised Edition.

   d. International Air Transport Association Restricted Article Regulations.

   e. U.S. Air Force AFM-71-4, "Preparation of Hazardous Materials for Military Air Shipment."

   f. American National Standards Institute Standard N14.5-1977, "American National Standard for Leakage Tests on Packages for Shipment of Radioactive Materials."

4. DEFINITIONS.

   a. Carrier. Any person engaged in the transportation of passengers or property, as common, contract, or private carrier, or freight forwarder, as those terms are used in the Interstate Commerce Act, as amended, or by the U.S. Postal Service.

b. Close Reflection by Water. Immediate contact by water of sufficient thickness to reflect a maximum number of neutrons.

c. Containment Vessel. The receptacle on which principal reliance is placed to retain the radioactive material during transport.

d. Fissile Classification. Classification of a package or shipment of fissile materials according to the controls needed to provide nuclear criticality safety during transportation as follows:

(1) Fissile Class I. Packages that may be transported in unlimited numbers and in any arrangement and that require no nuclear criticality safety controls during transportation. For purposes of nuclear criticality safety control, a transport index is not assigned to Fissile Class I packages. However, the external radiation levels may require a transport index number.

(2) Fissile Class II. Packages that may be transported in any arrangement but in numbers that do not exceed a transport index of 50. For purposes of nuclear criticality safety control, individual packages may have a transport index of not less than 0.1 and not more than 10. However, the external radiation levels may require a higher transport index number but not to exceed 10. Such shipments require no nuclear criticality safety control by the shipper during transportation.

(3) Fissile Class III. Shipments of packages that do not meet the requirements of Fissile Class I and II and that are controlled in transportation by special arrangements between the shipper and the carrier to provide nuclear criticality safety.

e. Fissile Materials. Uranium-233, uranium-235, plutonium-238, plutonium-239, plutonium-241, neptunium-237, and curium-244.

f. Limited Quantities of Radioactive Materials excepted from packaging, marking, labeling are described in Code of Federal Regulations, Tite 49, Part 173.391.

g. Low Specific Activity Material is material of low radioactivity level such as uranium ores and chemical concentrates of those ores. The low specific activity definition is in Code of Federal Regulations, Title 49, Part 173.389c. The shipping requirements are explained in Code of Federal Regulations, Title 49, Part 173.392.

h. Maximum Normal Operating Pressure. The maximum gauge pressure that is expected to develop in the containment vessel under the normal conditions of transport.

i. Moderator. A material used to reduce the kinetic energy of neutrons by scattering collisions without appreciable neutron capture.

j. Optimum Interspersed Hydrogenous Moderation. The occurrence of hydrogenous material between containment vessels to such an extent that the maximum nuclear reactivity results.

k. Package. Packaging and its radioactive contents.

l. Packaging. One or more receptacles and wrappers and their contents excluding fissile material and other radioactive material, but including absorbent material, spacing structures, thermal insulation, radiation shielding, devices for cooling and for absorbing mechanical shock, external fittings, neutron moderators, nonfissile neutron absorbers, and other supplementary equipment.

m. Primary Coolant. A gas, liquid, or solid, or combination of them, in contact with radioactive material, or, if the material is in special form, in contact with its capsule, and used to remove decay heat.

n. Special Form. To qualify as special form the radioactive material must either be in massive solid form or encapsulated. Special tests which are required of special form material are explained in the Code of Federal Regulations, Title 49, Part 173.398a.

o. Transport Index. The number placed on a package to designate the degree of control to be exercised by the carrier during transportation. The transport index to be assigned to a package of radioactive material shall be determined by either paragraph (1) or (2) below, whichever is larger. The number expressing the transport index shall be rounded up to the next higher tenth; e.g., 1.01 becomes 1.1.

(1) The highest radiation dose rate in millirem per hour at 3 feet from any accessible external surface of the package.

(2) The transport index of each Fissile Class II package is calculated by dividing the number 50 by the number of such Fissile Class II packages that may be transported together as determined under the limitations of Code of Federal Regulations Title 10, Part 71.39.

p. For other definitions (such as Type A or Type B quantities for packaging) refer to Code of Federal Regulations, Title 49, Parts 173.389 to 173.398 of the Department of Transportation regulations.

5. RESPONSIBILITIES AND AUTHORITIES.

a. The Director, Operational and Environmental Safety Division, Office of Environment:

(1) Administers the program for design review and issuance of Department of Energy Certificates of Compliance for Type B packaging.

(2) Assists field offices in securing waivers or exemptions for hazardous materials issued by the Department of Transportation. (Reference Code of Federal Regulations, Title 49, Parts 107.101-107.123, and 173.22a.)

(3) Prepares guidance criteria and procedures for application of package testing and quality assurance standards.

(4) Coordinates Department of Energy participation in the development and revision of transportation regulations.

(5) Provides a central point of coordination with the Nuclear Regulatory Commission for developing safety standards for transporting nuclear materials and design approvals bridging contractor and licensee packaging requirements.

(6) Conducts periodic appraisal to determine the adequacy of the implementation of this chapter except as provided in item 5d.

b. Heads of Offices and Divisions, Headquarters, provide program guidance, instruction, and standards to assure the safe packaging of fissile and other radioactive materials, including:

(1) Directing cognizant Heads of Field Organizations to require modifications of equipment, procedures, or practices and to coordinate budget requirements.

(2) Imposing additional requirements for packaging standards.

(3) Curtailing or suspending the use of specific packages, when necessary.

(4) Participating at their option in reviewing safety analysis reports.

c. Heads of Field Organizations, consistent with guidance instructions, standards, and criteria issued pursuant to paragraph b above:

(1) Grant Department of Energy approval when required for packages that meet the standards of this chapter, and that are to be used for the transportation of fissile or other radioactive materials in greater than Type A quantities, and issue Certificates of Compliance for approved designs.

(2) Perform an objective evaluation of contractors' safety analysis reports for packaging designs.

(3) Grant Department of Energy approval for shipments made under the National Security Exemption provided to the Department of Energy and the Department of Defense under the Code of Federal Regulations, Title 49, Part 173.7b.

(4) Grant such alternatives to the requirements set forth in this chapter as will provide equivalent protection to life or property and to the common defense and security; and within 30 days after granting an alternative, provide the Director, Operational and Environmental Safety Division, a detailed report of the reasons for granting it. The granting of such alternatives is in no way to be construed as the granting of exemptions or exceptions from or to the Department of Transportation or other regulatory agency requirements.

(5) Conduct periodic appraisals to determine the adequacy of contractor performance in the implementation of this chapter, except as provided in item 5d.

d. The Deputy Assistant Secretary for Naval Reactors is responsible for administering the program for design review and issuance of Department of Energy Certificates of Compliance for Naval Reactors packagings. The Deputy Assistant Secretary assumes the responsibility for conducting appraisals and the responsibilities of the Headquarters Office and Division Directors and Heads of Field Organizations for auditing the performance in appropriate programs.

6. EXEMPT QUANTITIES OF FISSILE MATERIALS. The following limited quantities of fissile material are exempt from the packaging requirements in the Code of Federal Regulations, Title 49, Part 173.396. This material must be packaged in accordance with other provisions for external radiation levels to meet Department of Transportation regulations.

a. Not more than 15 grams of fissile material.

b. Thorium or uranium containing not more than 0.72 percent by weight of fissile material.

c. Uranium compounds, other than metal (e.g., uranium tetrafluoride, uranium hexafluoride, or uranium oxide in bulk form, not pelleted

or fabricated into shapes), or aqueous solutions of uranium, in which the total amount of uranium-233 and plutonium present does not exceed 1 percent by weight of the uranium-235 content, and the total fissile content does not exceed 1 percent by weight of the total uranium content.

d. Homogenous hydrogenous solutions or mixtures containing not more than:

(1) 500 grams of any fissile material, provided the atomic ratio of hydrogen to fissile material is greater than 7600.

(2) 800 grams of uranium-235 provided that the atomic ratio of hydrogen to fissile material is greater than 5200 and the content of other fissile material is not more than 1 percent by weight of the total uranium-235 content.

(3) 500 grams of uranium-233 and uranium-235, provided that the atomic ratio of hydrogen to fissile material is greater than 5200 and the content of plutonium is not more than 1 percent by weight of the total uranium-233 and uranium-235 content.

e. Less than 350 grams of fissile material, provided that there is not more than 5 grams of fissile material in any cubic foot within the package.

7. REQUIREMENTS.

a. Federal Regulations. When offered to the carrier, each shipment of radioactive materials shall be in compliance with this chapter and the applicable safety regulations of the Department of Transportation, and follow the applicable packaging standards of the Nuclear Regulatory Commission (Code of Federal Regulations, Title 10, Parts 71.31 - 71.42), that as presently set forth provide a reasonable set of technical standards.

b. Special Plutonium Air Shipment Requirements.

(1) Departmental shipments of less than 10 microcuries of plutonium are exempt from specification packaging and marking and can be carried aboard any aircraft providing the conditions of Code of Federal Regulations, Title 49, Part 173.391 are met.

(2) Up to Type A2 quantities of plutonium may be shipped by air in a Type A packaging.

(3) More than Type A2 quantities of plutonium must be air shipped in the certified packaging, USA/0361/BF, or in a newly designed

packaging meeting the NUREG-0360 criteria. The form of more than 20 curies of plutonium must meet the standards of the Code of Federal Regulations, Title 10, Part 71.42.

. Other Regulations.

(1) International Atomic Energy Agency Regulations. Each shipment of fissile and other radioactive materials consigned to a foreign country must meet the requirements set forth in International Atomic Energy Agency Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Materials." Specifically, "Requirements for Packaging and for Delivery of Packages to Transport," must be met to be in compliance with this chapter. Packaging must be approved by appropriate national competent authorities. (Code of Federal Regulations, Title 49, Part 393 a, b.)

(2) International Air Transport Association Restricted Article Regulations. Each shipment of fissile and other radioactive materials consigned to a foreign country must meet the requirements set forth in International Air Transport Association Restricted Article Regulations when shipped via commercial aircraft.

(3) U.S. Air Force AFM-71-4, "Packaging and Handling of Dangerous Materials for Transport by Military Aircraft." Each shipment of fissile and other radioactive materials must meet the requirements set forth in AFM-71-4 when shipped via U.S. Air Force aircraft.

d. Package Standards for Radioactive Materials in Amounts Greater than Type A Quantities.

(1) Packages of radioactive materials shall be prepared for shipment and transported in accordance with the provisions of this chapter. Department of Transportation specification containers for Type B and fissile materials are considered to meet the standards of this chapter and no specific Department of Energy Certificates of Compliance are required for this use when lading meets the specification. Packaging having a current Nuclear Regulatory Commission Certificate of Compliance can be used after registering with the Nuclear Regulatory Commission as a user.

(2) Nuclear weapons and their components shall be packaged and transported in accordance with the standards in this chapter or

Vertical line denotes change.

with other standards in DOE 5610.1, which provide a degree of safety at least equivalent to that provided by the Department of Energy and Department of Transportation regulations.

(3) Packages shipped under the National Security Exemption of the Code of Federal Regulations, Title 49, Part 173.7b must be in compliance with the standards in this chapter and must also comply with the provisions of other pertinent Department of Energy orders.

(4) A quality assurance program must be established and implemented to assure that packages or radioactive materials are fabricated, maintained, and used in accordance with the regulations and approved design features.

Department of Energy Certificates of Compliance for Packages of Radioactive Materials in Excess of Type A Quantities. Upon determination that a package design does in fact meet the requirements of this chapter, a Department of Energy Certificate of Compliance will be issued by the Department to the contractor.

Department of Energy as Consignor. When a Department of Energy field organization serves as the actual consignor, rather than a contractor, independent internal procedures shall be established by the responsible Head of the Field Organization to assure compliance with the standards contained in this chapter.

Waivers and Exemptions. Packages that do not meet the standards in the Department of Transportation Hazardous Materials Regulations and that do not qualify for shipment under the National Security Exemption may be shipped only under the provisions of a waiver or exemption issued by the Department of Transportation, or on public vehicles or aircraft if approved under the provisions of paragraph 5c, above. Applications for an exemption shall be prepared in accordance with the Code of Federal Regulations, Title 49, Part 107.103 and shall be forwarded through the Operational and Environmental Safety Division to the Department of Transportation.

8. PACKAGE STANDARDS.

a. General Standards for All Packaging.

(1) Reference the Code of Federal Regulations, Title 10, Part 71.31.

(2) For determination of transport indexes for packaging, see paragraph 4o of this chapter.

(3) Excluded from the standards, testing requirements, packaging certification, and documentation described in this chapter are

low specific activity shipments consigned as exclusive use. The requirements for this type of shipment are contained in Code of Federal Regulations, Title 49, Part 173.392.

(4) Type A packaging requirements are contained in Code of Federal Regulations, Title 49, Part 173.393 and Part 173.395.

b. Structural Standards for Type B and Large Quantity Packaging. Packaging used to ship a quantity of radioactive material larger than Type A shall be designed and constructed in compliance with the structural standards of this section. Standards different from those specified in this section may be approved by the Head of the Field Organization or other designated official if the controls proposed to be exercised by the shipper are demonstrated to be adequate to assure the safety of the shipment.

(1) Load Resistance. Regarded as a simple beam support at its end along any major axis, packaging shall be capable of withstanding a static load, normal to and uniformly distributed along its length, equal to 5 times its fully loaded weight, without generating stress in any material of the packaging in excess of its yield strength.

(2) External Pressure. Packaging shall be adequate to assure that the containment vessel will suffer no loss of contents if subjected to an external pressure of 25 pounds per square inch gauge.

c. Criticality Standards for Fissile Material Packages.

(1) A package used for the transport of fissile material shall be so designed and constructed and its contents so limited that it would be subcritical if it is assumed that water leaks into the containment vessel, and:

(a) Water moderation of the contents occurs to the most reactive credible extent consistent with the chemical and physical form of its contents.

(b) The containment vessel is fully reflected on all sides by water.

(2) A package used for the transport of fissile material shall be so designed and constructed and its contents so limited that it would be subcritical if it is assumed that any contents of the package that are liquid during normal transport leak out of the containment vessel, and that the fissile material is then:

(a) In the most reactive credible configuration consistent with the chemical and physical form of the material.

(b) Moderated by water outside of the containment vessel to the most reactive credible extent.

(c) Fully reflected on all sides by water.

(3) The Head of the Field Organization or other designated official may approve exceptions to the requirements of this section where the containment vessel incorporates special design features that would preclude leakage of liquids in spite of any single packaging error, and appropriate measures are taken before each shipment to verify the leak tightness of each containment vessel.

d. Evaluation of a Single Package.

(1) The effect of the transport environment on the safety of any single package of radioactive material shall be evaluated as follows:

(a) The ability of a package to withstand conditions likely to occur in normal transport shall be assessed by subjecting a single package of scale model, by test or other assessment, to the normal conditions of transport as specified in paragraph 8e below.

(b) The effect on a package of conditions likely to occur in an accident shall be assessed by subjecting a sample package or scale model, by test or other assessment, to the hypothetical accident conditions as specified in paragraph 8f below.

(2) Taking into account controls to be exercised by the shipper, the Head of the Field Organization or other designated official may permit the shipment to be evaluated together with or without the transporting vehicle for the purpose of one or more tests.

(3) Normal conditions of transport and hypothetical accident conditions different from those specified in paragraph 8e and 8f below, may be approved by the Head of the Field Organization or other designated official if the controls proposed to be exercised by the shipper are demonstrated to be adequate to assure the safety of the shipment.

e. Standards for Normal Conditions of Transport for a Single Package.

(1) A package used for the shipment of fissile material or more than Type A quantity of radioactive material shall be so designed and constructed, and its contents so limited, that under the normal conditions of transport specified in paragraph 11:

(a) There will be no release of radioactive materials from the containment vessel.

(b) The effectiveness of the packaging will not be substantially reduced.

(c) There will be no mixture of gases or vapors in the package that could, through any credible increases of pressure or an explosion, significantly reduce the effectiveness of the package.

(d) Radioactive contamination of the liquid or gaseous primary coolant will not exceed 10^{-7} curies of activity of Group I radionuclides per milliliter, 5×10^{-6} curies of activity of Group II radionuclides per milliliter, 3×10^{-4} curies of activity of Group III and Group IV radionuclides per milliliter.

(e) There will be no loss of coolant or loss of operation of any mechanical cooling device.

(2) A package used for the shipment of fissile material shall be designed and constructed, and its contents so limited, that under normal conditions of transport specified in paragraph 11, considered individually:

(a) The package will be subcritical.

(b) The geometric form of the package contents would not be substantially altered.

(c) There will be no leakage of water into the containment vessel. This requirement need not be met if, in the evaluation of undamaged packages under paragraphs 8h, 8i, or 8j below, it has been assumed that moderation is present to such an extent as to cause maximum reactivity consistent with the chemical and physical form of the material.

(d) There will be no substantial reduction in the effectiveness of the packaging, including:

1 Reduction by more than 5 percent in the total effective volume of the packaging on which nuclear safety is assessed.

2 Reduction by more than 5 percent in the effective spacing on which nuclear safety is assessed between the center of the containment vessel and the outer surface of the packaging.

3 Occurrence of any aperture in the outer surface of the packaging large enough to permit the entry of a 4-inch cube.

(3) A package used for the shipment of more than Type A quantity of radioactive material shall be so designed and constructed, and its contents so limited, that under normal conditions of transport specified in paragraph 11 considered individually, the containment vessel would not be vented directly to the atmosphere.

f. Standards for Hypothetical Accident Conditions for a Single Package.

(1) A package used for the shipment of more than Type A quantity of radioactive material shall be so designed and constructed and its contents so limited that if subjected to the sequence of the hypothetical accident conditions specified in paragraph 12, it will meet the following conditions:

(a) The reduction of shielding would not be sufficient to increase the external radiation dose rate to more than 1000 millirems per hour at 3 feet from the external surface of the package.

(b) No radioactive material would be released from the package except for gases and contaminated coolant containing total radioactivity exceeding neither:

1 0.1 percent of the total radioactivity of the package contents.

2 0.01 curie of Group I radionuclides, 0.5 curies of Group II radionuclides, 10 curies of Group III and Group IV radionuclides, and 1000 curies of inert gases irrespective of transport group.

(2) A package used for the shipment of fissile material shall be so designed and constructed, and its contents so limited, that if subjected to the sequence of the hypothetical accident conditions specified in paragraph 12, the package would be subcritical. In determining whether this standard is satisfied, it shall be assumed that:

(a) The fissile material is in the most reactive credible configuration consistent with the damaged condition of the package and the chemical and physical form of the contents.

(b) Water moderation occurs to the most reactive credible extent consistent with the damaged condition of the package and the chemical and physical form of the contents.

(c) There is reflection by water on all sides and as close as is consistent with the damaged condition of the package.

g. Criticality Standards for Packaging Fissile Materials. The fissile characteristics of each package and array of packages shall be evaluated for criticality and the assignment of the proper fissile Class I, II, or III. The packaging standards of the Nuclear Regulatory Commission (Reference Section 3a of this chapter) are an acceptable set of technical standards to assist this evaluation.

9. QUALITY ASSURANCE PROCEDURES FOR THE FABRICATION, ASSEMBLY, AND TESTING OF OFFSITE SHIPPPING CONTAINERS.

a. Establishment and Maintenance of Procedures. Each field organization shall require its contractors to establish and to maintain a quality assurance program to:

(1) Assure that the requisite standards of quality are met in the fabrication, assembly, and testing of each package.

(2) Assure that packages in use continue to meet the requisite standards of quality.

b. Elements of a Quality Assurance Program. For guidance in developing a comprehensive quality assurance program, see the Code of Federal Regulations, Title 10, Part 71, Appendix E, "Quality Assurance Criteria for Shipping Packages of Radioactive Material." Reference should also be made to Chapter II of this Order. The contractor's programs shall consist of a formal system of procedural and organizational arrangements that:

(1) Require that specific responsibilities be assigned to designated units (including those of the vendor, the fabricator, and the contractor) for assuring specified quality at all stages of construction.

(2) Designate codes, standards, and specifications for materials, equipment, methods of fabrication, testing, and performance.

(3) Provide for quality control of materials, equipment, and services in instances where these have not already been established by existing standards and specifications.

(4) Provide that quality assurance records are maintained in an auditable file during the service life of the container.

(5) Provide for a quality control method of determining that packagings procured for use from other sources, including contractors and subcontractors or from Nuclear Regulatory Commission licensees, meet the requirements of this chapter.

(6) Establish acceptance criteria in terms of measurable characteristics and the effects of appropriate tests prescribed in paragraphs 11, 12, 14 and required in paragraph 8(c).

(7) Provide for a program of routine maintenance inspection and, where necessary, retesting to assure that reusable containers continue to meet the applicable design standards.

(8) Provide for required training, testing, and certification of manufacturing and inspection personnel involved in special processes, such as welding and nondestructive examination, and for the required certification of equipment and procedures used in the performance of special processes.

(9) Field organizations provide for a periodic audit of the contractors' programs and new packaging to assess effectiveness of the quality assurance program.

10. OPERATING PROCEDURES.

a. Establishment and Maintenance of Procedures. The shipper shall establish and maintain:

(1) Operating procedures adequate to assure that the determinations and controls required by this section are accomplished.

(2) Regular and periodic inspection procedures adequate to assure that the procedures required by paragraph (1) above are followed.

b. Assumptions as to Unknown Properties. When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the shipper shall package the fissile material as if the unknown properties have such credible values as will cause the maximum nuclear reactivity. Any special instructions needed to safely open the package are to be made available to the consignee.

c. Preliminary Determinations.

(1) Prior to the first use of any packaging for the shipment of more than a Type A quantity of radioactive material or fissile materials, such packaging shall be inspected to ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce its effectiveness.

(2) Prior to the first use of any packaging for the shipment of more than a Type A quantity of radioactive or fissile materials, where the maximum normal operating pressure will exceed 5 pounds per square inch

gauge, the containment vessel shall be tested to assure that it will not leak at an integral pressure 50 percent higher than the maximum normal operating pressure.

(3) Packaging shall be marked conspicuously and durably with its model number. Prior to applying the model number, an inspection shall be made to determine that the packaging has been fabricated in accordance with the approved design.

d. Routine Determinations. Prior to each use of a package for shipment of radioactive or fissile material, the shipper shall ascertain that the package with its contents satisfies the applicable requirements of paragraph 8 including determination that:

(1) The packaging has not been significantly damaged.

(2) Any moderators and nonfissile neutron absorbers, if required, are as authorized.

(3) The closure of the package and any sealing gaskets present are free from defects.

(4) Any valve through which primary coolant can flow is protected against tampering.

(5) The internal gauge pressure of the package will not exceed, during the anticipated period of transport, the maximum normal operating pressure.

(6) Contamination of the primary coolant will not exceed, during the anticipated period of transport, the limits in paragraph 8e(1)(d).

e. Records. The shipper shall maintain for 2 years or more a record of each shipment of fissile material and each shipment of amounts of radioactive material greater than Type A quantities in single packages, showing where applicable:

(1) Identification of the packaging by model number and the number of the certificate of compliance.

(2) Details of any significant defects in the packaging, with the means employed to repair the defects and prevent their recurrence.

(3) Volume and identification of coolant.

(4) Type and quantity of material in each package, and the total quantity in each shipment.

(5) For each item of irradiated fissile material:

(a) Identification by model number.

(b) Irradiation and decay history to the extent appropriate to demonstrate that its nuclear and thermal characteristics comply with approved conditions.

(c) Any abnormal or unusual condition relevant to radiation safety.

(6) Date of the shipment.

(7) For Fissile Class III, any special controls exercised.

(8) Name and address of the transferee.

(9) Address to which shipment was made.

(10) Results of the determination required by paragraphs 10c and 10d above.

f. Documentation of Technical Backup Support for Specification, Certified, and Exempt Packagings. Packagings that have been certified by the Department of Energy as meeting Department of Transportation regulations and packagings for which specifications have been published by the Department of Transportation may be used by other Department of Energy shippers having authority to ship radioactive or fissile materials. If the Nuclear Regulatory Commission also certifies that the standards of the Code of Federal Regulations, Title 10, Part 71, licensees can be listed as users by the Nuclear Regulatory Commission and ship in the packagings to either Department of Energy contractors or to other licensees. Therefore, it is essential that technical information and limits pertinent to the construction and use of these packagings be available to all potential users. The following are requirements to meet these objectives:

(1) Heads of Field Organizations shall require contractors under their jurisdiction to prepare a distributable document for each new specification or certified packaging designed, developed, and fabricated for offsite shipment of fissile and other radioactive materials in quantities exceeding Type A. Obsolete packagings no longer in use and containers used for onsite movement of materials are not subject to these documentation requirements unless they are reactivated, altered, or requested for use in offsite shipments. In such instances, the party or parties requiring reactivation or alterations shall prepare or have prepared the appropriate document.

(2) Each document shall provide, as a minimum, the information below (following the format in the Code of Federal Regulations, Title 10, Part 71.21-24 for guidance as appropriate):

(a) A complete physical and technical description of the package.

(b) A safety analysis report for packaging including considerations for meeting the requirement for packaging and transport safety, nuclear criticality safety, and radiological safety, Type B packaging should meet the Type B hypothetical accident test conditions.

(c) Design and development information including pertinent data, analytical methods, and the results of the prescribed tests.

(d) Tables, graphs, drawings, pictures, and technical references as required to give a clear treatment of the subject.

g. Notification Procedures for Shipment and Nonreceipt of Radioactive Materials. To reduce to a minimum the number of shipments that must ultimately be considered lost, the following procedures shall be implemented:

(1) Prior to each shipment of fissile radioactive materials, or shipments of more than Type A quantity of radioactive material, the shipper shall notify the consignee of the dates of the shipment and of expected arrival. The shipper shall also notify each consignee of any special loading or unloading instructions prior to his first shipment.

(2) The consignee shall be requested to notify the shipper immediately at the end of 4 days after the estimated arrival date if the shipment has not been received. Prompt notification by telephone or teletype should be followed by receipted registered mail to provide a written notice.

(3) Lost, strayed, or stolen shipments that are not recovered or accounted for shall be reported to the field office transportation officer as an unusual occurrence. The cognizant field organization head shall determine if an investigation is warranted and advise the Operational and Environmental Safety Division of his or her decision at the time of the unusual occurrence report.

(4) For all radioactive material shipments, Type A, Type B, low specific activity, everything, a return receipt shall be requested. The shipper shall follow up on the shipment status if the return receipt is not received within one month.

11. NORMAL CONDITIONS OF TRANSPORT. Each of the following normal conditions of transport is to be applied separately to determine its effect on a package.

a. Heat. Direct sunlight at an ambient temperature of 130 degrees Fahrenheit in still air.

b. Cold. An ambient temperature of -40 degrees Fahrenheit in still air and shade.

c. Pressure. Atmospheric pressure of 0.5 times standard atmospheric pressure.

d. Vibration. Vibration is normally incident to transport.

e. Water Spray. A water spray sufficiently heavy to keep the entire exposed surface of the package except the bottom continuously wet during a period of 30 minutes.

f. Free Drop. Between 1-1/2 and 2-1/2 hours after the conclusion of the water spray test, a free drop through the distance specified below onto a flat essentially unyielding horizontal surface, striking the surface in a position for which maximum damage is expected.

Free Fall Distance

Package Weight (pounds)	Distance (feet)
Less than 10,000	4
10,000 to 20,000	3
20,000 to 30,000	2
More than 30,000	1

g. Corner Drop. A free drop onto each corner of the package in succession or in the case of a cylindrical package, onto each quarter of each rim, from a height of 1 foot onto a flat essentially unyielding horizontal surface. This test applies only to packages which are constructed primarily of wood or fiberboard, and do not exceed 110 pounds gross weight, and to all Fissile Class II packages.

h. Penetration. Impact of the hemispherical end of a vertical steel cylinder 1-1/4 inches in diameter and weighting 13 pounds, dropped from a height of 40 inches onto the exposed surface of the package which is expected to be more vulnerable to puncture. The long axis of the cylinder shall be perpendicular to the package surface.

i. Compression. For packages not exceeding 10,000 pounds in weight, a compressive load equal to either 5 times the weight of the package or 2 pounds per square inch multiplied by the maximum horizontal cross section

of the package, whichever is greater. The load shall be applied during a period of 24 hours, uniformly against the top and bottom of the package in the position in which the package would normally be transported.

12. HYPOTHETICAL ACCIDENT CONDITIONS. The following hypothetical accident test conditions are to be applied sequentially, in the order indicated, to determine their cumulative effect on a package or array of packages:

    a. Free Drop. A free drop through a distance of 30 feet onto a flat essentially unyielding horizontal surface, striking the surface in a position for which maximum damage is expected.

    b. Puncture. A free drop through a distance of 40 inches striking in a position for which maximum damage is expected, the top end of a vertical cylindrical mild steel bar mounted on an essentially unyielding horizontal surface. The bar shall be 6 inches in diameter, with the top horizontal and its edge rounded to a radius of not more than 1/4 inch, and of such length as to cause maximum damage to the package, but not less than 8 inches long. The long axis of the bar shall be perpendicular to the unyielding horizontal surface.

    c. Thermal. Exposure to a thermal test in which the heat input to the package is not less that that which would result from exposure of the whole package to a radiation environment of 1475 degrees Fahrenheit for 30 minutes with an emissivity coefficient of 0.9, assuming the surfaces of the package have an absorption coefficient of 0.8. The package shall not be cooled artificially until 3 hours after the test period unless it can be shown that the temperature on the inside of the package has begun to fall in less than 3 hours.

    d. Water Immersion (fissile material packages only). Immersion in water to the extent that all portions of the package to be tested are under at least 3 feet of water for a period of not less than 8 hours.

13. TRANSPORT GROUPING OF RADIONUCLIDES. These groupings shall be in accordance with the Code of Federal Regulations, Title 49, Part 173.390.

14. TESTS FOR SPECIAL FORM MATERIAL.

    a. Free Drop. A free drop through a distance of 30 feet onto a flat essentially unyielding horizontal surface, striking the surface in such a position as to suffer maximum damage.

    b. Percussion. Impact of the flat circular end of a 1 inch diameter steel rod weighing 3 pounds, dropped through a distance of 40 inches. The capsule or material shall be placed on a sheet of lead, of hardness number 3.5 to 4.5 on the Vickers scale, and not more than 1 inch thick, supported by a smooth essentially unyielding surface.

c. Heating. Heating in air to a temperature of 1475 degrees Fahrenheit and remaining at that temperature for a period of 10 minutes.

d. Immersion. Immersion for 24 hours in water at room temperature. The water shall be a pH6 - pH8 with a maximum conductivity of 10 micromhos per centimeter.

CHAPTER V

SAFETY OF NUCLEAR FACILITIES

1. PURPOSE. This chapter establishes safety procedures and requirements for nuclear facilities to assure:

   a. That nuclear facilities are sited, designed, constructed, modified, operated, maintained, and decommissioned in accordance with generally uniform standards, guides, and codes which are consistent with those applied to comparable licensed nuclear facilities.

   b. That radioactive and fissionable materials are produced, processed, stored, transferred, or handled in such a manner that the probability of an accident is acceptably low.

   c. That an environmental protection, safety, and health protection program is established in accordance with the requirements stipulated in paragraphs 6 through 11 of this chapter.

   d. That environmental protection, safety, and health protection matters are comprehensively addressed and receive an objective review with all identifiable risks reduced to acceptably low levels, and that management authorization of the operation is documented.

   e. That consideration is given to all potential criticality hazards associated with fissionable material operations outside nuclear reactors.

   f. The protection of Government property and essential operations from the effects of potential accidents.

2. SCOPE. This chapter applies to Headquarters and field organizations, Department of Energy contractors, and Government-owned laboratories and non-reactor nuclear facilities. The requirements of this chapter shall be applied to the design, construction, maintenance, operation, and decommissioning of a given facility with due consideration to the degree of risk that facility presents to employees, the public, and the environment. Accelerator and nuclear reactor facilities and their operation are not included in this chapter, but are covered by other Environmental, Safety, and Health Orders, as appropriate.

3. REFERENCES.

   a. DOE 5480.1, Chapter XI, "Requirements for Radiation Protection."

   b. Code of Federal Regulations, Title 10, Part 30, "Rules of General Applicability to Licensing of Byproduct Material."

c. Code of Federal Regulations, Title 10, Part 40, "Licensing of Source Material."

d. Code of Federal Regulations, Title 10, Part 50, "Licensing of Production and Utilization Facilities."

e. Code of Federal Regulations, Title 10, Part 55, "Operators' Licenses."

f. Code of Federal Regulations, Title 10, Part 70, "Special Nuclear Material."

g. "Handbook of Nuclear Safety," Clark, H.K., 1-61 (DP-532).

h. "Los Alamos Critical Mass Data," Paxton, H.C., 5-64 (LAMS-3067).

i. "Criticality Control in Chemical and Metallurgical Plants," Karlsruhe Symposium, Organization for Economic Cooperation and Development, European Nuclear Energy Agency, 1961.

j. "Criticality Control of Fissile Materials," Proceedings of Symposium, Stockholm, Sweden, International Atomic Energy Agency, 1966.

k. ANSI N16 Series, N16.1 thru N16.5 inclusive, N16.8, and N16.9.

l. The Criticality Data Center Report Series.

m. "Criticality Control in Operations With Fissile Materials," 11-72 (LA-3366, Rev.), Paxton, H.C.

n. "Criticality Problems of Actinide Elements," Clayton, E.D., and Bierman, S.R., Actinides Reviews 1 (1971), 409-432.

o. "Nuclear Safety Guide" (TID-7016, Revision 2, 1978, available as NUREG/CR-0095).

p. DOE 5484.1, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION INFORMATION REPORTING REQUIREMENTS, of 2-24-81.

q. DOE 5484.2, UNUSUAL OCCURRENCE REPORTING SYSTEM.

r. DOE 5482.1A, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION APPRAISAL PROGRAM.

s. DOE 5700.6A, QUALITY ASSURANCE.

t. DOE 6430., GENERAL DESIGN CRITERIA FOR DEPARTMENT OF ENERGY FACILITIES.

u. DOE 5481.1A, SAFETY ANALYSIS AND REVIEW SYSTEM.

v. "Critical Dimensions of Systems Containing U-235, PU-239, and U-233," TID-7028.

4. DEFINITIONS.

a. Critical Mass. The smallest mass of fissionable material that will support a self-sustaining chain reaction under specified conditions.

b. Fissionable Materials. Nuclides capable of sustaining a neutron induced fission chain reaction, e.g., uranium 233, uranium 235, plutonium 239, plutonium 238, plutonium 241, neptunium 237, americium 241 and curium 244. (Additional fissionable nuclides shall be included as significant quantities become available.)

c. Fissionable Materials Handler. An individual officially designated by management to manipulate or handle significant quantities of materials; or manipulate the controls of equipment used to produce, process, transfer, store, or package significant quantities of such materials.

d. Supervisor. An individual officially designated by management to direct the activities of operators or fissionable materials handlers and to supervise the operation of equipment that handles, produces, processes, stores, packages, or uses radioactive material or significant quantities of fissionable materials.

e. Nuclear Criticality. A self-sustaining chain reaction, i.e., the state in which the effective neutron multiplication constant of a system of fissionable material equals or exceeds unity.

f. Nuclear Criticality Safety. Prevention or termination of inadvertent nuclear criticality, mitigation of consequences, and protection against injury or damage due to an accidental nuclear criticality.

g. Nuclear Facility. A facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees and the general public. Included, are facilities that (1) produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium; (2) conduct separations operations; (3) conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations; (4) conduct fuel enrichment operations. Incidental use of radioactive materials in a facility operation (e.g., check sources, radioactive sources, and X-ray machines) does not necessarily require the facility to be included in this definition. Accelerators and reactors and their operations are not included.

h. Operational Safety Requirements. Those requirements which define the conditions, safe boundaries, and bases thereof, and management control required to assure the safe operation of a nuclear facility.

i. Operator. An individual designated by management to perform operations or conduct activities with radioactive materials at a nuclear facility.

j. Safety Analysis. A documented process to systematically identify the hazards of a Department of Energy operation, to describe and analyze the adequacy of the measures taken to eliminate, control, or mitigate identified hazards, and to analyze and evaluate potential accidents and their associated risks.

k. Safety Guides. Documents designated or recognized as an acceptable basis for nuclear criticality safety evaluations. The guides are used as aids by Department of Energy field organizations when suggesting acceptable safety practices, and include material developed by Department of Energy contractors, professional societies, industrial organizations, and foreign atomic energy industries.

l. Safe Mass. That mass of fissionable materials which is subcritical for all conditions to which it could reasonably be expected to be exposed, including processing, handling, storing, and procedural uncertainties.

m. Significant Modification. A change to the nuclear facility that involves an unreviewed safety question, as defined below.

n. Significant Quantities. A mass of fissionable materials greater than a safe mass, as defined above.

o. Risk. A quantitative or qualitative expression of possible loss which considers both the probability that a hazard will cause harm and the consequences of that event.

p. Undue Risk. A level of identifiable risk which is unacceptable to the Department.

q. Unreviewed Safety Question. A proposed change, test, or experiment is an unreviewed safety question if:

(1) The probability of occurrence or the consequence of an accident or malfunction of equipment important to safety, previously reviewed by the Department will be significantly increased, or

(2) A possibility for an accident or malfunction of a different type than previously reviewed by the Department will be created which could result in significant safety consequences.

r. Unusual Occurrence. See DOE 5484.2, UNUSUAL OCCURRENCE REPORTING SYSTEM.

s. Verification of Training and Retraining. The confirmation by an auditable record of the experience, education, medical conditions, training, and testing pertinent to the candidate's specific job assignment and responsibilities. This record should show that all applicable requirements of paragraph 8, are met.

5. RESPONSIBILITIES AND AUTHORITIES.

a. Program Secretarial Officers, or their designees, perform the following functions for nuclear facilities under their program responsibility:

(1) Assume line management responsibility for nuclear facility safety.

(2) Provide for independent review and assessment of nuclear facility activities in their program organizations and the field offices to assure that they are accomplished in consonance with the need for protecting the environment, safety, and health of DOE and DOE contractor employees, and the public.

(3) Assure that the construction and initial startup of high hazard (as defined in DOE 5481.1A) facilities and any subsequent modifications involving a high hazard to a facility will not create undue environmental protection, safety, or health protection risks by:

(a) Assuring that an acceptable safety review has been made and documented by the appropriate field organization.

(b) Determining that such independent safety reviews indicate that an adequate degree of protection of health and safety exist.

(4) Transmit the results of the actions taken under subparagraphs (2) and (3), above, to the responsible field organizations with any necessary or appropriate instructions as to subsequent action to be taken with a copy to the Office of Nuclear Safety.

(5) Submit to higher management for action, any disagreement with recommendations made during safety reviews that cannot be resolved.

(6) Provide assistance and guidance to field organizations in the performance of safety reviews, appraisals, and the preparation of safety analysis reports.

(7) Recommend additions or revisions to nuclear safety standards, guides, and codes to the Office of Nuclear Safety.

(8) Perform program reviews and assessments to assure compliance of field organizations with subparagraph 5(e) below. In the execution of this responsibility, maximum use should be made of the appraisals performed by the Office of Nuclear Safety.

(9) Assure the safe operation of nuclear facilities by:

(a) Directing the responsible field organization to require modification of equipment, procedures, or practices to assure safe operation.

(b) Taking other actions to assure the implementation of this chapter, including directing the field organization to curtail or suspend the operation of their nuclear facilities when necessary.

(c) Taking other actions as deemed appropriate.

(10) Provide to the Deputy Assistant Secretary for Environment, Safety, and Health (EP-30) a copy of directions given under subparagraph (9), above.

(11) Include, in long-range program objectives and plans, the requirements to assure safe operation.

(12) Assure that program budgets provide adequate funds for health and safety requirements during all phases of facility life.

(13) Consider nuclear facility safety factors in connection with review and approval of designs, program and project proposals, and other proposals requiring Headquarters action.

(14) Obtain special technical assistance as needed in performance of assigned functions when the expertise is not available in the office in need of assistance.

(15) Transmit to cognizant field organizations proposed new safety requirements. Upon consideration of field organization assessments of such requirements and EP-30 comments, provide final approval.

(16) Review and approve the field office designation of nuclear facilities after considering comments recieved from the Assistant Secretary, Environmental Protection, Safety, and Emergency Preparedness (EP-1).

b. Assistant Secretary, Environmental Protection, Safety, and Emergency Preparedness, through the Deputy Assistant Secretary for Environment, Safety, and Health:

(1) Provides the Secretary with an independent safety overview and assessment of the operation at DOE-owned nuclear facilities.

(2) Establishes priorities for conducting safety appraisals of programs in conjunction with program Secretarial Officers and Operations Office Managers.

(3) Assures that nuclear facilities projects are consistent with DOE nuclear safety policy.

(4) Overviews and appraises both the line and independent nuclear safety activities of the cognizant Secretarial Officers and the Operations Office Managers to assure that DOE nuclear projects are accomplished in consonance with a need for protecting the safety and health of DOE and DOE contractor employees, and the public. Specific emphasis will be placed on training programs to assure that they include requirements necessary to achieve the goal of well-trained operators.

(5) Conducts appraisal with teams which are augmented with experts from other DOE organizations.

(6) Provides nuclear safety expertise to assist other Headquarters and field organizations.

(7) Develops and maintains generic qualification and training standards for operators.

(8) Assures that responsible EP personnel are proficient in the operations personnel training area, including diverse expertise so that important areas related to nuclear safety are covered.

(9) Collects new safety requirements applicable to licensed nuclear facilities and consults with the cognizant program Secretarial Officer to make a preliminary evaluation to determine their potential applicability to DOE nuclear facilities and:

(a) Evaluates field office assessments and program Secretarial Office disposition of newly proposed requirements and considers the requirements for inclusion in DOE Orders, as appropriate.

(b) Maintains a summary of the consideration and disposition given by the Department to each of the newly proposed requirements for nuclear facilities.

NOTE: The above process for implementing newly proposed environmental protection, safety, and health requirements into DOE orders, policies, or directives does not relieve the line

program organization from its responsibility to assure that new environmental protection, safety, and health requirements are considered and applied as necessary to their facilities.

c. The Deputy Assistant Secretary for Naval Reactors.

(1) Directs a program for assuring environmental protection, safety, and health protection at supporting contractor facilities for the Naval Reactors program and fulfills the responsibilities described for Heads of Field Organizations under subparagraph 5d, below, for the Schenectady and Pittsburgh Naval Reactors Offices.

(2) Fulfills the responsibilities of this chapter and DOE 5482.1A, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION APPRAISAL PROGRAM, for criticality control and nuclear facilty safety overview, assessments, and appaisals for nuclear facilities under the cognizance of the Deputy Assistant Secretary for Naval Reactors.

(3) Shall be exempt from the requirement to submit copies of correspondence, reports, and documents, as provided elsewhere in this chapter, to the Deputy Assistant Secretary for Environment, Safety, and Health.

d. Heads of Field Organizations shall, for nuclear facilities and operations under their jurisdiction:

(1) Assume line management responsibility for the safety of assigned nuclear facilities.

(2) Assure adequate consideration for, and take action on, environmental protection, safety, and health protection matters during siting, design, construction, operation, maintenance, modification, deactivation, decontamination, and decommissioning.

(3) Require preparation of safety analyses including nuclear criticality safety evaluation. In preparing safety analyses for facilities under this chapter, consideration should be given to the appropriate NRC Division 3 Regulatory Guides (e.g., 3.5, 3.15, 3.25, 3.26, 3.33, 3.34, 3.35, 3.39, 3.44).

(4) Require preparation of, and approve, facility Operational Safety Requirements and changes thereto.

(5) Authorize operation of a new nuclear facility after assuring that adequate consideration has been given to all hazards including nuclear criticality safety, and determining by reviewing safety analyses and Operational Safety Requirements that its operation

will not create undue environmental protection, safety, and health protection risks.

(6) Authorize activities, operations, and modifications that change the Operational Safety Requirements or involve an unreviewed safety question only after assuring that:

(a) The contractor has performed and documented a safety review of each proposed change or each unreviewed safety question.

(b) An independent safety review has been performed and documented to assure that continued operation is acceptable for environmental protection, safety, and health protection.

(7) Take such action as may be appropriate to assure implementation of this chapter, including curtailment and suspension of operations when, in their opinion, such operation would result in an undue environmental protection, safety, and health protection risk.

(8) Assure implementation by Department of Energy contractors and subcontractors of the requirements set forth in paragraph 6 through 11 of this chapter, and provide advisory services to Department of Energy contractor and subcontractors on matters dealing with nuclear facilities, environmental protection, safety, and health protection policies; standards, codes, guides and procedures, including the requirements of this chapter.

(9) Require that contractors having significant quantities of material:

(a) Prepare and utilize written procedures for the handling of fissionable materials, including storage, transfer, and processing.

(b) Establish and maintain suitable management review and audit systems and clear lines of responsibility for nuclear criticality safety within their organizations. These systems shall include provisions for contractor internal review of operations for nuclear criticality safety.

(c) Develop, establish, and maintain training programs and employee indoctrination or instruction which will promote an awareness of the risks involved and a level of proficiency consistent with assigned tasks.

(d) Develop emergency plans to handle potential accidents, including complete medical support of irradiated or contaminated people.

(10) Assume the establishment of an unusual occurrence investigation and reporting system in accordance with DOE 5484.1 and DOE 5484.2.

(11) Assist in the review and development of environmental protection, safety, and health protection codes, standards, and guides.

(12) Conduct appraisals in accordance with DOE 5482.1A.

(13) Review newly proposed safety requirements and determine applicability to specific facilities and submit assessments of such proposed requirements to the cognizant program Secretarial Officer.

(14) Identify those facilities on his or her site(s) which are designated to be nuclear facilities and submit to the cognizant program Secretarial Officer for approval.

6. BASIC REQUIREMENTS. The environmental protection, safety, and health protection program for nuclear facilities shall include the following:

a. An independent safety analysis review process which includes a formal documented system for the identification and control of risks through preparation, independent review, and approval of safety analyses.

b. Administrative and procedural controls that delineate (1) responsibilities and methods for safe operation under normal and emergency conditions, and (2) a system of configuration control that requires independent safety review and approval of all changes to components, equipment, procedures and systems required for facility safety.

c. A documented training program for personnel involved in operating nuclear facilities which meets the requirements specified on page V-13, paragraph 8.

d. Operational Safety Requirements setting forth, in a concise manner, the approved limitations of safe operation. The requirements shall be commensurate with the potential risks involved.

e. Development and implementation of quality assurance programs that fulfill the requirements of DOE 5700.6A.

f. Application of environmental protection, safety, and health protection codes, standards, and guides covering siting, design, construction, modification, operation, maintenance, deactivation, decontamination, and decommissioning. Where established standards are determined to be inadequate or not available, suitable operating standards shall be

developed, using contractor expertise as necessary, so that a defined and agreed upon basis for conducting and assessing operations is established and used. The Safety Analysis or other design documentation shall identify, on a facility specific basis, the standards applied.

g. Notification, investigation, and reporting of occurrences and the followup system to assure remedial action has been implemented. (See DOE 5484.1 and 5484.2).

h. For new nuclear facilities and for significant modifications to existing nuclear facilities, review of safety analyses design criteria, environmental assessments and environmental impact statements, and other design documents to assure adequate environmental protection, safety, and health protection consideration.

i. For new nuclear facilities and for significant modifications to existing nuclear facilities, reviews and inspections during construction, acceptance of systems and preoperational phases to assure compliance with the appropriate environmental protection, safety, and health protection standards and requirements.

j. A formal documented system for the control and traceability of records and documentation specified herein.

k. A program of nuclear criticality safety which meets the requirements of paragraphs 9 and 10 of this chapter.

l. A contractor independent safety review and appraisal system which meets the requirements of paragraph 7 of this chapter.

m. The safe storage criteria for unirradiated fissionable material meeting the requirements of paragraph 11 of this chapter.

7. CONTRACTOR INDEPENDENT OF REVIEW AND APPRAISAL SYSTEM. The field office shall require each contractor to establish and maintain an internal safety review system for nuclear facilities which:

a. Functions primarily in an advisory capacity to the line organization, reporting to a designated position or authority at a level of management sufficiently high to take any necessary corrective action. (Safety is a line responsibility; neither review nor subsequent approval releases line management from its responsibility for safety of people and equipment.)

b. Is clearly defined and delineated in writing (e.g., purposes, objectives, functions, authority, responsibility, composition, quorum, meeting frequency, and reporting requirements).

c. Can be audited by contractor management and by the Department. The performance of the system shall be recorded in sufficient detail to permit contractor management and the Department to evaluate its effectiveness. Actions taken on any recommendations resulting from reviews, audits, inspections, appraisals, and surveillance shall be included in these records.

d. Provides technical competence in the areas being reviewed. Each review, except subparagraph i, below, shall be carried out by persons whose technical disciplines cover the range of technical fields encountered in performing a safety review. Safety considerations are to be treated in such breadth and depth as is necessary to identify the potential hazards and to evaluate the risks.

e. Provides for group interaction and discussions between reviewers on all but the more routine matters.

f. Provides an independent determination of whether a proposed activity involves an unreviewed safety question, violation of a Criticality Safety Limit, Operational Safety Requirement, or any matter for which approval is required.

g. Provides an appraisal of the overall operation of each facility at least annually. This appraisal shall be made by individuals, the majority of whom are independent of the operation being appraised. It shall include, but not be limited to, applicable areas listed in subparagraph h, below.

h. Provides for objective and independent review of:

(1) Proposed modifications to nuclear facilities and equipment having safety significance, and safety analysis thereof.

(2) Proposed experiments and operations having safety significance.

(3) Procedures, i.e., administrative, operating (normal and abnormal), maintenance, repair, testing, quality assurance, and emergency, and significant changes thereto.

(4) Organization and staffing.

(5) Standards, Nuclear Criticality Safety Limits, Operational Safety Requirements, and changes thereto.

(6) Nuclear facility safety training programs, including the initial and subsequent qualification and verification requirements and procedures for criticality safety.

(7) Unusual occurrences, including those referred to as incidents, operating anomalies and violations of Criticality Safety Limits or Operational Safety Requirements.

(8) The physical condition of the nuclear facilities.

(9) The accuracy and completeness of recordkeeping and documentation.

i. Is reviewed by contractor management for adequacy of performance at least every 3 years.

8. PERSONNEL SELECTION AND TRAINING. A program shall be established for the selection, training, and retraining of all individuals who operate, maintain, or supervise activities in nuclear facilities. The program will promote an awareness of the risks involved and a level of proficiency consistent with assigned tasks. The purpose of this program is to assure that the nuclear facility is operated and maintained by personnel who are qualified to carry out their assigned responsibilities. It includes the following:

a. Operating Personnel.

(1) The elements of the training program shall be documented.

(2) Documentation shall provide a means to ascertain that the candidate has achieved the necessary qualification status, both initially and on a continuous basis, to perform his or her assigned tasks in a safe and proficient manner.

(3) Sufficient time shall be provided for training and retraining on a continuing basis.

(4) For each type of nuclear operation, management shall determine the physical demands imposed upon the operating personnel by the job tasks that are required to perform both routine and emergency duties. A medical examination shall be given to prospective employees and a reexamination shall be given to requalifying operators and supervisors to verify health and physical fitness to safely perform their defined tasks. Operators and supervisors must be cleared by medical examination prior to returning to work following any serious injury or illness.

(5) On-the-job training shall be provided to assure that personnel are familiar with all aspects of their positions. Such training shall include but not be limited to:

(a) Normal procedures.

(b) Emergency actions.

(c) Radiation control practices.

(d) Location and functions of the pertinent safety systems.

(e) Configuration control procedures.

(f) Procedures for making changes or alterations in the operations.

(6) Verification of training shall be made by a cognizant management or supervisory official following a finding that the candidate's proficiency is satisfactory after completion of the training program and receipt of a satisfactory statement of the candidate's medical condition and other pertinent information. Verification of training for fissionable material handlers, operators, or supervisors may not be made by his or her immediate supervisor.

(7) Retraining and reexamination shall be required at least annually on all procedures for handling abnormal nuclear facility conditions and emergency situations relative to the employee's assigned responsibilities, and at least every 2 years on all other subjects in which the fissionable materials handler, operator, or supervisor is expected to be proficient.

(8) Verification of training shall be documented by contractor management at least every 2 years.

(9) The program shall be auditable by contractor management and by the Department.

(10) In addition to the above, a program shall be established for those fissionable materials handlers, operators, and supervisor candidates who process, store, transfer, or handle significant quantities of fissionable materials, which includes the following elements:

(a) Fissionable materials handlers, operators, and supervisor candidates shall possess either formal training or pertinent experience or both, commensurate with the stated degree of responsibility and complexity of the prospective position.

(b) The training program shall provide for evaluating the progress of each trainee periodically during training. Each evaluation shall require the demonstraiton of a satisfactory knowledge of all required subjects and procedures covered in the training program. This demonstration may include written, oral, and operational examinations as appropriate to the position,

experience, and educational level of the employee. Upon completion of the program, the final evaluation of the candidate's proficiency shall be made by the examining official. A file record of the employee's training, including a record of the subjects covered in oral and operating tests along with the written examinations, shall be maintained.

(c) Retraining for fissionable materials handlers, operators, and supervisors following extended absence from the nuclear facility shall be required. The extent of retraining will depend upon the length of absence and the type of work and operational routine in the event of changes. For absences of 3 months or less, if retraining is deemed necessary, informal retraining and oral testing may be sufficient. For absences of 3 to 12 months, selected retraining as appears necessary, including training in the use of, and familiarization with, any new devices or changes in the process, with appropriate demonstrations of knowledge and proficiency, is required. For absences greater than 1 year, a written reexamination shall be required and where indicated by the results of that examination, retraining shall be mandatory.

(d) The program shall provide for training, retraining, examination, and reexamination in the following areas to the extent that they are pertinent to the position in question (supervisor training shall require an understanding in greater depth than fissionable materials handler and operator training):

1 Standard and Emergency Operating Procedures. Normal operating procedures, abnormal and emergency actions, and administrative controls and responsibilities.

2 Radiological Safety and Control. Radiation hazards, monitoring, safety practices, control procedures, and terminology.

3 Safety and Emergency Systems. The kind of equipment, operating characteristics and procedures, and testing requirements of safety systems.

4 Instrumentation and Control. Types of instruments and control systems, including principles of operation and consequences of malfunctions.

5 Facility Operating Characteristics. Principal features, operating parameters, and operating limits of the facility, including the auxiliary systems.

6 Principles of Nuclear Facility Operation. The processes involved and technical terminology for the chemical, physical, and metallurgical reactions.

(e) In the case of initial startup of a new nuclear facility or operation precluding prior on-the-job training, practical experience at similar facilities, training on simulators, training with inert materials, or other appropriate training shall be considered.

(f) The supervisor training program, in addition to the above, shall include the following material to the extent that it is pertinent:

1 Design, control, and operating limitations for the facility, including instrumentation characteristics, adjustment, operation, facility console control mechanisms, and control room manipulations.

2 Procedures for making design and operating changes, including changes in operating procedures.

3 Radiation hazards which may arise during the performance of experiments other than those in critical assemblies.

4 Nuclear and radiation theory, including details of fission process, neutron multiplication, source effects, neutron poison effects, and reactor kinetics.

5 Specific operating characteristics of the facility, such as causes and effects of temperature, pressure, and reactivity changes.

6 Procedures and limitations involved in initial equipment loading, alterations in fissionable material configuration, and determination of various internal and external effects on reactivity.

7 Procedures, equipment, and facilities available for handling and disposing of radioactive materials and effluents.

(g) Any waiver from the requirements set forth in subparagraph 8a shall be obtained from the field office manager. (The name of the fissionable materials handler, operator, or supervisor and the specific subject for which the waiver is requested,

along with the justification for the waiver shall be submitted.) Waivers may be requested only in specific areas for those fissionable materials handlers, operators, and supervisors who are exceptionally well qualified by past experience and education, and who have been continuously employed in the same type position.

b. Maintenance Personnel. The training requirements for maintenance personnel shall be determined by the class of maintenance which the personnel are to perform, the degree of supervision required, and the required knowledge of the nuclear facility.

(1) All maintenance operations shall be performed by personnel who are properly trained in their respective discipline or under direct supervision of trained personnel.

(2) A written policy shall be established that describes functions, assignments, and responsibilities of the maintenance organization as it relates to nuclear safety.

(3) The successful completion of the training and qualification effort shall be documented.

9. NUCLEAR CRITICALITY SAFETY ELEMENTS. The following basic elements of nuclear criticality safety shall be provided in contractors' programs involving significant quantities of fissionable materials:

a. Process Analysis. Before beginning an operation with significant quantities of fissionable materials, or changing an existing operation, a preoperational audit shall be made to determine that the entire process will be subcritical under both normal and abnormal operating conditions that could reasonably be expected to occur. Distinction may be made between shielded and unshielded facilities, and the criteria may be less stringent when adequate shielding assures the protection of personnel.

b. Identification of the Parameters on which Prevention of Accidental Nuclear Criticality will Depend. The basis for establishing subcriticality shall be noted for all significant conditions at each step in the process. This may, in the case of established facilities or operations, consist of references to existing nuclear criticality safety evaluations.

c. Written Plans and Procedures. Operations shall be governed by written plans and procedures. These plans and procedures shall be an integral part of the initial proposal for the nuclear facility, its operations, and subsequent modifications that may affect the nuclear reactivity. The plans and procedures shall include the following, where applicable:

(1) Plans for receiving fissionable material into the facility and for inspecting the shipment on receipt, including procedures for:

(a) Determining, verifying, or noting the contents of each package, including the net weight of fissionable material therein.

(b) The placing of materials in the receiving area and the storage facility.

(c) Handling wet or damaged packages.

(2) Plans and procedures for storing fissionable material, including:

(a) Limitations on total quantity of material, quantity of each individual unit, container dimensions, and spacing between units.

(b) Description of containers in which fissionable materials are stored.

(c) Description of the storage facility, including dimension and materials used in construction of the enclosure and shelving, cubicles, cages, and other equipment within the storage area.

(d) Precautions to avoid entry of water or other material into a storage area where moderating and reflecting effects would be unsafe.

(e) Administrative controls over the distribution of fissionable material from storage and its return to storage, including means of verifying the weight, isotopic content, chemical composition, and degree of moderation.

(3) Plans and procedures for processing the fissionable material, including:

(a) A description, using appropriate sketches or drawings, of equipment and facilities in which the hazard of criticality exists, and showing dimensions in sufficient detail to permit evaluation of the information mentioned in subparagraphs (c) and (f), below.

(b) A statement of the chemical and physical form of fissionable material in each step of the operation, including isotopic content, the nature of any material, and the resulting concentrations, densities, and degrees of moderation throughout the steps of the process.

(c) A statement of the maximum quantities of fissionable material allowed at any one time in each step of the process.

(d) Spacing of masses of fissionable material within each process area, and separation from fissionable material in adjoining areas.

(e) Methods of collecting, handling, and transporting fissionable material from each process area or individual operation, and evaluation of the nuclear safety of these methods.

(f) Description of procedures which are intended to prevent criticality resulting from accumulation of fissionable material in scrap or waste, lathe turnings, crucible slag, pickling solutions, choppings, sumps, filters.

(g) Installed or proposed criticality alarm system and emergency procedures, including alarm levels, fail-safe features, response time of devices, and frequency of evacuation drills. Pertinent documents shall show the location of all detectors, their distance to possible sources of criticality, and intervening shielding. The criticality alarm system shall be installed in all locations wherein the quantities of fissionable material may exceed 700 grams of uranium 235, 520 grams of uranium 233, 450 grams of plutonium, or 450 grams of any combination of these three nuclides. (Limits for other fissionable materials shall be as indicated in American National Standard Institute Standard ANS 8.15, "Nuclear Criticality Control of Special Actinide Elements," when issued.) These limits may be exceeded when justified by consideration of the physical form and isotopic distribution of the fissionable material. This justification must be based upon a documented analysis demonstrating that, in such cases, the alarm system is not required. Special attention shall be given to all processes in which reflectors and moderators more effective than hydrogen are present and, as appropriate, the above limits reduced so that nuclear reactivity is not increased.

(h) A monitoring system, using gamma- or neutron-sensitive radiation detectors which will initiate a clearly audible alarm, distinctive in tone, if accidental criticality occurs, is required. The detectors shall be capable of detecting a criticality condition that produces an absorbed dose in free air of 20 rads of combined neutron and gamma radiation at an unshielded distance of 2 meters from the fissionable material within 60 seconds. Provisions shall be made to minimize false alarms. These provisions may include concurrent response of

two or more detectors or single, highly reliable detectors to initiate an alarm. In redundant systems, failure of any single channel shall be into the alarm state. Warning of malfunctions within the alarm system without activation of the alarm shall be provided. Evacuation for such warning may not be required. This paragraph is not intended to require underwater monitoring when special nuclear material is handled or stored beneath water shielding adequate to protect the personnel. Also, such alarm systems are not required for material during shipment or material packaged in approved shipping containers awaiting transport, provided no other operation involving fissionable material not so packaged is permitted on the dock or in the shipment area. Such an area or dock shall be located so that the interaction between fissionable material positioned thereon, and any other arrays of fissionable material is essentially zero. (See Chapter III of this Order for details regarding the safe shipment of fissionable materials.)

(i) Where the function of the facility is to store radioactive waste packaged elsewhere, the plans and procedures required in subparagraph 9c(3), may be appropriately combined with those required for storage in subparagraph 9c(2).

(j) The plans described in paragraphs 9c(1) and (2), may make suitable allowance for situations where fissionable contents are repetitive or known from the work of others; e.g., the cases of mass-produced fuel elements and waste containers for which the fissionable content has previously been determined by a method known to be reliable.

d. Records. Operations shall provide for control, sign-off, and traceability of records, such as plans, procedures, inspections, monitoring systems, regarding the collection, handling, transportation, inspection, receipt, and monitoring of fissionable material.

10. NUCLEAR CRITICALITY SAFETY CONTROL PARAMETERS. Nuclear criticality safety of fissionable materials may be provided by maintaining any one of the single parameter limits set forth in the latest revision of American National Standards Institute Standard N16-1. Although the single parameter limits are adequate for many purposes they are inconveniently and uneconomically small for many others. In many cases, simultaneous limitation of two or more parameters may allow more flexible operational control. General guidance for multiparameter limits may be found in subparagraphs 3f, 3j, 3n, and paragraph 6 of this chapter. The following basic control parameters for nuclear criticality safety shall be considered:

a. Controlling Factors. Nuclear criticality safety is achieved by exercising control over:

(1) The Mass and Distribution of All Fissionable Materials.

(a) Mass Controls. For operations where nuclear criticality safety depends upon mass control, the allowable mass shall be no greater than the safe mass for the associated conditions. The safe mass in all cases shall be based upon current published or available nuclear safety guides and handbooks. These guides and handbooks may include values which, in the absence of directly applicable experimental measurements, are derived from calculations made by a method shown to be valid by comparison with experimental data, provided allowances are made for uncertainties in the data and in the calculations. For operations depending upon mass control where the contained volume does not automatically limit the contents to the safe mass or less, the possibility of multiple batching shall be considered. If a batch of fissionable materials consists of different physical and chemical forms of a particular isotope, e.g., metallic uranium 235, compounds of uranium 235, the safe mass for the most reactive combinations under the associated conditions shall be the governing criterion. If a batch of fissionable materials consists of a mixture of fissionable nuclides, i.e., plutonium 239, uranium 235, uranium 233, neptunium 237, and curium 244, the allowable safe mass shall be determined experimentally or determined from calculations made by a method shown to be valid by comparison with experimental data.

(b) Density Controls. Density (mass of fissionable nuclides per unit volume) is an accepted parameter for control of nuclear criticality safety. Systems that use density control shall meet established density criteria. These criteria may be found in safety guides, handbooks, and data compilations.

(c) Spacing Controls. Individual items of equipment and containers holding fissionable materials, when arranged in a group, in storage, or when being transferred within a nuclear facility or between facilities onsite, shall be spaced so that the entire array is subcritical for all conditions that affect or might affect the nuclear facility or site. Movement of material under credible in-plant and onsite accident conditions shall be considered.

(2) The Mass, Distribution, and Use of the Nuclear Properties of All Other Materials With Which Fissionable Elements are Associated.

(a) Neutron Absorbers. Neutron-absorbing materials, such as cadmium and boron, may be used to make equipment and processes safe, provided available data confirm their suitability and assure their presence and reliability. Care should be exercised in the use of solutions of neutron absorbers because of the controls required to assure their continued effectiveness.

(b) Moderation Controls. For operations in which nuclear criticality safety depends upon control of neutron moderation, there shall be assurance that the prescribed extent of moderation remains unchanged or that, if it does change, the reactivity of the system remains below acceptable subcritical limits. Such assurance shall include consideration of all credible accidents involving any moderator or combination of moderators.

(c) Neutron Reflection. Neutron reflection shall be considered for all systems of fissionable material. The extent of reflection shall be based upon the actual reflectors present or those to be expected during normal operations or as a result of a credible accident.

b. Double Contingency Principle. Process designs shall incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before an accidental nuclear criticality is possible.

c. Geometry Control. Where practicable, reliance shall be placed on equipment design in which dimensions are limited, rather than on administrative controls. Full advantage may be taken of any nuclear characteristics of the process materials. Control shall be exercised to maintain all dimensions and nuclear properties on which reliance is placed.

d. Nuclear Criticality Safety Limits. Limits for nuclear criticality safety shall be established on bases derived from experiments. In the absence of directly applicable experimental measurements, the limits may be derived from calculations made by a method shown to be valid by comparison with experimental data, provided allowances are made for uncertainties in the data and in the calculations.

e. Margins of Safety. Safety margins used shall meet the control parameter requirements above. Further, a cumulative margin of safety shall provide allowance for experimental and computational uncertainties. Procedure violations also shall be a consideration.

f. Onsite Movement and Offsite Shipment of Fissionable Materials.

(1) Onsite movement includes all activities where fissionable materials are transferred from one operation to another within a facility and

from location to location onsite. For all such movements, the following requirements shall be met:

(a) For the onsite movement of fissionable materials that do not present a radiation hazard, the pertinent requirements set forth in this chapter shall be met.

(b) For onsite movement of fissinable materials that presents a radiation hazard, as well as the possibility of an accidental chain reaction, the pertinent requirements of this chapter and Chapter XI of this Order shall be met.

(c) In addition to the physical controls specified above, administrative controls, including traffic controls, shall be exercised as deemed necessary by Heads of Field Organizations to minimize accident probabilities.

(d) Fire protection, security, health physics, and any other emergency personnel, when deemed appropriate by Heads of Field Organizations, shall be alerted and advised of movements and routings.

(2) Safety standards for the packaging of fissionable materials for any offsite shipment are outlined in Chapter III of this Order. Further, such shipments shall meet the nuclear criticality safety requirements set forth in this chapter and the radiological safety standards outlined in Chapter XI of this Order.

11. SAFE STORAGE CRITERIA FOR UNIRRADIATED FISSIONABLE MATERIAL. These criteria are applicable to the storage of all forms and significant quantities of unirradiated fissionable material.

NOTE: These criteria are not applicable:

(a) Where these materials are in-process as part of production, analytical and development procedures, or transport operations.

(b) Where an assembly cell is used for assembly and/or storage of weapons components made with these materials.

(c) For these materials packaged for shipment with number of packages limited in accordance with the requirements of Chapter III of this Order.

(d) To radioactive waste storage or disposal facilities.

a. Operating Requirements for Storage.

(1) Nonessential combustible materials shall not be stored in the storage area.

(2) Process operations, storage of nonnuclear materials or equipment which is not directly required for storage operations, and all other functions not directly a part of normal storage operations shall be excluded from the storage area. Deviations from this requirement must be approved by the field office manager.

(3) Documented periodic inspections, in situ tests, and preventive maintenance shall be performed at designated frequencies to assure that the safety systems and components necessary for criticality control, fire control, radiation detection, and environmental monitoring, as well as their alarm systems, are being properly maintained in readiness for use.

(4) Limits for criticality safety shall be posted in conspicuous places near the storage area.

(5) Signs or other appropriate devices shall be utilized at strategic locations to provide instructions regarding:

(a) Interpretations of and response to alarms.

(b) Evacuation routes.

(c) Combating fires.

(6) In conjunction with site emergency planning, a fire fighting plan shall be developed, incorporated into the overall site fire plan, and exercised through periodic drills which include use of emergency equipment.

(7) Auxiliary fire fighting equipment, self-contained breathing apparatus, and protective clothing shall be provided, as necessary, to facilitate manual fire suppression.

(8) Excess fissionable material shall not be construed to be "In-Process" to circumvent the requirements of this paragraph.

(9) Fissionable material shall not be stored in shipping containers for the purpose of negating the requirements of this paragraph.

(10) All material shall be stored in racks or equivalent equipment (such as birdcages) capable of securely locating stored material to prevent displacement, to assure spacing control, and to meet designs

for safety under operational and credible accident conditions. Floor storage within the storage facility will be permitted only where control of location and other safety requirements (equivalent to those of racks) are inherently provided by the individual containers and their restraints.

(11) All pyrophoric materials shall be put in a safe form prior to storage or stored in approved containers that will not permit spontaneous ignition or dispersal. Other dispersible materials must be stored in approved storage containers.

(12) All containers shall be marked or coded to indicate the type or category of material, amount, degree of enrichment, and the radiation level at the outside surface of the vessel. Containers shall be securely closed and positioned so as to prevent significant displacement and maintain criticality prevention requirements.

(13) Container design shall be appropriate to the form of stored material. Criteria for container integrity shall be developed in the course of the required safety analysis and the application of these criteria ascertained by periodic inspection. Containers involving any significant gas buildup or automatic pressure relief or other venting should be designed to assure that no personnel exposure to any released toxic material will occur under normal storage conditions or, insofar as practical, under accident conditions. Such venting must not permit spread of contamination.

(14) Plutonium or U-233 bearing or contaminated material shall be packaged in a closed metal container. Combustibles within the container shall be minimized.

(15) Plutonium storage facilities and containers shall be monitored and checked periodically to assure continued integrity of containment. When required by the form or hazard potential of the stored material, procedures shall be developed to detect contamination or loss of primary containment upon entering the plutonium storage facility.

(16) Plutonium containers in which gas buildup can occur shall be designed to prevent leakage of gas over the maximum storage period or vented to prevent an accumulation of explosive gases; however, such venting must not permit spread of contamination.

(17) Criteria, such as corrosion rate, external and internal, for determining suitability of the plutonium containers shall be developed and set forth in writing. All containers shall be periodically inspected against the criteria developed. The time between inspections may vary depending upon container quality and type.

(18) Provisions shall be made in a plutonium storage facility to assure, in plutonium containers, necessary and adequate heat removal as established by the safety assessment.

b. Multipurpose Facility (Storage and Processing) Criteria. In making the safety assessment for any building or area which includes both storage and processing functions, the operating contractor shall, with the approval of the field office manager, specify which manufacturing, production, or laboratory materials may be termed "in-process" and which may not. Materials in excess of in-process requirements shall be promptly placed in approved storage facilities. Definitions of in-process material shall be established and approved prior to start of the related operations and maintained thereafter unless approved changes are effected.

c. Facility Functional Design Requirements for Storage. The design criteria shall meet the requirements of Chapter XXI, Plutonium Facilities, and Chapter XXIII, Unirradiated Enriched Uranium Storage Facilities of DOE 6430., FACILITIES GENERAL DESIGN CRITERIA, currently in coordination for use, by Assistant Secretary, Management and Administration memorandum of 6-10-81.

CHAPTER VI

SAFETY OF DEPARTMENT OF ENERGY OWNED REACTORS

1. PURPOSE. The purpose of this chapter is to establish safety procedures and requirements for nuclear reactors to assure that:

   a. The safety of each Department of Energy-owned reactor is properly analyzed, evaluated, documented, and approved by the Department.

   b. Reactors are sited, designed, constructed, modified, operated, maintained, and decommissioned in a manner that gives adequate protection for health and safety and will be in accordance with uniform standards, guides, and codes which are consistent with those applied to comparable licensed reactors.

2. SCOPE. This chapter applies to Headquarters and field organizations, and Departmental contractors having responsibilities for Department reactor projects. This chapter applies to Department-owned reactors exempt from Nuclear Regulatory Commission licensing; additional guidance applicable to Department-owned licensed reactors will be provided as needed by future revision of the chapter.

3. REFERENCES.

   a. Code of Federal Regulations, Title 10, Part 50, "Licensing of Production and Utilization Facilities."

   b. Code of Federal Regulations, Title 10, Part 100, "Reactor Site Criteria."

   c. DOE 5484.1, ENVIRONMENTAL PROTECTION, SAFETY AND HEALTH PROTECTION INFORMATION REPORTING REQUIREMENTS.

   d. DOE 5700.6A, QUALITY ASSURANCE.

   e. DOE 5482.1A, ENVIRONMENTAL SAFETY AND HEALTH APPRAISAL PROGRAM.

   f. DOE 5500.2, EMERGENCY PLANNING, PREPAREDNESS, AND RESPONSE FOR OPERATIONS.

   g. ANS 3.1, American Nuclear Society Standard 3.1, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants," October 1980.

   h. ANSI N546-1976, "Medical Certification and Monitoring of Personnel Requiring Operator Licenses for Nuclear Power Plants."

i. USNRC Regulatory Guide 1.134, Rev. 1, March 1979, "Medical Evaluation of Nuclear Power Plant Personnel Requiring Operator Licenses."

j. DOE 5484.2, UNUSUAL OCCURRENCE REPORTING SYSTEM.

4. DEFINITIONS.

a. Category A or B Reactor. Departmental designation as a Category A reactor is based on power level (e.g., 20 MW steady state), potential fission product inventory, and experimental capability. All other DOE-owned reactors (not including Naval Reactors) are designated Category B. Category A reactors are listed in Attachment VI-1, paragraph 3.

b. Controls. When used with respect to nuclear reactors, means apparatus and mechanisms that, when manipulated, directly or indirectly affect the reactivity or power level of a reactor or engineered safety feature status.

c. Health Examination. An examination by a licensed medical physician to cover medical and physical fitness for duty.

d. Initial Startup. Those activities subsequent to preoperational testing, starting with the initial loading of fuel and involving all actions taken including tests to assure a safe, orderly, incremental approach to predefined conditions of reactor operation.

e. Inspections. A deliberate and systematic examination at the reactor including, but not limited to, physical inspection of reactor systems, operating and maintenance procedures, logs, records, and reactor operations.

f. Modification. Any change made to structures, systems, components, or procedures during any phase of the life of the reactor project.

g. Operable. When the reactor is being operated or has the potential for being operated. A reactor that cannot be operated on a day-to-day basis because of refueling, extensive modifications, or technical problems is still considered to be operable.

h. Reactor Operator. An individual certified by contractor management to operate a Department-owned reactor.

i. Reactor Facility.

(1) The term reactor, unless it is modified by words such as containment, vessel, or core, means the entire reactor facility including the housing and equipment and associated areas devoted to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled

manner, including critical and pulsed assemblies and research, test and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments which could potentially reach criticality are also to be considered reactors.

(2) Critical assemblies are special nuclear devices designed and used to sustain nuclear reactions. Critical assemblies may be subject to frequent core and lattice configuration changes, and may be used frequently as mockups of reactor configurations. Therefore, requirements for modifications do not apply unless the overall assembly room is modified, a new assembly room is proposed, or a new configuration is not covered in previous safety evaluations (i.e., Safety Analysis Reports, Safety Analysis Report Addenda, or Technical Specifications).

j. Reactor Operations. All those activities involved (or functions performed) in operating and using a reactor which, for purposes of this chapter, begins with the initial loading of fuel in the reactor vessel and ends with the removal of fuel to officially decommission or place the reactor in a standby status.

k. Reactor Project. Those activities which contribute to siting, designing, constructing, operating, or decommissioning a reactor, and those activities involving the operation or maintenance of operable and standby reactors, including shutdown reactors containing fuel.

l. Reactor Supervisor. An individual certified by contractor management to operate or to direct the operation of a Department-owned Category B reactor.

m. Risk. A quantitative or qualitative expression of possible loss which considers both the probability that a hazard will cause harm and the consequences of that event.

n. Safety Analysis Report. A safety document providing a concise but complete description and safety evaluation of the site, design, normal and emergency operation, potential accidents, and predicted consequences of such accidents, and the means proposed to prevent such accidents or mitigate the consequences of such accidents. A Safety Analysis Report is designated as final when it is based on final design information. Otherwise, it is designated as preliminary.

o. Safety Document. A document prepared specifically to assure that the safety aspects of part or all of the activities conducted at a reactor are formally and thoroughly analyzed, evaluated, and recorded; e.g., Technical Specifications, Safety Analysis Reports and addenda, and documented reports of special safety reviews and studies.

p. Safety Review. A deliberate and critical examination of the safety impact of a proposed activity or an ongoing activity during the siting, designing, constructing, maintaining, modifying, or decommissioning of a reactor, which could affect health and safety. Documentation shall be considered part of the safety review, to provide management with adequate identification of the safety issues and their possible implications, and also to allow others not directly involved in the program or review process to independently evaluate the completeness or adequacy of the review.

q. Senior Reactor Operator. An individual certified by contractor management to operate or to direct the operation of a Department-owned Category A reactor.

r. Shutdown. That condition in which a reactor facility has ceased operation and the Department has declared officially that it does not intend to operate the reactor further.

s. Standby. That condition in which a reactor facility is neither operable nor declared excess, and documentary authorization exists to maintain the reactor for possible future operation.

t. Technical Specifications. A safety document approved by the Department which in a specified format defines the conditions, safety boundaries, and procedures under which activities are to be carried out at a reactor. See Code of Federal Regulations, title 10, part 50.36.

u. Under Construction. When the authorization for construction has been issued and authorization for operation has not yet been issued.

v. Unreviewed Safety Question. A proposed change, test, or experiment shall be deemed to involve an unreviewed safety question if:

(1) The probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the Safety Analysis Report and addenda will be significantly increased.

(2) A possibility for an accident or malfunction of a different type than any evaluated previously in the Safety Analysis Report and addenda will be created which could result in significant safety consequences.

w. Unusual Occurrence. See DOE 5484.2, UNUSUAL OCCURRENCE REPORTING SYSTEM.

5. RESPONSIBILITIES AND AUTHORITIES.

a. Program Secretarial Officers, or their designees, perform the following functions for reactors under their program responsibility:

(1) Assume line management responsibility for reactor safety.

(2) Provide for an independent review and assessment of the reactor program activities in their program organizations and the field offices to assure that they are accomplished in consonance with the need for protecting the safety and health of DOE and DOE contactor employees, and the public.

(3) Assure that the construction, initial startup, and subsequent modifications of reactors involving an unreviewed safety question will not create undue environmental, safety, or health risks by:

(a) Assuring that an acceptable safety review has been made and documented by the appropriate field organization.

(b) Determining that such independent safety reviews indicate that an adequate degree of protection of health and safety exists.

(4) Approve summary of training plans which define and describe the selective application of ANS 3.1 requirements to Category A reactors (see Attachment VI-1, paragraph 3), when assured that the summary provides for the requirements necessary to achieve the goal of well-trained personnel for the reactor(s) covered by the summary.

(5) Transmit the results of the actions taken under subparagraph (2), (3), and (4), above, to the responsible field organizations with any necessary or appropriate instructions as to subsequent action to be taken, with a copy to EP-30.

(6) Submit to higher management for action any disagreement with recommendations made during safety reviews that cannot be resolved.

(7) Provide assistance and guidance to field organizations in the performance of safety reviews, appraisals, and the preparation of safety analysis reports.

(8) Recommend additions or revisions to reactor safety standards, guides, and codes to EP-30.

(9) Perform program reviews and assessments to assure that field organizations comply with subparagraph d, below. In the execution of this responsibility, maximum use should be made of the appraisals and other reviews performed by EP-30.

(10) Assure the safe operation of reactors by:

(a) Directing the responsible field organization to require modification of equipment, procedures, or practices to assure safe operation.

(b) Taking other actions to assure the implementation of this chapter, including directing the field organization to curtail or suspend the operation of their reactors when necessary.

(c) Taking other actions, as deemed necessary.

(11) Provide to EP-30 a copy of directions given under subparagraph (10), above.

(12) Include, in long-range program objectives and plans, the requirements to assure safe reactor operation.

(13) Assure that program budgets provide adequate funds for health and safety requirements during all phases of reactor life.

(14) Consider reactor safety factors in connection with review and approval of designs, program and project proposals, and other proposals requiring Headquarters action.

(15) Obtain special technical assistance as needed in performance of assigned functions when the expertise is not available in the office in need of assistance.

(16) Transmit to cognizant field organizations proposed new safety requirements. Upon consideration of field organization assessments of such requirements and EP-30 comments, provide final approval.

b. Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness (EP-1), through EP-30, performs the following:

(1) Provides the Secretary with an independent safety overview and assessment of the operation at DOE-owned reactors.

(2) Establishes priorities for conducting appraisals of reactor programs in conjunction with program Secretarial Officers and field office managers.

(3) Assures that reactor projects are consistent with DOE reactor safety policy.

(4) Overviews and appraises both the line and independent reactor safety activities of the cognizant Secretarial Officers and the field office managers to assure that DOE reactor projects are accomplished in consonance with a need for protecting the safety and health of DOE and DOE contractor employees, and the public. Specific emphasis will be placed on training programs to assure that they include the requirements necessary to achieve the goal of well-trained operators.

(5) Conducts appraisals with teams which are augmented with experts from other DOE organizations.

(6) Provides reactor safety expertise to assist other Headquarters and field organizations.

(7) Develops training fundamentals covering fields such as nuclear theory, heat transfer, fluid flow, and thermodynamics for DOE application.

(8) Issues and keeps current Attachment VI-1, which identifies the officials having program safety responsibility for each DOE-owned reactor.

(9) Assures that responsible EP personnel are proficient in the operations personnel training area, including diverse expertise so that important areas related to nuclear safety are covered.

(10) Collects new safety requirements applicable to licensed nuclear reactors and consults with the cognizant program Secretarial Officer to make a preliminary evaluation to determine their potential applicability to specific DOE-owned reactors, and:

(a) Evaluates field office assessments and program Secretarial Officer disposition of newly proposed requirements and considers for inclusion in DOE Orders as appropriate.

(b) Maintains a summary of the consideration and disposition given by the Department to each of the newly proposed requirements for DOE-owned reactors.

NOTE: The above process for implementing newly proposed environmental protection, safety, and health requirements into DOE directives does not relieve the line program organization from its responsibility to assure that new environmental protection, safety, and health requirements are considered and applied as necessary to their facilities.

c. Deputy Assistant Secretary for Naval Reactors.

(1) With the assistance of the Managers of Pittsburgh and Schenectady Naval Reactors Offices, is responsible for assuring that adequate provision is made for the protection of health and safety in accordance with the provisions of this chapter for reactors and facilities under his or her cognizance.

(2) Is responsible for approving initial startup and modifications involving an unreviewed safety question for Naval Reactors prototype

plants and critical facilities at supporting contractor laboratory facilities, for performing appraisals in accordance with DOE 5482.1 as deemed necessary at Naval Reactor prototype plants and supporting contractor laboratory critical facilities and, for selection, qualification, training, and certification of operating personnel for naval reactor prototype plants and critical facilities of supporting contractor laboratory facilities.

(3) Is exempt from appraisals conducted by EP-1, and for reporting and analysis of occurrences.

(4) Fulfills the responsibilities listed under paragraph 5d for Heads of Field Organizations.

d. Heads of Field Organizations have the immediate responsibility for assuring that adequate provision is made for the protection of health and safety in accordance with the provisions of this chapter. They:

(1) Assume line management responsibility for the safety of assigned reactors.

(2) Provide for an overview of reactor safety in their organization independent of line management responsibility.

(3) Review and provide to the appropriate Headquarters offices, Safety Analysis Reports, addenda, and other safety documents for all new reactor construction and for modifications involving an unreviewed safety question.

(4) Assure that approved Technical Specifications exist for all reactors under their surveillance.

(5) Authorize construction and initial operation of a new reactor or modifications involving an unreviewed safety question. Prior to initial operation or after modifications involving an unreviewed safety question, a preoperational inspection of the reactor shall be conducted and documented.

(6) Specify in writing to the contractor those activities for which safety evaluations are to be submitted for Department of Energy review and approval. Field offices shall, as a minimum, review proposed modifications involving plant protection, reactivity control systems, and engineered safety features.

(7) Authorize modifications to reactor operations including the addition of critical assemblies or critical assembly rooms to existing and approved critical facilities when these modifications could have

an impact on reactor safety, but do not involve unreviewed safety questions after assuring that:

(a) The contractor has performed and documented a detailed evaluation of each proposed modification.

(b) The field offices' safety reviews are appropriately performed and documented in the depth necessary to justify authorizing the modification.

(c) An adequate degree of protection of health and safety exists.

(d) Additional requirements of the Headquarters program organization having safety review responsibility have been met.

(8) Review (either during inspections, appraisals, or through reviews of documents submitted by the contractor) changes made to reactor operations, including revision of procedures, experimental program changes, and physical modifications which could have safety implications, to assure that the contractor has made appropriate reviews and that the changes made do not violate Technical Specifications or involve an unreviewed safety question.

(9) Take such actions as may be appropriate including curtailment and suspension of operation of any reactor under their surveillance when, in their opinion, such operation may result in undue risk to health and safety.

(10) Monitor contractor activities, as appropriate, during siting, design, construction, operation, modification, and decommissioning phases by periodic inspections of, and visits to, individual reactor facilities.

(11) Assure the establishment of an appraisal program in accordance with DOE 5482.1, including periodic appraisal of the reactor operating personnel training program. Appraisals of the overall operation of each reactor facility shall be conducted; however, individual reactor facility appraisal reports may be combined.

(12) Assure the establishment of an appropriate quality assurance program by the contractor in accordance with DOE 5700.6.

(13) Assure the establishment of a reactor personnel training and qualification program by the contractor in accordance with paragraphs 6e(1) and (2).

(14) Assist in the review and development of environmental protection, safety, and health protection codes, standards, and guides.

(15) Assure the establishment of an unusual occurrence investigation and reporting system in accordance with DOE 5484.1 and 5484.2.

(16) Prepare a summary of the training plan which defines and describes selective application of ANS 3.1 requirements of Category A reactors. Submit this summary through the cognizant Headquarters program organization to the program Secretarial Officer for approval. The summary shall include a description of the field office review and approval process of contractor prepared training plans.

(17) Assure that staff includes an individual having broad knowledge in reactor design, construction, operations, and safety, including some experience in the area of reactor operations personnel training.

(18) Keep appropriate Headquarters program organizations advised of reactor safety problems, deficiencies, and needs, and of actions taken under this chapter.

(19) Perform additional duties including safety reviews, inspections, and appraisals as directed by the responsible Headquarters program organizations.

(20) Reviews newly proposed safety requirements and determines applicability to specific reactors and submits assessments of such proposed requirements to the cognizant program Secretarial Officer.

6. PROGRAM REQUIREMENTS.

a. Siting. In the selection of the site for a new reactor and during modification of an operating reactor that has a significant impact on property damage or dose commitment, the Code of Federal Regulations, title 10, part 100, shall be considered.

b. General Design Criteria. The General Design Criteria specified in the Code of Federal Regulations, title 10, part 50, Appendix A, shall be applied to all Department-owned reactors in the following cases:

(1) All new construction of reactor facilities.

(2) When the Department determines that safety can be significantly improved by implementing one or more of the criteria (for example, when modifications or repairs of those structures, systems, or components which involve an unreviewed safety question are undertaken).

c. Safety Analysis Reports. New Safety Analysis Reports shall follow the Nuclear Regulatory Commission's guidelines on the Standard Format and Content of Safety Analysis Reports. While this guidance may focus on large complex reactor systems, the format and content is generally

applicable to all reactors. The requirements of this subparagraph and subparagraph (b), above, do not apply to space-based nuclear reactors which will use criteria consistent with space applications.

d. Technical Specifications.

(1) Each Department-owned reactor shall have a technical specification document meeting the Code of Federal Regulations, title 10, part 50.36. Technical Specifications for Department-owned reactors shall be similar to those required for comparable facilities licensed by the Nuclear Regulatory Commission and yet provide the flexibility necessary for experimental activities. The Technical Specifications serve as an understanding between the Department and the operating contractor regarding limits and conditions under which the reactor will be operated and maintained. Documentation for Naval reactor plants will be in accordance with Naval Reactor requirements.

(2) The field office manager has the responsibility to transmit proposed and final Technical Specifications to Headquarters and to approve Technical Specifications. The field office manager shall require notification in a timely manner of any violation of the Technical Specifications.

e. Reactor Personnel Training and Qualification Program.

(1) Category A Reactors. This subparagraph contains the requirements for the qualification and training of personnel involved in the operation of Department-owned Category A reactors. (See Attachment VI-1, paragraph 3.)

(a) General. American Nuclear Society Standard 3.1, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants" (Draft), October 1980, shall be the basis for qualification and training requirements for reactor personnel for Category A reactors. The requirements of ANS 3.1 are to be followed to the extent that they are appropriate for the facility or operation being considered. Paragraphs 6e(1)(a) through 6e(1)(d), contain interpretations of, or variations from, ANS 3.1 requirements.

1 Application. In view of the diversity of the Department of Energy Category A reactors and in order to facilitate the application of a power reactor standard to a Department-owned reactor, requirements of ANS 3.1 shall be selectively applied as appropriate to each site or reactor. U.S. NRC Regulatory Guide 1.8 (Draft), of September 1980, shall also be considered, as appropriate, for DOE Category A reactors.

2 Training Plans. Training plans, which define and describe the selective application of ANS 3.1 requirements, shall be prepared by the operating contractor of each Category A reactor. Suitable justification shall be included for provisions of ANS 3.1 which are not applied. These plans shall be submitted to the field office manager for final approval.

3 Security Requirements. The requirements for security forces, including training, shall be in accordance with Department of Energy requirements.

(b) Definitions (ANS 3.1, Section 2).

1 Nuclear Power Plant Experience. Experience acquired at production, training, test, military, and research reactors may also qualify as equivalent experience on a one-for-one time basis.

2 Operator. An individual who has been certified by contractor management to operate or direct the operation of a Department-owned reactor is considered comparable to a licensed operator for the purposes of this chapter. Certification shall be valid for a 2-year period.

(c) Qualifications (ANS 3.1, Section 4).

1 General. ANS 3.1, Section 4.1, includes provisions for substitution of experience for formal education on a case-by-case basis. Substitution of appropriate formal education for experience may also be considered. However, formal education shall not be allowed to substitute for more than 50 percent of the experience requirements.

2 Senior Reactor Operator. Senior reactor operators shall have 1 year experience as a reactor operator at the plant for which the senior operator certification is required (ANS 3.1, Section 4.3.1.2).

3 Reactor Operators. The power plant experience required by ANS 3.1, Section 4.5.1.2b, for the reactor operator position may be revised to 2 years.

4 Technicians. ANS 3.1, Section 4.5.2, discusses training for technicians, and references Sections 5.3.4 and 5.4 for necessary training. In amplification of these requirements, the training program for radiation protection technicians

should include the training in Sections 5.3.4 and 5.4 and training in:

a Principles of radiation protection;

b Standards and regulatory requirements concerning radiation protection;

c The type and magnitude of potential radiological hazard for each plant system;

d Responsibilities and authorities for their position; and

e Tasks to be performed by the technician in normal, abnormal, and emergency situations.

Additionally, each radiation protection technician shall have demonstrated an understanding of the elements of the training program by satisfactory completion of both a written examination and a practical demonstration of the tasks referred to in subparagraph e, above.

5 Medical Certification. Medical certification requirements shall be in accordance with ANSI N546-1976, "Medical Certification and Monitoring of Personnel Requiring Operator Licenses for Nuclear Power Plants," and USNRC Regulatory Guide 1.134, Rev. 1, March 1979, "Medical Evaluation of Nuclear Power Plant Personnel Requiring Operator Licenses." Form NRC-396, "Certificate of Medical Examination," or an alternative form may be utilized.

(d) Training (ANS 3.1, Section 5).

1 Position Task Analysis. A position task analysis shall be conducted by the operating contractor as necessary for operating personnel to define the tasks performed by the person in each position, and to identify the required training, in conjunction with education and experience, necessary to provide assurance that the tasks can be effectively performed. The position task analysis should include normal and emergency duties and place emphasis on the role played by every member of an operating organization that assures safe plant operation. The position task analysis shall support the selection of requirements of ANS 3.1 and any supplemental requirements appropriate to the position.

2 Simulator Training. ANS 3.1, section 5, requires specific simulator training. However, adequate training may be

achieved by actual plant maneuvers, drills, partial plant simulators, or combinations of these. The use of a simulator for a Department of Energy Category A reactor shall be based on an evaluation of the ability to adequately provide in-plant training covering all operator actions, where timely operator action must be taken to bring the reactor to a safe state or maintain the reactor in a safe state, and to provide adequate training in normal operations, anticipated transients, and accident conditions. In-plant training shall not lead to or have the potential for significant safety concerns.

3 Retraining and Reexamination Programs.

a Annual retraining and reexamination programs covering abnormal plant procedures and emergencies shall be required. Retraining and reexamination programs meeting all other requirements of ANS 3.1, section 5, shall be scheduled on a biennial basis. Examination content shall be varied from test to test.

b For tasks performed by shift operating personnel in response to off-normal or accident situations, in-plant drills shall be conducted to enable personnel to maintain proficiency in those tasks.

c In addition to the training and retraining addressed in ANS 3.1, section 4, instruction should be provided to operations personnel in the use of plant systems to control or mitigate accidents in which the core may be severely damaged. Such training should include, as a minimum, classroom training and in-plant training.

4 Control Manipulations. ANS 3.1, section 5.5.1.2.1, identifies specific control manipulations and plant evolutions applicable to power reactors. For each Category A reactor, specific control manipulation training requirements shall be developed by the operating contractor and approved by the cognizant Deparment of Energy field office.

5 Certification. The program leading to certification shall be documented and written procedures for certification by management of shift supervisors, senior reactor operators, and reactor operators shall be made either by senior line management or others designated by management. Neither an operator nor a supervisor may be certified by his or her immediate supervisor. Certification shall be made only after assuring that all the requirements of training and examinations (including written, operating, oral, and medical)

have been satisfied, and management has assured that the individual is capable of performing satisfactorily all functions of the assigned tasks. The qualification of all other personnel shall be appropriately documented, i.e., experience, education, medical condition, training, and testing, as pertinent to the specific job assignment.

6 On the Job Training. ANS 3.1, section 5.2.1.3.1, requires that, as part of the operator training program, candidates shall observe operating practices in the control room. In addition:

a Operators. Operator trainees should have received 3 months shift training, with no other concurrent duties, at the facility. During this training, under the observation and control of a certified operator, the trainee should have manipulated the facility controls and performed duties a person would perform as a certified operator.

b Senior Reactor Operators. Senior reactor operator trainees should have received 3 months of shift training, with no other concurrent duties, at the facility. During this training, under the observation and control of a certified senior reactor operator, the trainee should have supervised the manipulation of the facility controls and performed duties a person would perform as a certified senior operator.

7 Record Requirements. Record retention requirements (ANS 3.1, section 5.6) shall be in accordance with paragraph 6k.

(e) Implementation. Training plans for each Category A reactor shall be issued within 1 year from the date of issue of this chapter. Effective 3 years from the date of issue of this chapter, all personnel filling the functional or equivalent positions contained in ANS 3.1 shall meet the training requirements of the applicable training plan. Personnel not holding the position prior to 1 year after the date of issue of this chapter shall meet the selection and training requirements of the training plan.

(2) Category B Reactors. This section contains the requirements for the qualification and training of personnel involved in the operation of Department-owned Category B reactors (see Attachment VI-1, paragraph 3).

(a) Selection.

1 Candidates for reactor operator should possess that combination of education, experience, and training which provides the equivalent of at least a high school education. Candidates for reactor supervisor should possess that combination of education, experience, and training which provides the equivalent of at least a college education in engineering or science.

2 Contractor management shall specify the demands on health, physical condition, coordination, and manual dexterity required to perform both routine and emergency functions. A health examination shall be given to establish the candidate's fitness to perform all proposed job tasks.

(b) Training.

1 Reactor Operator Training. The reactor operator's training shall be sufficiently comprehensive to cover areas which are fundamental to the candidate's job description.

a The program shall include on-the-job training for operators and supervisors to assure their familiarity with all required aspects of reactor operations, including normal operations, anticipated transients, and accident conditions. Where construction precludes on-the-job training, practical experience at similar reactors, training on simulators, and other appropriate training are acceptable.

b Training categories shall include nuclear theory, principles of reactor operation, features of facility design, design and operating characteristics and limitations, instruments and controls, safety and emergency systems, shielding, engineered safety features, standard and emergency operating procedures, radiation monitoring systems and survey equipment, radiological safety principles, effects of experiments, and manipulation of reactivity controls. Training in heat transfer, fluid flow, and thermodynamics shall also be provided as necessary for the specific design of the reactor.

2 Reactor Supervisor Training. The supervisor training program shall include the categories and on-the-job training specified above for reactor operators, but with increased depth to reflect the added responsibilities of the supervisor. In addition, emphasis shall be placed on design and operating limitations, bases for technical specifications, radiation

hazards, reactivity effects during experimental and maintenance activities, fuel handling, burnup and reactivity worth, alterations in core configuration, and administrative responsibilities associated with the facility and appropriate for his or her level of responsibility.

(c) Examination. Written, operational, and oral examinations shall be prepared and administered by the contractor to satisfactorily demonstrate the required knowledge of reactor operators and supervisors. These examinations shall include questions on all categories listed above and the examination content shall be varied from test to test. The Department shall review the type, depth, and breadth of the examinations for initial certification. Administration of examinations of reactor operators and supervisors shall be by those personnel sufficiently knowledgeable to ascertain candidate deficiencies. The examination contents, administration, and evaluation shall be reviewed by personnel other than the candidate or his immediate supervisor.

(d) Certification. The program leading to certification shall be documented, and written procedures for certification by management of qualified reactor operators and supervisors shall be made either by senior line management or others designated by management. Neither a reactor operator nor a supervisor may be certified by his or her immediate supervisor. Certification shall be made only after assuring that all the requirements of training and examinations (including written, operating, oral, and medical) have been satisfied, and management has assured that the reactor operator or supervisor is capable of performing satisfactorily all of the functions of the assigned tasks.

(e) Retraining. A retraining program shall be established to provide training on changes to plant or procedures, areas in which the candidate shows deficiency, areas in which the candidate is not routinely exposed, and other areas necessary to keep operators and supervisors proficient. The retraining program shall include:

1 Periodic refresher training.

2 Indepth retraining and reexamination at least annually in abnormal plant procedures and emergencies.

3 Immediate retraining in identifiable weak areas (see (f)2c, below).

(f) Reexamination.

1 The reexamination should emphasize those subjects which are necessary to determine weaknesses which could affect continued proficiency. The reexamination shall:

a Include the appropriate categories listed in paragraphs 6e(2)(b) 1 and 2, for operators and supervisors, respectively.

b Cover all areas in addition to subparagraph a, above, in which the candidates are expected to be proficient.

c Include written, oral, and operational testing.

2 The contractor has the following options:

a Giving one examination biennially which covers all categories.

b Giving examinations on selected categories throughout the 2-year period.

c In lieu of retraining prior to examination, give a comprehensive examination (written and oral) in each category, and an operational examination to determine weak areas in which the operator or supervisor shall be retrained and retested.

3 A line manager or supervisor may administer the examination if the contractor does not have other qualified personnel from which to draw. However, if the employee who administers the examination is also to be certified or recertified, he shall not be examined by those persons whom he examines nor can he examine himself.

(g) Recertification. The candidate shall not be allowed to function as a certified operator or supervisor if he has not completed all of the requalification program within 2 years from the previous certification. If a certified operator fails a required portion of a recertification examination or shows serious deficiencies which indicate he may operate in an unsafe manner, then he is to be removed from activities requiring certification until retraining and reexamination are satisfactorily completed. In addition the recertification of previously certified operators and supervisors shall be based on:

1 Operating records and experiences during the past certification period.

2 Successful completion of appropriate portions of the retraining and retesting program.

3 A review made either by senior line management by a committee, or by an individual designated by management. Reactor operators and supervisors may not be certified by their immediate supervisors.

4 If an operator or supervisor has been away from reactor operations for a significant period, but less than 12 months, selected retraining including oral, written, and operative examinations shall be given as deemed necessary. However, if the absence is greater than 12 months, comprehensive written, oral, and operating examinations (as required of initial qualifying candidates) shall be given to determine weak areas. Retraining and retesting shall be required in areas of weakness.

5 A health examination shall be administered biennially, or more frequently if circumstances warrant, to assure continued physical stamina, coordination, and manual dexterity, required to perform his or her assigned job tasks. Naval personnel at Naval Reactors prototypes receive medical examinations as required by Department of Navy standards.

(h) Documentation. The qualification of personnel shall be documented in a form amenable to audit. The documentation shall include:

1 Education, experience, employment history, and health evaluation.

2 Training programs completed.

3 Records of initial and most recent written examinations consisting of the candidate's answers and examiner's evaluation.

4 Records of initial and most recent oral and operational demonstration examinations, including:

a Either a listing of the basic questions asked and tasks performed, or a general summary of each area covered.

b An evaluation of the operator's or supervisor's response.

c A general summary of oral examination by the examiner including an evaluation of the knowledge, ability, and performance of the operator or supervisor.

5 Records of initial certification and the most recent recertification, with dates and approval signatures.

(i) Maintenance Personnel. The training requirements for maintenance personnel shall be determined by the class of maintenance which the personnel are to perform, the degree of supervision required, and the required knowledge of the reactor.

1 All maintenance operations shall be performed by personnel who are properly trained in their respective discipline or under direct supervision of trained personnel.

2 A written policy shall be established that describes functions, assignments, and responsibilities of the maintenance organization as it relates to reactor safety.

3 The successful completion of the training and qualification effort shall be documented.

(j) Fuel Handling Operations. All fuel handling operations shall be performed by or under the direct supervision of an individual certified by management as qualified to perform the required functions. The requirements below are not necessary if fuel handling is performed by individuals qualified for such under regular reactor operator and supervisor training programs.

1 A specific qualification program shall be established for the fuel handling supervisor. Operators shall receive appropriate training for their assigned tasks.

2 The initial qualification and recertification program for the supervisor shall consist of training, examination, certification, retraining, reexamination, and recertification. The training and testing may be limited to that needed for fuel handling safety, the impact of fuel handling on the safety of the reactor, and actions to be taken during abnormal and emergency conditions.

3 Documentation requirements in subparagraph e(2)(h) above, shall be followed.

f. Quality Assurance. Department-owned reactors shall adhere to the quality assurance requirements in DOE 5700.6A.

g. Contractor Independent Review and Appraisal System. The field office shall require each contractor to establish and maintain an internal safety

review system for each phase of the reactor program life (e.g., design, construction, testing, operation) which:

(1) Functions primarily in an advisory capacity to the line organization, reporting to a designated position at a level of management sufficiently high to take any necessary corrective action. (Safety is a line responsibility; neither review nor subsequent approval releases line management from its responsibility for safety of people and equipment.)

(2) Is clearly defined and delineated in writing (e.g., purposes, objectives, functions, authority, responsibility, composition, quorum, meeting frequency, and reporting requirements.)

(3) Can be audited by contractor management and by the Department. The performance of the system shall be recorded in sufficient detail to permit contractor management and the Department to evaluate its effectiveness. Actions taken on any recommendations resulting from reviews, audits, inspections, appraisals, and surveillance shall be included in these records.

(4) Provides technical competence in the areas being reviewed. Each review, except subparagraph (9), below, shall be carried out by persons whose technical disciplines cover the range of technical fields encountered in performing a safety review. Safety considerations are to be treated in such breadth and depth as is necessary to identify the potential hazards and to evaluate the risks.

(5) Provides for group discussions between reviewers on all but the more routine matters.

(6) Provides an independent determination of whether a proposed activity involves an unreviewed safety question, violation of a Technical Specification, or any other matter for which approval is required.

(7) Provides an appraisal of the overall operation of each facility at least annually. This appraisal shall be made by individuals the majority of whom are independent of the operation being appraised. It shall include, but not be limited to, applicable areas listed in subparagraph (8), below.

(8) Provides for objective and independent review of:

(a) Proposed modifications to plant and equipment having safety significance and safety analysis thereof.

(b) Proposed experiments and irradiations having safety significance.

(c) Procedures, i.e., administrative, operating (normal and abnormal), maintenance, repair, testing, quality assurance, and emergency and significant changes thereto.

(d) Organization and staffing.

(e) Safety evaluations and Technical Specifications, and changes thereto.

(f) Appropriate training programs, initial and subsequent qualification and certification requirements and procedures. Emphasis in the training program review shall include the involvement of all appropriate levels of management, including senior management, in assuring adequate coverage for: understanding of basic principles, mitigation of the severity of postulated reactor accidents, and understanding of plant-specific limitations; and in reviewing general exam approach, management, and update techniques.

(g) Occurrences, including violations of Technical Specifications.

(h) The condition of the physical plant.

(i) The accuracy and completeness of recordkeeping and documentation.

(9) Is reviewed by contractor management for adequacy of performance at least every 3 years.

h. Standards. Reactor operations shall be conducted in accordance with established standards, where applicable. Where established standards are determined to be inadequate or not available, suitable operating standards shall be developed, using contractor expertise as necessary, so that a defined and agreed upon basis for conducting and assessing operations is established and used. The Safety Analysis Report shall identify on a reactor specific basis the standards applied.

i. Standby and Decommissioning. Before placing a reactor in standby or decommissioning it (i.e., permanently shutting down the reactor and dismantling or entombing it), the activities shall be planned and documented. The field office manager shall approve all standby and decommissioning plans before implementation.

j. Reporting and Analysis of Occurrences. Policies and procedures for reporting and analysis of occurrences shall be in accordance with DOE 5484.1 and DOE 5484.2.

k. Emergency Planning. Emergency planning shall be in accordance with DOE 5500.2.

l. Recordkeeping. Records shall be maintained in accordance with the requirements of DOE 1324.2, RECORDS DISPOSITION.

m. Tenant-Landlord Safety Responsibilities. When reactor projects are located at sites which are under the direct control of a field office manager (landlord) other than the field office manager having contractual responsibility for the reactor project (tenant), the tenant shall be assigned a parcel of land (the reactor test area) within which he will confine his activities. Specific authorities, responsibilities, and limitations for the tenant and the landlord shall be described in a written agreement between the two field office managers for each test area that is established. This agreement shall conform to the following general provisions:

(1) The reactor test area shall be described in writing.

(2) The tenant shall assume responsibility for the health and safety of persons and property within the reactor test area and for keeping the landlord informed regarding the nature of activities undertaken and the condition of the reactors, including any reportable occurrences.

(3) The landlord shall have full responsibility for all safety matters except those within the confines of a reactor test area being operated by the tenant.

(4) The landlord shall have the right to take whatever action may be appropriate, including curtailment of operations within a reactor test area, when in his opinion such operation may jeopardize the health and safety of persons or property beyond the limits of the reactor test area.

(5) The landlord may accept responsibility for certain safety aspects within the tenants' reactor test area, particularly when those activities utilize landlord personnel or landlord contractor personnel and equipment.

7. ORGANIZATIONS HAVING RESPONSIBILITY FOR DEPARTMENT OF ENERGY OWNED REACTORS. Assignments of responsibility for each Department-owned reactor are listed in Attachment VI-1. To facilitate the updating of this information, the Headquarters organization which has the program responsibility for a reactor shall notify EP-30 when additions or changes are made in the responsibility for a reactor or its designation.

ORGANIZATIONS RESPONSIBLE FOR DEPARTMENT OF ENERGY OWNED REACTORS

The table provided on the following pages lists all Department of Energy owned reactors. The key to the abbreviations used in the tables and those reactors designated as Category A reactors is provided below.

1. FIELD ORGANIZATIONS AND OPERATING CONTRACTORS.

AL - Albuquerque Operations Office
ANL - Argonne National Laboratory
BNL - Brookhaven National Laboratory
BNW - Battelle Northwest Laboratory
CH - Chicago Operations Office
CRBRP-PO - Clinch River Breeder Reactor Plant - Project Office
Du Pont - E. I. Du Pont de Nemours and Company
Duquesne - Duquesne Light Company
EG&G - EG&G Idaho, Inc.
GE - General Electric Company
HEDL - Hanford Engineering Development Laboratory
ID - Idaho Operations Office
LASL - University of California, Los Alamos National Laboratory
LLL - University of California, Lawrence Livermore Laboratory
OR - Oak Ridge Operations Office
ORNL - Oak Ridge National Laboratory
PRNC - Puerto Rico Nuclear Center
RI - Rockwell International
RL - Richland Operations Office
SAN - San Francisco Operations Office
Sandia - Sandia Laboratories
SR - Savannah River Operations Office
UNI - United Nuclear Industries
WEST - Westinghouse Electric Corporation

2. HEADQUARTERS ORGANIZATIONS.

DP-1 - Defense Programs
EP-14 - Environmental Safety Engineering Division
ER-10 - Office of Basic Energy Sciences
ER-30 - Office of Health and Environmental Research
NE-40 - Office of Naval Reactors
NE-530 - Office of Reactor Research and Technology

3. DESIGNATED CATEGORY A REACTORS. Department-owned reactors designated as Category A reactors are as listed below. Designation as a Category A reactor is generally based on power level (e.g., 20 MW steady state), potential fission product inventory, and experimental capability. All other DOE-owned reactors (not including Naval Reactors) are designated Category B.

ATR - Advanced Test Reactor
C - C Production Reactor
EBR-II - Experimental Breeder Reactor II
ETR - Engineering Test Reactor
FFTF - Fast Flux Test Facility
HFBR - High Flux Beam Reactor
HFIR - High Flux Isotope Reactor
K - K Production Reactor
LOFT - Loss of Fluid Test
N - N Production Reactor
ORR - Oak Ridge Research Reactor
P - P Production Reactor
PBF - Power Burst Facility

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Annular Core	ACRR	AL	DP-1	Sandia	Operable
Kinetic Intense Neutron Generator Critical Assembly	KINGLET	AL	DP-1	LASL	In Standby
Pajarito: Los Alamos Critical Assembly Facility	Big Ten	AL	DP-1	LASL	Operable
	Coment	AL	DP-1	LASL	Operable
	Flattop	AL	DP-1	LASL	Operable
	Godiva IV	AL	DP-1	LASL	Operable
	Honeycomb	AL	DP-1	LASL	Operable
	Jezebel	AL	DP-1	LASL	Operable
	Parka	AL	DP-1	LASL	Operable
	Mars (Plasma Core Assembly)	AL	DP-1	LASL	Operable
	Skua	AL	DP-1	LASL	Operable
	Venus	AL	DP-1	LASL	Operable
Omega West Reactor	OWR	AL	DP-1	LASL	Operable
	SUPO	AL	DP-1	LASL	Shutdown (No fuel)

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Rocky Flats Nuclear Safety Facility (Critical Facility)	RFP-NSF: Horizontal Split Table	AL	DP-1	RI	Operable
	RFP-NSF: Vertical Split: Table	AL	DP-1	RI	Operable
	RFP-NSF: Solution System	AL	DP-1	RI	Operable
	RFT-NSF: Tank Reservoir	AL	DP-1	RI	Operable
Sandia Pulsed Reactor II	SPR II	AL	DP-1	SANDIA	Operable
Sandia Pulsed Reactor III	SPR III	AL	DP-1	SANDIA	Operable
Argonne Fast Source Reactor	AFSR	CH	NE-530	ANL	Operable
Argonne Thermal Source Reactor	ATSR	CH	NE-530	ANL	Operable
Biological Research Reactor	JANUS	CH	ER-1	ANL	Operable
Chicago Pile No. 5	CP-5	CH	ER-10	ANL	Shutdown

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Experimental Breeder Reactor II	EBR II	CH	NE-530	ANL	Operable
Transient Reactor Test	TREAT	CH	NE-530	ANL	Operable
Neutron Radioograph Facility	NRAD	CH	NE-530	ANL	Operable
Zero Power Reactor-6	ZPR-6	CH	NE-530	ANL	Operable
Zero Power Reactor-9	ZPR-9	CH	NE-530	ANL	Operable
Zero Power Plutonium Reactor	ZPPR	CH	NE-530	ANL	Operable
Brookhaven Medical Research Reactor	BMRRIII	CH	ER-30	BNL	Operable
High Flux Beam Reactor	HFBR	CH	ER-10	BNL	Operable
Clinch River Breeder Reactor Plant	CRBRP	CRBRP-PO	NE-530	PMC	Operable
Advanced Reactivity Measurement Facility (Critical Facility)	ARMF I	ID	NE-530	EG&G	Operable

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Advanced Test Reactor	ATR	ID	NE-530	EG&G	Operable
Advanced Test Reactor Critical Facility	ATRC	ID	NE-530	EG&G	Operable
Coupled Fast Reactor Measurement Facility (Critical Facility)	CFRMF	ID	NE-530	EG&G	Operable
Engineering Test Reactor	ETR	ID	NE-530	EG&G	Operable
Engineering Test Reactor Critical Facility	ETRC	ID	NE-530	EG&G	Operable
Loss of Fluid Test	LOFT	ID	EP-14	EG&G	Operable
Power Burst Facility	PBF	ID	EP-14	EG&G	Operable
Critical Facilities (1 cell)	BETTIS	NE-40	NE-40	WEST	In Standby
Critical Facilities (1 cell)	BETTIS	NE-40	NE-40	WEST	Operable

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Critical Facilities (1 cell)	KAPL	NE-40	NE-40	GE	Operable
Critical Facilities (2 cells)	KAPL	NE-40	NE-40	GE	In Standby
Destroyer Reactor Prototype	DIG	NE-40	NE-40	GE	Operable
Large Ship Reactor Prototype (2 reactors)	AIW	NE-40	NE-40	WEST	Operable
Modifications and Additions to Reactor Facilities	MARF	NE-40	NE-40	GE	Operable
Natural Circulation West Plant	S5G	NE-40	NE-40	WEST	Operable
S1W Facility	S1W	NE-40	NE-40	WEST	Operable
Shippingport Atomic Power Station	SHIPPINGPORT	NE-40	NE-40	Duquesne	Operable
Small Submarine Reactor Prototype	S1C	NE-40	NE-40	GE	Operable

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Submarine Advanced Reactor Prototype	S3G	NE-40	NE-40	GE	Operable
Thermal Reactor No. 1	TTR-1	NE-40	NE-40	GE	Operable
Trident Reactor Prototype	S8G	NE-40	NE-40	GE	Operable
Bulk Shielding Reactor	BSR	OR	ER-10	ORNL	Operable
High Flux Isotope Reactor	HFIR	OR	ER-10	ORNL	Operable
Health Physics Research Reactor	HPRR	OR	ER-30	ORNL	Operable
Oak Ridge Critical Experiments Facility	OR-CEF: Cell "W"	OR	ER-10	ORNL	Operable
Oak Ridge Research Reactor	ORR	OR	ER-10	ORNL	Operable
Pool Critical Assembly	PCA	OR	ER-10	ORNL	Operable
Tower Shielding Reactor II	TSR-II	OR	NE-530	ORNL	Operable

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Puerto Rico Nuclear Center pe L-77	PRNC-L-77	OR	ER-30	PRNC	Shutdown
B Production Reactor	B	RL	DP-1	UNI	Shutdown
C Production Reactor	C	RL	DP-1	UNI	Shutdown
Fast Flux Test Facility	FFTF	FFTFPO	NE-530	HEDL	Under Construction
Neutron Radiography Facility	NRF	FFTFPO	NE-530	HEDL	Operable
K East Production Reactor	KE	RL	DP-1	UNI	In Standby
K West Production Reactor	KW	RL	DP-1	UNI	In Standby
N Production Reactor	N	RL	DP-1	UNI	Operable

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
Pacific Northwest Lab - Critical Mass Lab	PNL-CML: Split Table	RL	NE-530	BNW	Operable
	PNL-CML: Plutonium Solution System	RL	NE-530	BNW	Operable
Pacific Northwest Lab Plutonium Recycle Critical Facility	PNL-PRCF	RL	NE-530	BNW	Shutdown
Livermore Pool Type Reactor	LPTR	SAN	DP-1	LLL	Shutdown
Nuclear Effects Reactor	SUPER KUKLA	SAN	DP-1	LLL	In Standby
C Production Reactor	C	SR	DP-1	Du Pont	Operable
K Production Reactor	K	SR	DP-1	Du Pont	Operable
L Production Reactor	L	SR	DP-1	Du Pont	In Standby
Nuclear Test Gauge (Subcritical Facility)	NTG	SR	DP-1	Du Pont	Operable
P Production Reactor	P	SR	DP-1	Du Pont	Operable
Process Development Pile	PDP	SR	DP-1	Du Pont	In Standby

REACTORS

Name	Designation	Responsible Field Organization	Headquarters Program Responsibility	Operating Contractor	Current Status
R Production Reactor	R	SR	DP-1	Du Pont	In Standby
Resonance Test Reactor	RTR	SR	DP-1	Du Pont	In Standby
Subcritical Experiment	SE	SR	DP-1	Du Pont	In Standby
Standard Pile	SP	SR	DP-1	Du Pont	In Standby
Savannah River Test Pile 305	SP	SR	DP-1	Du Pont	Operable

CHAPTER VII

FIRE PROTECTION

1. PURPOSE. This chapter establishes requirements for an "improved risk" level of fire protection sufficient to attain the objectives listed below. A higher standard of protection may be justified in certain instances for the purpose of national security, program continuity, or protection of the public. The objectives of this program are that:

   a. No threats to the public health or welfare will result from fire.

   b. There are no undue hazards to employees from fire.

   c. Vital Department of Energy programs will not suffer unacceptable delays as a result of fire.

   d. Property damage will be held to manageable levels.

2. DEFINITIONS.

   a. Improved Risk. This term has the same meaning and intent as is commonly understood when this term or the term, "Highly Protected Risk," is used in the insurance industry. The term involves the use and application of judgment and thus does not lend itself to a precise, fixed definition applicable in all locations and situations. Generally, an improved risk property is one that would qualify for complete insurance coverage by the Factory Mutual System, the Industrial Risk Insurers, and other industrial insurance companies that limit their insurance underwriting to the best protected class of industrial risk. Essential elements of a program complying with the improved risk concept are included in this chapter. Improved risk protection requires compliance with the fire protection and loss prevention standards detailed in Chapter I of this Order. This term also implies that qualified fire protection engineering judgment has been used to obtain the highest economically justifiable level of industrial loss prevention. The most evident characteristic of an improved risk property is the existence of reliable, automatic fire extinguishing systems throughout all buildings of combustible construction or content where the building is vital to operational continuity or may experience a large property loss from fire in the absence of an automatic extinguishing system.

b. National Security. Those aspects of national security as referred to in the Atomic Energy Act of 1954 that could be affected adversely by fire, explosion, or other catastrophes.

c. Protection of the Public Health and Welfare. Control of fire, explosion, or effects of hazards to minimize potential injury to the public and damage to property not owned by the Department of Energy.

d. Property. All Government-owned or leased property for which the Department has responsibility, except:

(1) Property furnished under Department of Energy contract requiring contractor assumption of the risk of loss or damage to Government furnished property.

(2) Property covered by a private insurance policy specifying the Department of Energy as the beneficiary.

e. Fire Protection. Protection from a broad range of fire risks normally included in the analysis conducted by fire protection engineers. These include some aspects of related perils such as explosion, windstorm, earthquake, lightning, and water damage. Fire prevention programs are a necessary part of a fire protection program.

f. Maximum Credible Loss. The maximum loss that could occur from a combination of events resulting from a single fire. Considerable judgment is required to evaluate the full range of potential losses, but in general, readily conceivable fires in sensitive areas are considered. Examples are power wiring failures in cable trays, flammable liquid spills, and high value parts storage areas or combustible exposures to sensitive machines. Any installed fire protection systems are assumed to function as designed. Due to the uncertainties of predicting human action, the effect of emergency response is generally omitted except for post fire actions such as salvage work, shutting down water systems, and restoring production.

g. Maximum Possible Fire Loss. The maximum possible loss that could occur in a single fire area assuming the failure of both automatic and manual fire extinguishing actions.

h. Property Loss. Property loss is defined as the dollar cost of restoring a damaged facility or equipment to its original condition, whether or not such restoration actually occurs. In determining loss, the estimated damage to the building and its contents shall include replacement cost less salvage value plus the cost of decontamination and cleanup. Effects upon program continuity, auxiliary costs of fire extinguishment, and consequent effects on related areas should be included if the effects can be determined.

i. Consultant Fire Protection Survey Program. The program under which fire protection surveys of principal Department of Energy facilities are conducted for the Operational and Environmental Safety Division by fire protection engineers of selected contractors administered by the Operational and Environmental Safety Division.

j. Fire Protection System. Any system designed to control or extinguish fires or to limit the extent of fire damage. These include:

(1) Automatic suppression systems such as sprinklers, Halon, or carbon dioxide systems.

(2) Watchmen or automatic detection systems, water supplies, plus a fire department.

(3) Walls and doors.

(4) Building separation with credit for water supplies plus a fire department.

3. RESPONSIBILITIES AND AUTHORITIES.

a. The Director, Operational and Environmental Safety Division.

(1) Develops fire protection requirements for Department of Energy programs and facilities and coordinates the development of design criteria with the Director, Office of Construction and Facility Management, and other appropriate Headquarters divisions and offices to assure the consistency of such criteria with the requirements of applicable codes and standards and the provisions of this chapter and Chapter I of this Order.

(2) Evaluates and appraises (per Order DOE 5482.1) the adequacy of field organizations' fire protection programs and provides assistance to all Headquarters divisions and offices and field organizations on all aspects of fire protection.

(3) Administers the consultant fire protection survey program, issues survey reports to applicable field organizations and Headquarters divisions and offices, and reviews the Headquarters and field organization programs for handling recommendations resulting from the surveys.

b. Directors of Program Divisions. As the following matters affect facilities under the director's programmatic responsibility, the director:

(1) Reviews proposed fire protection programs for that property under his responsibility.

(2) Reviews field requests for exemptions from Department of Energy criteria with the Operational and Environmental Safety Division and the Office of Construction and Facilities Management in those exemption requests requiring approval.

(3) Reviews field organization implementation of the recommendations resulting from the consultant fire protection survey program. The Operational and Environmental Safety Division will act as the primary point of contact for the survey program and will distribute survey reports to field organizations and Headquarters divisions and offices as applicable.

(4) For Department of Energy facilities not subordinate to a field organization, the program division shall comply with the procedures under paragraph 3c, below.

c. Heads of Field Organizations.

(1) Provide and maintain an improved risk level of fire protection adequate to meet the objectives under paragraph 1, above, for all physical property or material that represents an investment by the Department.

(2) Provide and maintain a higher standard of fire protection than that required to meet the improved risk requirements in instances when justified for purposes of national security, DOE program continuity, or protection of the public.

(3) Submit requests for exemptions to the Operational and Environmental Safety Division, for those facilities where, in the judgment of the head of the field organization, compliance with the objectives of paragraph 1, above, is not feasible.

(4) Establish and maintain a system to assure that the intent of all Department of Energy fire protection standards is incorporated in the plans and specifications for all new buildings and for major modifications of existing buildings.

(5) Assist the Operational and Environmental Safety Division in coordinating the consultant fire protection team surveys at those facilities included in the survey program, establish action plans for compliance with recommendations resulting from the surveys,

and forward compliance plans, exemption requests, and other requested data to the Operational and Environmental Safety Division.

(6) Establish and maintain lists of facilities for which they have fire protection appraisal responsibility and designate for each the minimum frequency at which Department of Energy fire protection appraisals will be made. This list shall include facilities at which:

(a) Property is valued at $1,000,000 or more. (All values in this paragraph and paragraphs 5c and 5d, below are based on Factory Mutual System's Industrial Cost Trends of July 1979, using a July 1979 multiplier of 1.0. Post-1979 escalated values may be based on either Factory Mutual or Engineering News Record indexes.).

(b) Property valued at less than $1,000,000 is located but where a fire protection appraisal is deemed to be justified.

(c) A credible loss could delay a vital Department of Energy program in excess of 3 months or a significant component of a program in excess of 6 months.

(7) Conduct fire protection appraisals of facilities for which they have responsibility.

(8) Provide loss prevention advice and assistance to contractors in need of assistance or who do not have their own professional staff assistance.

(9) Submit to the Operational and Environmental Safety Division, an annual summary as set forth in Order DOE 5484 (to be issued) covering the fire protection program and loss experience of the previous year.

4. DELEGATION OF "AUTHORITY HAVING JURISDICTION". For those fire protection standards specifying alternative means of compliance subject to "the authority having jurisdiction," this authority is the applicable Department of Energy Headquarters or field organization.

5. COMPLIANCE WITH IMPROVED RISK OBJECTIVES.

a. Threats to the Public Health or Welfare and Hazards to Life. The objectives of having no threats to the public health and welfare and no undue hazards to life from fire can be considered to have been attained when:

(1) Department of Energy buildings comply with the intent of the "Life Safety Code" (National Fire Protection Association Code 101) and with specific requirements of the Occupational Safety and Health Standards (Code of Federal Regulations, Title 29, Part 1910) applicable to exits and fire protection features.

(2) The potential for fast spreading fires is controlled by severe restrictions on the ratings of interior finish materials for flame spread and smoke development and by compartmentation of hazardous materials.

(a) Materials of unusual fire characteristics such as exposed urethane foams and materials developing large quantities of toxic products of combustion should be prohibited for interior finish.

(b) Hazardous materials, such as flammable liquids and explosives, should be severely restricted in quantity and handled in conformance with all applicable codes. Special protection features suitable to the hazard should be installed and limits imposed on the number of people who must be exposed to the hazard.

(c) Where noncompliance with some Life Safety Code provisions may be required for public safety, as in some containment structures, additional protective systems and personnel limits should be maintained.

(3) The facility containment systems are designed to preclude an offsite release of hazardous amounts of toxic materials under maximum credible fire conditions.

(4) Exhaust and ventilation systems, including filters, are protected or isolated from the effects of a credible fire to the extent that hazardous amounts of toxic materials or combustion products will not escape.

(5) Natural or artificial means of controlling liquid runoffs from a credible fire are provided so that contaminated or polluting liquids will not escape the site, including potentially contaminated water resulting from firefighting operations.

b. Unacceptable Program Delays. The objective of no unacceptable impairment of a vital Department of Energy program can be considered to have been attained when:

(1) The maximum credible fire will not result in the loss of use of a vital facility for a period longer than that specified as acceptable to the applicable program division.

(2) In the absence of a defined acceptable shutdown period, the maximum credible fire will not result in the interruption of a vital program (weapons production, uranium enrichment, etc.) for a period in excess of 3 months, or a significant part of a program (major accelerator, single diffusion plant, etc.) for a period in excess of 6 months.

c. Property Damage Limitation. The objective of limiting property loss can be considered to have been attained when fire protection systems are provided as follows:

(1) When the maximum possible property loss is in the range of $1-25 million, an automatic fire protection system is provided that will limit the probable loss to the lower figure.

(2) When the maximum possible property loss is in the range of $25-50 million, a redundant protection system is provided that, even in the failure of the primary system, should limit the loss to the lower figure.

(3) When the maximum possible property loss exceeds $50 million, redundant systems are provided as in (1) and (2), above, and a failure-proof type of fire protection system, such as blank walls or physical separation, is provided to limit the maximum property loss to $75 million.

d. Higher Standard of Protection. A higher standard of protection, usually including some form of automatic protection, is described in paragraph 1 as being justified when certain considerations, beyond those mentioned in paragraph 5 a-c, above, play a major role in the management decision process. The specific level at which an automatic protection system should be installed requires qualified fire protection engineering judgment. In general, the probable loss should be limited to $250,000 in such cases. The following points should be considered in evaluating the need for automatic fire extinguishing systems:

(1) Importance. Vital property may require protection without regard to the dollar loss potential. For example, it may be desirable to protect a low value or temporary storage shed when it may contain critical or long procurement time construction items. In illustration, a trailer may have a temporary protection system when it is used as a control center for a vital, one-time event. Particularly high public visibility or sensitivity may also be justification for protection of otherwise low value property.

(2) Effect on Production. Protection costs may be high in relation to the value protected, but still warranted, as in the case of cooling towers and electrical switchgear, where loss of the unit could result in the shutdown of other facilities.

(3) Cost Versus Benefit Ratios. A building such as a lumber or paint shed may be of low value and importance but may be easily protected by extending sprinklers from an adjoining protected building at a low incremental cost.

(4) Exposure. Construction sheds or trailers may warrant protection when they must be installed in or adjacent to more important facilities.

(5) Future Conditions. Even when the above conditions are not applicable, protection may still be warranted when conditions are extrapolated to the future. For example, a storage building may be of low value when designed, but normal escalation of content value may indicate it would need protection in a few years, in which case it would be more effective to install the protection as part of the original construction. Similarly, evaluation of office or low hazard laboratory occupancies may indicate that the hazard or combustible loading of similar facilities increases consistently with time, justifying protection at an early phase. Provision of automatic protection in the initial construction also allows more flexibility for future modifications. For example, conversion to a higher hazard occupancy may be prohibited due to a lack of appropriate built-in protection.

6. ESSENTIAL ELEMENTS OF AN IMPROVED RISK FACILITY.

a. An improved risk facility is characterized by a sufficiently high level of fire protection to fulfill requirements for insurability by the Factory Mutual System, Industrial Risk Insurers, or other private industrial fire insurance companies that limit their underwriting to the best protected class of industrial risks. A basic requirement is the provision of automatic fire extinguishing systems in all areas subject to serious property damage or business interruption losses as a result of fire. Above all other requirements, to qualify for an improved risk rating, it is necessary that strong, tangible evidence be available attesting to existence of continuing sincere interest by management and employees in minimizing losses from fire and related perils.

b. Department of Energy facilities qualifying as improved risks will incorporate the following physical improvements and internal programs, and maintain records for appraisal of the programs:

(1) Review of plans prior to contemplated construction to assure adequacy of fire risk appraisal and protection, and followup reviews to ensure that fire protection features are provided where necessary to comply with paragraph 5 of this chapter.

(2) Regular self-inspections, tests, fire loss potential reviews and appraisals to identify the nature, location, and severity of fire risks (injuries, dollar loss, programmatic interruption, release of toxic and radioactive materials, etc.); as well as to determine adequacy of fire loss control devices and activities.

(3) Periodic audits by outside fire protection authorities (e.g., contractor facility appraisals by field office fire protection engineers).

(4) Plans, procedures, devices, and trained personnel adequate to permit controlling any credible fire emergency that may arise on the facility.

(5) Limitation by physical means (e.g., geographic isolation, firewalls, firedoors, draft barriers) of areas that can be directly damaged in the event of a single fire.

(6) Quality construction. In most cases, fire resistive or noncombustible type buildings with segregation or isolation of particularly hazardous operations.

(7) Enclosures of adequate fire resistant construction for stairways, elevators, ducts, and other openings coupled with fixed or manual devices (e.g., self-closing doors or dampers, draft stops, or water curtains) to control or to limit both vertical and horizontal fire spread potentials.

(8) Protection of special hazards by isolation, segregation or use of special fire control systems (e.g., automatic sprinklers, inert gas flooding, explosion suppression) together with devices (e.g., relief valves, filters, roof hatches, scuppers, blast walls) for limiting or controlling damage potentials of fire, hazardous smoke, gases, water runoff, etc., that may reasonably be anticipated during a fire emergency.

(9) Adequate, reliable fire protection water supplies and distribution system coupled with adequate hydrants, inside standpipes, and other devices to facilitate utilization of such water during fire emergencies.

(10) Adequate automatic and manual means for detecting and reporting incipient fires (including, but not limited to, watchman service).

(11) Automatic sprinkler protection for all combustible construction or occupancies where potential losses exceed Department criteria.

c. Improved risk facilities shall be appraised periodically by the appropriate Headquarters or field organization in sufficient depth to establish that:

(1) The programs described in paragraph 6b, above, are being conducted.

(2) Loss potentials, including programmatic effects, have been determined and appropriate protection systems have been provided to reduce the effects to the levels acceptable under paragraph 1, or an exemption from these requirements has been obtained.

(3) Effective action has been taken to comply with previous recommendations, initiate corrective actions on previously identified deficiencies, and reduce the adverse effects of noncompliance in areas where compliance has not yet been achieved or where exemptions have been allowed.

(4) Losses, impairments, and unusual incidents are investigated and analyzed in sufficient depth to identify causes, economical and effective corrective methods, and areas where similar problems may exist or where additional studies may be required.

d. In addition to internal, Headquarters, and field organization appraisals, improved risks are generally characterized as those also surveyed by independent third party interests. For major facilities, this service is provided by the consultant fire protection survey program.

e. Periodic fire protection appraisals of each facility shall be initiated by qualified fire protection engineering personnel as soon as practicable after listing of the facility by the Department. The appraisals shall include the items under paragraph 6c, above.

f. In addition to performing periodic appraisals, the appraising office will maintain a continuous surveillance of improved risk facilities by:

(1) Assuring that plans, proposals, loss reports, investigation reports, and other applicable materials are reviewed by knowledgeable personnel in sufficient depth to determine that the facility is maintaining the review and protection programs described in paragraph 6b, above.

(2) Providing technical assistance and advice as requested by the contractor and as deemed necessary by the field office.

(3) Assuring that the facility management is kept advised of requirements, programs, and applicable information generated by Headquarters, or other agencies, and that information developed by the facility or by other facilities with mutual interests, is disseminated among the interested parties.

7. CONSULTANT FIRE PROTECTION SURVEY PROGRAM.

a. Consultant fire protection team surveys will be conducted periodically at facilities determined to be of major importance to the Department of Energy mission. The Department has contracted with major improved risk survey groups to conduct surveys of the improved risk status of Department of Energy facilities.

(1) A survey shall be conducted at each facility containing more than $25,000,000 in replacement value of Government property.

(2) Following the initial survey, a resurvey shall be made at each facility at approximately 4-year intervals.

(3) Reports of the surveys shall be submitted to the Operational and Environmental Safety Division for review and distribution to the appropriate contractors through the field organization and program divisions.

b. For each survey, Headquarters or the field organization:

(1) Shall designate a coordinator to assist the team in obtaining logistical support, facility access, and technical information as determined necessary by the Operational and Environmental Safety Division.

(2) Shall review the contractor's compliance efforts and forward compliance data as requested by the Operational and Environmental Safety Division.

(3) May omit any Department of Energy appraisal that would coincide with the period in which the consultant fire protection team survey is being conducted.

c. Following each survey, the appropriate organization will be requested to submit an action plan.

(1) Action plans are submitted directly to the Operational and Environmental Safety Division.

(2) Initial action plans are requested in the transmittal letter accompanying the final report of the survey and will be due at the next scheduled update.

(3) Action plans will be reviewed by the Operational and Environmental Safety Division and revised status reports will be requested, approximately annually, for those sites requiring prolonged corrective actions.

d. Output data from the action plans shall be furnished yearly to appropriate field organizations and Headquarters divisions and offices to assist in budgeting and planning purposes.

CHAPTER VIII

CONTRACTOR OCCUPATIONAL MEDICAL PROGRAM

1. PURPOSE. This chapter establishes the minimum occupational medical program requirements necessary to:

   a. Protect Department of Energy contractor employees against health hazards in their work environments.

   b. Assist management in assuring the placement of Department of Energy contractor employees in work that they can perform without undue hazard to themselves, their fellow workers, plant facilities, plant site environments, the public at large, or the general environment.

   c. Provide continuing medical surveillance of Department of Energy contractor employees and their job tasks and work environments.

   d. Assure the early detection, treatment, and rehabilitation of the ill or injured employee.

   e. Apply preventive medical measures toward the maintenance of good physical and mental health of employees.

   f. Encourage Department of Energy contractor employees to maintain their physical and mental health and to educate themselves in health and safety by providing them with professional guidance and counseling.

2. APPLICABILITY. See the parent Order DOE 5480.1.

3. DEFINITIONS.

   a. Occupational Medical Program. A program to:

      (1) Assure the health and safety of employees in their work environments through the application of occupational medical principles.

      (2) Determine the physical and mental fitness of employees to perform job assignments without undue hazard to themselves, fellow employees, or the public at large.

      (3) Assure the early detection and treatment of employee illness or injuries by means of scheduled periodic health evaluations and unscheduled employee health visits.

      (4) Contribute to the maintenance of good employee health through the application of preventive medical measures, such as immunizations, alcohol and drug abuse programs, and health counseling.

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b. Occupational Medicine. A specialty branch of the profession of medicine that deals with the health protection and health maintenance of employees, with special reference to job hazards, job stresses, and work environment hazards.

c. Minimum Requirements and Standards. The program content necessary to satisfy the policies and objectives of this chapter.

d. Guide. Information to assist in achieving the program policies and objectives.

e. Triage. The medical screening of patients to determine their priority for treatment; the separation of a large number of casualties in military or civilian disaster medical care into three groups: those who cannot be expected to survive even with treatment, those who will recover without treatment, and the priority group of those who need treatment in order to survive.

4. PROGRAM REQUIREMENTS.

a. Standards, Minimum Requirements, and Guides for Establishment and Operation of the Department of Energy Contractor Occupational Medical Program. The minimum requirements of this chapter are not to be cited as justification for reducing existing or proposed occupational medical program activities, particularly those determined to be necessary by the periodic program appraisal process or to adequately meet specific occupational conditions.

(1) Program Plan. The Occupational Medical Director for each contractor installation shall develop a written occupational medical plan detailing the methods and procedures to be used in establishing and operating the occupational medical program as required by this chapter.

(2) Maintenance of a Healthful Work Environment. Close cooperation and coordination with health physics, industrial hygiene, and safety organizations will optimize the maintenance of healthful work environments.

(a) Minimum Requirements.

1 Occupational medical physicians shall perform periodic visits to worksites and facilities to become familiar with employee job tasks, worksite environments, and related health hazards or potential health hazards. Such visits should be coordinated with industrial hygiene, health physics, toxicology, paramedical, and safety personnel. These periodic visits should include a review of materials, processes, and procedures used, with emphasis on physical, chemical, and biological hazards. The knowledge gained may form the basis for recommendations to management for corrective action or preventive measures.

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2 The frequency of periodic worksite visits by the physicians shall be determined by the Occupational Medical Director, taking into account such factors as plant and work force size; number of different operations; kinds and amounts of physical, chemical, or biological agents used; the accident and incident rate; the occupational illness and disability rate; and the occupational medical department staffing.

3 The plant manager shall provide an effective management mechanism to furnish the Occupational Medical Director with full and timely information on all new physical, chemical, and biological agents and new processes introduced onto the worksites.

(b) Guides.

1 It is suggested that individual physicians make a familiarization visit to one or more worksites at least monthly. Where there is more than one occupational medical physician, they can alternate their worksite visits and keep each other updated on significant health and safety information.

2 It is suggested that occupational medical physicians participate in new materials and process review committees, safety committees, etc.

(3) Employee Health Examinations--Minimum Requirements.

(a) Preplacement Examinations.

1 These examinations serve to determine the health status and the physical fitness of the individual in order to aid in placement in a suitable job that will not present a health hazard or accident risk to himself, his fellow workers, the plant facilities or site, the public at large, or the general environment.

2 Complete examinations shall be done at the time of employment or reemployment (see paragraph 4 below). In the case of a job change, the plant management shall advise the Occupational Medical Director, who will determine the need for, and extent of, a review of the health status and physical fitness of the employee, with emphasis on the health and physical factors that relate to the new job tasks and demands.

(b) Periodic Health Examinations.

1 Objective. The objective of periodic health examinations is to provide continuing, updated reassessments of the health status and physical fitness of employees in order to:

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a Detect any evidence of illness or injury, and determine whether or not there is an occupational relationship.

b Determine whether the employee's health status and physical fitness continue to be compatible with the safe performance of his assigned job tasks.

c Contribute to employee health maintenance by providing the opportunity for early detection, treatment, and prevention of disease or injuries and the complications or consequences of such diseases or injuries.

d Provide a documented record of the health status of employees.

2 Periodic Examinations--Minimum Requirements

a All employees age 45 and over shall be offered a comprehensive health examination annually. The scope of the comprehensive health examination is outlined in paragraph (4) below.

b All employees under age 45 shall be offered a comprehensive health examination biennially.

Note: The above are minimum requirements. However, it should be recognized that specific work hazards and conditions may dictate more frequent health examinations in order to maintain an effective occupational medical program.

3 Periodic Examinations--Guides. As a guide to strengthening the preventive medical aspects of the occupational medical program, it is suggested that all employees under age 45 be offered a brief interim health status examination biennially on alternate years to the required comprehensive health examination. The scope of the suggested interim health status examination is outlined in paragraph 4a(5) below.

(c) Termination Health Examinations--Minimum Requirements. A health status review shall be made for all terminating employees. The extent of such a review shall be determined by the Occupational Medical Director, taking into account such factors as the length of time since the last comprehensive health examination and the employee's work history and exposure history. For employees with known occupational illnesses or injuries, or with known exposures, and for those employed in potentially hazardous work areas, a comprehensive health examination (as outlined in paragraph 4a(4) below) shall be done if more than 1 year has elapsed since their last comprehensive examination. Physical

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evidence of internal or external effects of hazardous physical, chemical, or biological agents, including effects of exposure to any internal or external ionizing radiation shall be given special attention.

(d) Return to Work Health Examinations--Minimum Requirements.

1 Occupational Injury or Illness. All employees with occupationally related injury or illness shall be examined without undue delay, whether or not disability or lost time is involved. The scope and content of this examination shall be determined by the examining occupational medical physician, based upon the nature and extent of the injury or disease, and shall be sufficient to assure that the employee may return to work without undue health hazard or accident risk to himself or others. Written clearance from the occupational medical department shall be required before such an employee may return to work.

2 Nonoccupational Injury or Illness. Employees who have been absent from work because of nonoccupationally related illness or injury for 7 consecutive calendar days or more shall not be allowed to return to work until they receive a health evaluation and a written clearance from the occupational medical department. The extent of this health evaluation shall be as determined by the Occupational Medical Director and shall be sufficient to assure that the employee may return to work without undue health hazard or accident risk to himself or others.

(e) Special Health Examinations and Health Monitoring. Standards and requirements for special health examinations and health monitoring for employees who work in jobs involving specific physical, chemical, or biological hazards, or specific stressful work environments will be set forth in separate attachments to this chapter, or in applicable chapters of this order, as they are developed.

(4) Minimum Scope and Content of the Comprehensive Health Examination.

(a) The comprehensive health examination shall be conducted by an occupational medical physician using whatever ancillary assistance he needs.

(b) The scope and content of the comprehensive health examination shall be in accord with current sound and acceptable medical practices.

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1 Medical History. The medical history shall include the present illness or health status and review of symptoms, past medical history, present and past occupational hazards exposure, family history, allergy history, habits, travel history, and history of mental or emotional disorders.

2 Physical Examination. The physical examination shall be complete and cover head, neck, eyes, ears, nose, throat, mouth, heart, lungs, breasts, abdomen, vascular and lymphatic systems, skin, musculoskeletal system, a brief neurological examination, height, weight, pulse, temperature, and blood pressure. A digital rectal and prostate examination shall be offered to males age 40 and above. Examinations such as sigmoidoscopic, tonometric, and pelvic (and Pap smears) shall be offered or advised when indicated or required to conform to good preventive medical practices. Where the local capability does not exist to perform these specialized kinds of examinations, the employee shall be advised to obtain the examination from the private medical sector.

3 Laboratory Studies. The laboratory work shall include audiometry, visual acuity (near, distant, and color vision), pulmonary function tests, x-rays when clinically indicated (see guidelines below), resting electrocardiogram, complete blood count, a blood glucose challenge test or a glucose tolerance test (unless clinically contraindicated), serology, urinalysis, serum lipids when indicated, tuberculin skin tests when indicated, and any other laboratory tests deemed necessary or desirable by the examining occupational medical physician.

4 Guidelines for Use of X-Rays. The recommendations and guidance contained in the Federal Register Volume 43, No. 22, Wednesday, February 1, 1978, Part V, "Radiation Protection Guidance to Federal Agencies for Diagnostic X-Rays" shall be observed.

5 Review and Evaluation of Examination. The examining physician shall discuss his findings with the employee and provide any necessary health counseling and advice. Emphasis should be placed upon the evaluation of the employee's physical fitness and health status as it relates to the work environment and job safety, and to health maintenance and prevention of disease or the complications of disease. This evaluation should include a general assessment of the employee's emotional stability and mental health. Employees shall be encouraged to have a private physician, and the employee should be referred to his private physician for any necessary definitive

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care or followup treatment and for any necessary additional diagnostic studies that are beyond the scope of the occupational health examination. The health interests of employees are best served by communication and cooperation between their private physicians and physicians participating in occupational health programs. This practice helps to assure their continuation in, or prompt restoration to, suitable employment.

(5) The Interim Health Status Examination--Guides. The interim health examination may be conducted by a nurse or other paramedical personnel designated by the director of the occupational medical program, and under his direction and supervision, and may include the following:

(a) Medical History. A review may be done to elicit a history of illnesses, symptoms, or health complaints occurring in the interval since the last comprehensive health examination. This medical history review may be simplified so that it can be self-administered by the employee or administered by a nurse or other paramedical personnel. Computerized techniques may be employed.

(b) Physical Examination and Laboratory Studies. The interim health examination may include height, weight, temperature, pulse, blood pressure, audiogram, visual acuity, pulmonary function tests, hemoglobin determination, urinalysis, and tuberculin skin test. Electrocardiograms may be done if ordered by the occupational medical physician. The provisions of paragraph (4)(b)4, page VIII-6 shall apply to the use of x-rays.

(c) Review and Evaluation of Interim Examination.

1 In the case of an employee with abnormal interval history, or physical or laboratory findings, the examining nurse or paramedic shall consult with the occupational medical physician who will determine the need for further evaluation.

2 In the case of a negative interim review, the examining physician, nurse, or paramedic shall inform the employee accordingly.

b. Diagnosis and Treatment of Injury or Disease--Minimum Requirements.

(1) Occupational Injury or Disease.

(a) Diagnosis and treatment of occupational injury or disease shall be prompt, with emphasis placed on rehabilitation and return to work at the earliest possible time compatible with job safety and employee's health.

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(b) When it is necessary to refer the employee to a private physician (for example, specialist consultation or treatment, in-hospital treatment, etc.), the occupational medical physician shall maintain close cooperation with the private physician. The occupational medical physician, being knowledgeable of the employee's job duties and related hazards, shall determine the physical and mental fitness of the employee to return to either full duties or limited duty status.

(c) It is the responsibility of the plant manager to establish procedures to assure that all employees with occupational injury or disease receive formal (written) clearance from the occupational medical department before being permitted to return to work.

(d) The responsible health and safety group (health physics, industrial hygiene, safety, etc.), shall be given timely notification of any unhealthy work situations detected by the occupational medical program.

(2) Nonoccupational Injury and Illness. Employees shall be encouraged to utilize the services of a private physician or medical service where these are available for care of off-the-job illnesses or injuries. Treatment of nonoccupational injury and illness has never been and is not now ordinarily considered to be a routine responsibility of an occupational medical program with these limited exceptions:

(a) In an emergency, the employee shall be given the attention required to prevent loss of life or limb or to relieve suffering until placed under the care of his private physician.

(b) For minor disorders, first aid or palliative treatment may be given if the condition is one for which the employee would not reasonably be expected to seek the attention of his private physician, or to enable the employee to complete his current work shift.

c. Employee Health Maintenance and Preventive Medical Activities--Minimum Requirements.

(1) Health Education and Counseling.

(a) The availability of occupational medical personnel for health counseling and education activities is essential to the effectiveness of an occupational medical program and shall be taken into consideration in the planning for adequate occupational medical personnel staffing. Health counseling shall include areas of weight control, nutrition, mental hygiene, smoking, drugs and alcohol, etc., when indicated, and to the extent that such counseling can be done by the

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physicians, nurses or other qualified health professionals on the job. The extent of definitive treatment and indepth or followup counseling for physical, emotional, or mental problems shall be as determined by the Occupational Medical Director.

(b) Occupational medical education and counseling activities shall be coordinated with other health and safety organizations and with plant management in providing health and safety information to employees (e.g., habits of cleanliness, orderliness, safety, the proper use and maintenance of protective clothing and equipment, and the use of available health services and facilities).

(2) Immunization Programs.

(a) Tetanus immunization shall be available.

(b) Employees involved in foreign travel shall be advised to obtain the immunizations required by the Center for Disease Control and the Public Health Service of the U.S. Department of Health and Human Services. Special immunization requirements, such as serial desensitizations for allergy may be given at the discretion of the Occupational Medical Director with the written advice and consent of the employee's private attending physician, and in the interest of saving employee lost time off the job.

(3) Fitness for Continued Work Assignment. On all employee visits to the occupational medical department, including visits for minor first aid or health counseling, the occupational medical physician or nurse shall give due consideration to the employee's job duties, the possible occupational relationships of the health complaints, and the employee's continuing fitness to safely perform his job duties.

d. Medical Records--Minimum Requirements.

(1) The Maintenance of Records. The maintenance of complete medical records developed by the medical department for each employee from the time of his first examination or treatment is a basic requirement.

(2) Confidentiality. The confidential character of all employee medical records, including the results of health examinations, shall be rigidly observed by all members of the occupational medical staff. Such records shall remain in the exclusive custody or control of the occupational medical department. Disclosure of information from an employee's health record shall not be made without his consent, except as permitted by law.

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(3) Updating of Records. Summary data shall be added to update the employee's medical record at the time of each scheduled health examination, or unscheduled health visit, covering the following:

(a) The current health status of the employee. Particular note should be made of the development or progress of any disease process or injury occurring since the last examination or visit, as well as the employee's sick leave or disability history.

(b) Any hazardous or potentially hazardous physical, chemical, or biological agents at the employee's worksite.

(c) The employee's history of exposure to any physical, chemical, or biological agents.

(d) The employee's accident record.

(4) Flagging or Suitable Coding Identification of Medical Records. It shall be the responsibility of the Occupational Medical Director to see that all employee medical records are coded, flagged, or otherwise identified so that occupational medical personnel will be aware of related work hazards or potential hazards and be in a position to evaluate the possible relationship of such hazards to the employees' state of health. Forms used for routine sick call and emergency visits are included in this requirement.

(5) Specific Records Requirements.

(a) Records shall be retained on any disability or death related to an occupational injury or disease in accordance with DOE 5484. State workmen's compensation record requirements and the requirements of DOE 1324.1 shall be met.

(b) A personal health record shall be maintained for each employee and identified by name, date of birth, and social security number. The contractor may use additional identification systems as desired.

(c) All employee health records shall be retained in accordance with DOE 1324.1, Chapter III, which allows microfilming of the files and destruction of paper records.

(6) Disposition of Noncurrent Records. All employee health records shall be retained in accordance with DOE 1324.1, Attachment V-1, Schedule 25. However, noncurrent records shall be retired to low-cost storage in an onsite records holding area or a Federal Records Center. To protect the confidentiality of the records, the shipping cartons shall be sealed; and the transfer documents shall note that access to the records is limited to personnel of the medical department. Alternately, if resources permit, the files may be microfilmed and the paper records destroyed as provided in DOE 1324.1, Chapter III.

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e. Emergency and Disaster Preparedness--Minimum Requirements.

(1) Integrated Emergency and Disaster Preparedness Planning. The Occupational Medical Director is responsible for the development of a medical emergency and disaster plan adequate to the needs of the plant and site. This plan shall be closely integrated with, and made a part of, the overall plant and site emergency and disaster preparedness plan, in accordance with DOE 5500 and Chapter XI of this order. This will require close coordination and cooperation with management, safety organizations, fire and rescue units, health physics and industrial hygiene departments, etc.

(2) Integration with Community Emergency and Disaster Plans. The occupational medical emergency and disaster plan shall also be integrated with surrounding community emergency and disaster plans to the extent feasible consistent with the development of a maximum mutual aid and assistance capability.

(3) Preplanning Requirements.

(a) The medical emergency and disaster response capability shall be adequate to meet the kinds and degrees of accidents and trauma dictated by the character and history of plant operations and conditions.

(b) Preplanning and prearrangements are key factors vital to the effectiveness of a medical emergency and disaster plan and shall be accomplished to provide the following:

1 The services of health physicists to: evaluate any associated radiological hazards or potential hazards affecting either the environment, the casualties, or the general public; and advise rescue and medical personnel of any radiological hazards or potential hazards and assist them in the decision-making process.

2 Onsite capabilities for first aid, triage, and personnel decontamination by trained, qualified personnel. This shall include onsite capability for cardiorespiratory resuscitation, including cardiac defibrillation.

3 Arrangements for hospital care for contractor personnel and for Department of Energy personnel for whom the contractor provides health services. This shall include capabilities for evaluation and treatment of injuries, radiation exposures, internal and external radioactive decontamination, radioactively or chemically contaminated injuries, and internal deposition or effects of toxic agents, as needed.

4 The services of medical specialists and consultants.

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5 The services of rescue squads, ambulances, and helicopters, as needed, with capability for handling radioactively contaminated casualties. Ambulance drivers and attendants shall meet the national standards as established by the Public Health Service and the Department of Transportation (see Emergency Medical Services Program Standard Number 11).

6 First aid coverage during evacuation operations from facilities and the site.

7 Communication links between first aid and triage teams, fire and rescue units, hospitals, and hospital teams, local and State police, and the Emergency Operating Center. (See DOE 5500.)

(4) Recommended Guide. A recommended guide to emergency and disaster planning is the 30-minute film, "Date with Disaster," produced by the Office of Preparedness of the General Services Administration. This film is available through the Operational and Environmental Safety Division.

f. Organization and Staffing for Department of Energy Contractor Occupational Medical Programs--Minimum Requirements and Guides:

(1) The Occupational Medical Director:

(a) Shall be a physician who is a graduate of an accredited school of medicine or osteopathy and who meets the licensing requirements applicable to the location in which he works. Training and experience in occupational medicine is desirable.

(b) Shall be responsible for the development, interpretation, implementation, and administration of the occupational medical program.

(c) Shall report at a senior management level to assure program effectiveness. In the areas of safety, health protection, health maintenance, maintenance of a healthy work environment, and accident prevention, occupational medicine plays a vital role, which involves all work disciplines, and cuts across all levels of management and labor. Thus, it is essential to the success and effectiveness of the occupational medical program that the Occupational Medical Director have direct access to top management so as to keep it fully informed on a timely basis, and that top management exercise an active interest in the program and provide adequate support.

(d) Shall be afforded opportunities for continuing medical education, including attendance at professional medical meetings, health seminars, and subscriptions to medical journals.

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(2) Occupational Medical Physicians:

(a) Shall be graduates of accredited schools of medicine or osteopathy and meet the licensing requirements applicable to locations in which they work. Training and experience in occupational medicine is desirable.

(b) Shall be directly responsible to the Occupational Medical Director.

(c) Shall be afforded opportunities for continuing medical education, including attendance at professional medical meetings, health seminars, and subscriptions to medical journals.

(3) Occupational Medical Nurses:

(a) Shall be graduates of accredited schools of nursing, registered, and legally qualified to practice nursing where employed. Training and experience in occupational health is desirable.

(b) Shall be afforded opportunities for continuing nursing education, including attendance at professional meetings and subscriptions to journals as determined by the Occupational Medical Director.

(4) Professional Staffing.

(a) The proper ratio of physicians and nurses to employee population is related to many factors including:

1 Size of employee population.

2 Geographical distribution and location of employees.

3 Shifts worked.

4 Rate of employee turnover.

5 Age and sex distribution of the employee population.

6 Extent of occupational hazards.

7 Types and complexities of job tasks and operations performed.

8 Total number of health examinations required.

9 Degree of isolation of worksites from community and other medical services.

10 Degree of accessibility of the occupational health services to the employees.

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11 Degree of employee utilization of occupational health services.

(b) Guide for Physician Staffing.

1 At least one part-time physician for employee populations less than 1000.

2 One full-time physician for employee populations over 1000 and under 1500.

3 One full-time and one half-time physician for employee populations over 1500 but under 2000.

4 Two full-time physicians for employee populations over 2000 but under 3000.

5 An additional physician for each additional increase of 1000 to 1500 employees.

(c) Guide for Nurse Staffing.

1 One part-time nurse for up to 100 employees.

2 One full-time nurse for employee populations over 100 and up to 300.

3 Three full-time nurses for the first 1000 employees.

4 One additional full-time nurse for each additional 1000 employees up to 5000.

5 One additional full-time nurse for each 2000 employees over 5000.

(d) Minimum Requirements for Worksites not Covered by a Physician or Nurse. At worksites where the size of the employee population does not warrant a full-time nurse or physician, i.e., population less than 100 employees, there shall be at least one employee on duty who is trained and currently qualified in first aid. To assure that this requirement is met, the contractor shall have a sufficient number of employees trained and currently qualified in first aid and shall establish a management system of employee work scheduling that will assure that at least one such qualified employee is on duty for all shifts.

(e) Guide for Laboratory Technician and Ancillary Medical Staffing. The number and qualification of laboratory and other technicians and ancillary medical personnel required shall be as determined by the Occupational Medical Director. The number of clinical and support personnel should be adequate to

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support the needs of the occupational medical program. (The continuing increase in reporting requirements promulgated under the Occupational Safety and Health Administration make this particularly important.)

g. Facilities and Equipment--Minimum Requirements.

(1) Occupational Medical Facilities. General design criteria for occuptional medical facilities are contained in Order DOE 6430 (to be issued). These facilities:

(a) Shall be located in areas readily accessible to employees and to transportation. Accessibility of the occupational medical department is a key factor in employee utilization of medical services and is very important to the overall effectiveness of the program.

(b) Shall be sufficiently spacious, well lighted, ventilated, and heated.

(c) Shall include waiting, consultation, examining and treatment rooms, toilet, and shower or tub facilities adequate to assure privacy and comfort.

(d) Shall have necessary medical, laboratory, and other equipment, and adequate decontamination facilities as needed.

(e) Shall include a rest or recovery room, dressing rooms, and facilities for the laboratory and radiological examinations performed in the department.

(f) Shall include ambulance services and equipment that meet Public Health Service and Department of Transportation standards (see Emergency Medical Services Program Standard Number 11). The responsibility for ambulance and rescue personnel, operations, and equipment need not necessarily be assigned to the Occupational Medical Director.

(2) Equipment.

(a) The Occupational Medical Director shall assure that the medical department equipment is adequate in terms of present day accepted standards of medical practice and that it is maintained in good working order.

(b) The selection of specific kinds and brands of medical office and laboratory equipment shall be as determined by the Occupational Medical Director. The following minimum items should be included:

1 Standard distant and near visual acuity eye charts or optical testers.

Vertical line denotes change.

2 Standard color vision plates (Ishihara, Dvorine, or American Optical).

3 Audiometer with audiometer booth.

4 Electrocardiograph machine.

5 Pulmonary function equipment sufficient to measure total vital capacity, timed vital capacity (FEV-1), and maximum voluntary ventilation. (As a guide, consideration should be given to a small solid-state machine with capability for instant computer readouts of these parameters.)

6 Cardiac defibrillation and related monitoring equipment adequate for portable use or use without power.

7 Suction equipment, including manually operated suction equipment for portable use or use without power.

8 Pulmonary resuscitation equipment.

9 Adequate equipment for monitoring, handling, and decontamination of radioactively contaminated casualties and chemically contaminated casualties, as needed.

10 Physiotherapy equipment, as needed.

Vertical line denotes change.

CHAPTER IX

CONSTRUCTION SAFETY AND HEALTH PROGRAM

1. PURPOSE. This Chapter provides guidance and establishes procedures to protect the Department of Energy and Department of Energy contractor employees engaged in construction activities, to protect the general public from hazards in connection with Department construction activities, to protect adjacent property from damage, and to prevent delay or interruption in the Department's programs caused by accidents and fires in connection with Department construction activities.

2. DEFINITIONS.

   a. Department of Energy Project Construction Contractor. Any Department of Energy prime contractor or subcontractor engaged in construction activities exempt from, or not subject to, Nuclear Regulatory Commission licensing, but subject to the contractual provisions of Department of Energy Procurement Regulation 9-50.704-2 or modifications thereof. These contractors may make modifications to existing facilities or construct new facilities for the Department but they are not considered a permanent construction force. Their site tenure may be for short or long periods depending on the nature of the project.

   b. Department of Energy Resident Construction Contractor. Any Department of Energy prime contractor or subcontractor exempt from (or not subject to) Nuclear Regulatory Commission licensing but subject to the contractual provisions of Department of Energy Procurement Regulation 9-50.704-2 or modifications thereof, who is in residence and considered to be permanent. Field organizations that have such contractors include Nevada, Richland, Oak Ridge, Savannah River, and Albuquerque. The tenures of resident construction contractors on site are usually from 3 to 5 years and can be extended.

3. REQUIREMENTS.

   a. Safety and Health Program for Project Construction Contractors. All firms bidding on or selected for Department of Energy construction contracts shall be made fully aware of the requirement to comply with applicable Department safety and health standards listed in Chapter I of this Order. The contractor selected shall be required to submit the following to the contracting officer for acceptance before commencing work:

(1) A descriptive outline of the contractor's program encompassing industrial safety, health protection, and fire prevention and protection aspects. The program should be appropriate to the size of the project and associated hazards, and must include, but not be limited to:

(a) Adequate provision for emergency aid (e.g., trained medical aid personnel and treatment facilities, and adequate fire protection during all phases of construction).

(b) Programs for training, inspections, reporting, and for certifying the safe operating condition and assuring proper maintenance of earthmoving equipment, cranes, vehicles, pressure vessels, protective devices for portable electrical tools, etc.

(c) Adequate provision through meetings, established contacts or other means, for exchange of information on project changes, recognized hazards, identified inspection deficiencies, upcoming phases of work, interface and coordination problems, or other matters among:

1/ Supervisors.
2/ Crafts representatives.
3/ Other contractors and subcontractors on the project.

(2) Past injury, accident, fire, and property damage experience, including motor vehicle, for the previous two years. This information should contain the contractor's and subcontractor's experience. If acceptable to the field organization having jurisdiction, the contractor may submit the previous two years industrial insurance experience modifiers or rates.

(3) The name and qualifications of the jobsite contractor management official assigned responsibility for the administration of the safety and health program.

b. Safety and Health Program for Resident Construction Contractors. The requirements of 3a, above, apply to this type contractor during the initial selection process.

c. Program Compliance. Throughout all phases of a construction project, the contracting officer must be assured that construction activities continue to be conducted in accordance with the approved safety program and that appropriate measures are taken to minimize the possibility of:

(1) Personal injury.

(2) Damage to property on and adjacent to the construction site.

(3) Program interruption or delay resulting from accidents or fires.

(4) Adverse effects on the environment.

d. Department of Energy Onsite Construction Inspections. Department of Energy onsite construction inspections to assure compliance with applicable Department construction safety standards should be conducted, as a minimum, concurrently with major changes in type of construction activity, level of workforce, type of construction crafts on the site, and level of project completion. Factors influencing the frequency (more or less frequent) and scope of such onsite inspections include, but are not limited to the factors listed below. These factors must be taken into consideration and the inspection schedule adjusted accordingly.

(1) The number and type of hazards involved.

(2) Total level of risk to the workforce, property, and environment.

(3) Previous experience with the contractor.

(4) Presence of qualified contractor safety personnel.

(5) Duration of project.

(6) Time elapsed since last inspection.

(7) Availability of independent sources of inspection.

CHAPTER X

INDUSTRIAL HYGIENE PROGRAM

1. PURPOSE. This Chapter establishes the requirements and guidance for maintaining an effective industrial hygiene program.

2. DEFINITIONS.

   a. Industrial Hygiene. That science and art devoted to the recognition, evaluation, and control of environmental factors, or stresses, arising in or from the workplace that may cause sickness, impaired health and well-being, or significant discomfort and inefficiency among workers or those with whom they come into contact.

   b. The First Operating Level is the organization performing the actual work or job related tasks. It may be a contractor or it may be an element of the Department itself such as an Energy Technology Center or a Power Administration.

3. REQUIREMENTS. The following requirements are necessary elements for maintaining an effective industrial hygiene program and providing protection in accordance with the standards of paragraph 7c, Chapter I of this Order. The requirements shall be implemented by the first operating level, as appropriate, to the activity being conducted.

   a. Management Responsibility. The facility manager shall have responsibility to assure compliance with the requirements of this Chapter.

   b. Policy. A written policy statement shall be developed setting forth the purpose and intent of the industrial hygiene program and clearly specifying the authority vested in the staff administering the program. This policy statement may be incorporated into existing documents covering the health and safety program.

   c. Function. The industrial hygiene program shall be designed to preserve employee health and well-being. This shall be accomplished by recognition, evaluation, and control of environmental factors and stresses found in the occupational environment. These stresses include: chemical (e.g., liquid, particulate, vapor, and gas); physical (e.g., electromagnetic radiation, noise, vibration, magnetic fields, and extremes of temperature and pressure);

biological (e.g., agents of infectious diseases); and ergonomic (e.g., body position in relation to task, repetitive motion, and mental or physical fatigue). A program that incorporates the following features will provide a mechanism to deal with these occupational stresses or potential health hazards.

(1) Identification of Health Hazards. The industrial hygienist shall identify and document potential occupational health hazards through his knowledge and assessment of the operations, periodic walk-through surveys, information provided by inter-organizational communication and coordination, and the review of proposed projects and facilities.

(2) Hazard Evaluation. Once potential health hazards are identified, the industrial hygienist must determine the extent of the hazard through appropriate consultation with other professionals, sound judgment, and the application of established standards or guides and scientific techniques like air samples and bioassay. When potential occupational exposures are determined to be within acceptable limits, the opinion of the industrial hygienist, together with the supporting evidence, shall be recorded.

(3) Control Measures. Whenever it is determined that a potential health hazard exists sufficient to produce illness or injury or that applicable requirements are not being followed, the industrial hygienist shall formally recommend control measures that must be promptly addressed. The type of control must be dictated by each individual situation.

(4) Periodic Review. The satisfactory control of occupational health hazards must be given continuing attention despite the imposition of control measures. Periodic monitoring is essential to assure maintenance of satisfactory conditions. The industrial hygienist shall determine the type and frequency of periodic monitoring. The industrial hygienist shall report to management regarding the continuing adequacy of control, the need for additional controls, or recommendations for maintenance or reemphasis of administrative controls. The employees shall be given the opportunity to observe the monitoring for toxic materials or harmful physical agents and shall be given access to the results.

d. Industrial Hygiene Staff.

(1) A qualified industrial hygienist shall be assigned. His or her qualifications must be evaluated in regard to the size and scope of operations and the magnitude of hazard potential at the facility.

(2) As an alternative to a staff industrial hygienist, consultants who are qualified in industrial hygiene and are apprised by the requirements of this Chapter may be retained to augment the field organization or the contractor staff and to perform comprehensive or specific industrial hygiene surveys as needed.

e. Facilities, Instrumentation, and Technical Support. Facilities, instrumentation, and technical support personnel shall be available to implement the requirements of this Chapter. Provisions shall be made to take and analyze air and water samples and bioassy specimens, and to test, to calibrate, and to maintain instruments. Where it is impractical to provide these services onsite, the services of offsite laboratory facilities and instrument sources shall be retained.

f. Organizational Responsibilities. The industrial hygiene program shall require that functional organizations share with the industrial hygiene staff the following responsibilities as a minimum for the implementation of the objectives set forth in this Chapter.

(1) Operating or Engineering Organization Having Line Safety Responsibility.

(a) Conduct operations consistent with established procedures to control exposures to harmful environmental contaminants or stresses.

(b) Notify the industrial hygiene staff whenever a new process or facility is being planned or whenever an existing process is being considered for change or modification to allow the impact of the anticipated change on the work environment to be evaluated while it is still in the planning stage.

(c) Request the industrial hygiene staff to evaluate the effectiveness of proposed environmental control equipment and approve operational procedures for its operation.

(2) Medical Organization.

(a) Maintain records of occupational illnesses in accordance with the recordkeeping requirements of the Occupational Safety and Health Act of 1970.

(b) Consult with the industrial hygiene staff in the development of adequate methods to detect exposures to harmful environmental agents in the context of periodic physicals or bioassay.

(c) Alert the industrial hygiene staff to all suspected occupational illnesses to facilitate early evaluations and correction of problems.

(d) Alert the industrial hygiene staff to all diagnosed occupational illnesses for followup investigations. These followups shall be designed to supply the information required by Form EV-101, Supplementary Record of Occupational Injuries and Illnesses, or approved equivalent, for reportable occupational illnesses.

(3) Purchasing Organization.

(a) Submit order requests for all potentially hazardous materials or equipment to the industrial hygiene staff for review and approval or other appropriate action.

(b) Participate as requested by the industrial hygiene staff in auditing toxic chemical usage by:

1 Maintaining inventory and use data on toxic materials;

2 Participating in labeling procedures to the extent required; and,

3 Assisting the industrial hygiene staff in liaison with suppliers of proprietary products to obtain appropriate toxicological information.

(4) First Line Supervisors.

(a) Be responsible for maintaining healthful working conditions within his or her own organization and for directly implementing industrial hygiene recommendations.

(b) Follow administrative procedures to allow appropriate disciplinary action to be taken when health and safety rules are violated.

(5) Employees

(a) Observe all safety and health rules and make maximum use of all prescribed personal protective equipment and follow practices and procedures established to maintain health and safety for them and their fellow workers.

(b) Notify supervisors immediately of exposures to harmful agents and when certain conditions or practices may cause illness or injury.

g. Recordkeeping Requiremments.

(1) Survey Records. Area walk-through surveys that resulted in noted deficiencies in control of hazards, procedures, violations, etc., shall be documented as to what was observed and what action was taken. Deficiencies that are identified in formal compliance inspections shall be documented in accordance with 29 CFR 1960 or DOE 5483.1.

(2) Occupational Environmental Monitoring Records.

(a) The results of air samples or other environmental monitoring shall be documented in a manner that can be audited, that is directly comparable to the applicable standards, and which can reasonably be associated with an individual, a particular job station, or a job description.

(b) The industrial hygiene staff's evaluation as to compliance or noncompliance with the standard applicable to a particular situation shall be clearly evident in the record. Actions taken on his part in the event of noncompliance shall be included. The affected employees shall be notified promptly of any exposures or potential exposures exceeding the standards of Chapter I of this Order.

(3) Records Maintenance. Records shall be maintained in accordance with Order DOE 1324.1.

(4) Records Access. Records access shall be provided to employees or designated representatives of employees in accordance with the standards of paragraph 8a(1)(f), Chapter I of this Order.

CHAPTER XI

REQUIREMENTS FOR RADIATION PROTECTION

1. PURPOSE. This chapter establishes radiation protection standards and requirements for Department of Energy and Department of Energy contractor operations based upon the recommendations of the Environmental Protection Agency and the National Council on Radiation Protection and Measurement.

2. DEFINITIONS.

   a. Controlled Area. Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials.

   b. Dose Commitment. The dose equivalent (rem) received by specific organs during a period of one calendar year, that was the result of uptakes of radionuclides by a person occupationally exposed.

   c. First Collision Dose. A measure of radiation dose at a certain point, based on the incident energy transferred to secondary charged particles, per gram of absorbing materials, by primary particles that suffer only one collision in the medium.

   d. Neutron Spectrum. A description of a neutron radiation field in terms of the number of neutrons per unit energy interval.

   e. Primary Unit. A nuclear accident dosimetry unit placed in a position near a potential accident site.

   f. Screening. A method for rapidly selecting those individuals involved in a nuclear accident and subjected to acutely serious radiation exposure.

3. RESPONSIBILITIES AND AUTHORITIES.

   a. Heads of Field Organizations shall:

      (1) Review and approve emergency plans for rescue and recovery operations.

      (2) Act, where immediate decisions and actions are required, on requests for exemptions from the requirements of this chapter and immediately report and justify such action to the Deputy Assistant Secretary for Environmental Safety and Health (EP-30). Contractors may be authorized to take all appropriate measures in emergency situations. See page XI-9, paragraph 4e.

      (3) Assure that Department employees, Department contractor personnel, and the general public are protected against unnecessary radiation exposure and comply with the provisions of this chapter.

Vertical line denotes change.

b. The Deputy Assistant Secretary for Naval Reactors shall assume the same responsibilities as Heads of Field Organizations for Naval Reactors activities.

4. REQUIREMENTS.

a. Occupationally Related Exposure of Individuals in Controlled Areas. Radiation exposures shall be limited to levels reasonably achievable within the standards prescribed below.

(1) Radiation Protection Standards for External and Internal Exposures. (See Figure XI-1.)

(2) Procedural Requirements.

(a) Restrictions.

1 An individual under age 18 shall neither be employed in, nor allowed to enter, controlled areas in such a manner that he or she will receive doses of radiation in amounts exceeding one-tenth the standards in paragraph 4a(1) above.

2 Dose to students under age 18 exposed to radiation during educational activities shall not exceed 0.1 rem/year. This exposure shall be considered a part of the 0.5 rem/year limit for workers under age 18 and not supplemental to it.

(b) Combining Internal and External Dose. Current year whole body internal dose commitment from radionuclides for which the whole body is the critical organ must be combined with the external whole body dose. Where both the external penetrating dose and internal dose to critical organ are known, they shall be combined for that organ.

(c) Emergency or Accidental Exposure. Radiation doses received in emergency or accidental situations will be chargeable to the radiation exposure records of the exposed individuals. However, the decision as to whether an individual exposed to radiation in excess of the standards in subparagraph a(1) above will continue to work in a radiation area will be made on a case-by-case basis by operating contractor management in accordance with the advice of the contractor's health physics and occupational medical departments and subject to the approval of the Head of Field Organization. The operating contractor shall assure the head of the responsible field office that the unsafe conditions under which the emergency or accidental exposures were received

Vertical line denotes change.

Type of Exposure	Exposure Period	Dose Equivalent (Dose or Dose Commitment[1] rem)
Whole body, head and trunk, gonads, lens of the eye[2], red bone marrow, active blood-forming organs.	Year	5[3]
	Calendar Quarter	3
Unlimited areas of the skin (except hands and forearms). Other organs, tissues, and organ systems (except bone).	Year	15
	Calendar Quarter	5
Bone.	Year	30
	Calendar Quarter	10
Forearms[4]	Year	30
	Calendar Quarter	10
Hands[4] and feet.	Year	75
	Calendar Quarter	25

1/ To meet the above dose commitment standards, operations must be conducted in such a manner that it would be unlikely that an individual would assimilate in a critical organ, by inhalation, ingestion, or absorption, a quantity of radionuclide or mixture of radionuclides that would commit the individual to an organ dose that exceeds the limits specified in the above table.

2/ A beta exposure below a maximum energy of 700 KeV will not penetrate the lens of the eye; therefore, the applicable limit for these energies would be that for the skin (15 rem/year).

3/ In special cases, with the approval of EP-30, a worker may exceed 5 rem/year, provided his or her average exposure per year since age 18 will not exceed 5 rem per year. This does not apply to emergency situations.

4/ All reasonable effort shall be made to keep exposures of forearms and hands to the general limit for the skin.

FIGURE XI-1
RADIATION PROTECTION STANDARDS FOR
OCCUPATIONALLY RELATED EXTERNAL AND INTERNAL EXPOSURES

Vertical line denotes change.

have been eliminated. The decision to resume operations following an emergency or accidental radiation exposure shall be subject to the approval of the head of the responsible field office.

(d) Monitoring Requirements. Monitoring is required where the potential exists for the individual to receive a dose or dose commitment in any calendar quarter in excess of 10 percent of the quarterly standards stated in paragraphs 4a(1) and 4a(2)(a)2 above. Monitoring requirements as specified for the following conditions shall include:

1 External Radiation. Personnel monitoring equipment for each individual.

2 Internal Radiation. Periodic (monthly, quarterly, annually, etc.) bioassay analysis or in vivo counting or evaluation of air concentration to which the individual is exposed, or a combination of all methods.

(e) Methods of Estimating Dose Commitment. Methods of estimating dose commitment to the organ of interest should be suitable to the existing conditions and consistent with assumptions and recommendations of the Environmental Protection Agency, the National Council on Radiation Protection and Masurement, and the International Commission on Radiological Protection.

(3) Concentration Guides.

(a) Air. Concentration Guides in Attachment 1, Table I, Column 1, were derived for the most part from the yearly standards in paragraph 4a(1) above (assume a 40 hour workweek). They should be used in evaluating the adequacy of health protection measures against airborne radioactivity in occupied areas.

(b) Water. The Concentration Guides in Attachment 1, Table I, Column 2, are applicable to the discharge of liquid effluents to sanitary sewage systems (see paragraph 4b(5) on page XI-6). Drinking water concentrations in controlled areas shall be maintained within the concentration guides specified in Table II, Column 2.

b. Exposure of Individuals and Population Groups in Uncontrolled Areas. Exposures to members of the public shall be as low as reasonably achievable levels within the standards prescribed below.

Vertical line denotes change.

Type of Exposure	Annual Dose Equivalent or Dose Commitment (rem)[1]/	
	Based on dose to individuals at points of maximum probable exposure (rem)	Based on average dose to a suitable sample of the exposed population[2]/ (rem)
Whole body, gonads, or bone marrow	0.5	0.17
Other organs	1.5	0.5

1/ In keeping with Department of Energy policy on lowest practicable exposures, exposures to the public shall be limited to as small a fraction of the respective annual dose limits as is reasonably achievable.

2/ See Paragraph 5.4, Federal Radiation Council Report No. 1, for discussion on concept of suitable sample of exposed population.

FIGURE XI-2
RADIATION PROTECTION STANDARDS FOR EXTERNAL AND INTERNAL EXPOSURE OF MEMBERS OF THE PUBLIC

(1) Radiation Protection Standards for External and Internal Exposure. (See Figure XI-2.)

(2) Monitoring Requirements. To assure that doses to the public are maintained as low as reasonably achievable consistent with dose standards set forth in paragraph 4b(1) above, effluents to the environment, and other parameters shall be monitored and documented in accordance with DOE 5484.1.

(3) Concentration Guides.

(a) Concentration Guides in Attachment XI-1, Table II, were derived for the most part from the dose standards for individuals in paragraph 4b(1) above (assume 168 hours of exposure per week). These guides shall be reduced by a factor of three when applied to a suitable sample of the population. Where transient exposures can be calculated, the concentration guides other than those in Attachment XI-1, Table II, may be used to evaluate compliance with the dose commitment standard.

(b) There may be situations where it is not feasible or desirable to evaluate the exposure of individuals and samples of exposed populations to effluents to assure compliance with standards in paragraph 4b(1) above. In those cases, effluent releases to uncontrolled areas shall be such that average concentrations of radioactivity at the point of release are within the concentration guides and are as low as reasonably achievable. The point of release shall be considered to be the point at which the effluents pass beyond the site boundary. Radioactivity concentrations may be averaged over periods up to 1 year.

(4) Further Limitations on Effluent Discharges. In any situation in which the effluents discharged by one or more activities of the Department, Department contractors, or others cause exposure to approach the standards specified in subparagraph b(1) above, appropriate effluent discharge limits may be set for these operations. In such cases, the manager of the field organization may take the necessary corrective action if all activities concerned are within his or her area of responsibility. Otherwise, each case will be referred to EP-30 for appropriate action including, where appropriate, coordination with actions taken by the Nuclear Regulatory Commission under the Code of Federal Regulations, Title 10, Part 20.106(e).

(5) Discharge to Sanitary Sewage Systems.

(a) Effluents may be discharged to public sanitary sewage systems provided:

Vertical line denotes change.

1 The quantity of radioactivity released in any one month, if diluted by the average monthly quantity of water released by the installation, will not result in an average concentration exceeding the concentration guide in Attachment 1, Table I, Column 2.

2 The radiation protection standards in paragraph (1), above, are not exceeded.

(b) Concentrations or quantities of radioactive materials greater than those specified in paragraphs 4(b) and (5)(a)1 and 2, above, may be released to chemical or sanitary sewage systems owned by the Federal Government provided the standards in paragraph 4b(1) above are not exceeded in uncontrolled areas.

c. Nuclear Accident Dosimetry. These requirements are applicable to Department of Energy contractor installations possessing sufficient quantities and kinds of fissile material to potentially constitute a critical mass and where a nuclear accident is possible and may result in the excessive exposure of personnel to radiation.

(1) Basic Elements.

(a) A method for initial "screening" of personnel involved in nuclear accidents.

(b) A system of fixed units (primary unit) capable of yielding first collision radiation dose and the approximate neutron spectrum at the locations.

(c) Personnel dosimeters capable of furnishing data sufficient to normalize data derived from the fixed system.

(d) Methods for analysis of biological materials (including sodium 24 activity, and phosphorous 32 activity in hair).

(2) Nuclear Accident Dosimeter Units.

(a) The fixed unit should be capable of determining first collision fission neutron dose at its location within 25 percent.

(b) The gamma ray components for all units should permit measuring fission gamma radiation in the presence of neutrons at the location of the unit within approximately 20 percent.

(c) The exposure range of the gamma components should extend from 10 Roentgen to about 10^4 Roentgen.

(d) The unit should measure the approximate neutron spectrum to permit converting rad to rem dose.

(e) A system for counting to provide the dose data within the time necessary to achieve accuracy required by the above criteria (paragraphs 4c(2)(a) and (b)) should be available.

(f) The units should be assembled in such a manner as to permit easy recovery.

(g) Units using foils containing radioactive material shall be placed in fire-resistant containers.

(h) Units should be shock resistant and they should also be protected against contamination to avoid false measurements.

(3) Number and Placement of Dosimeter Units. The number of units needed and the placement of units will depend on the nature of the operation, structural design of the facility, and accessibility of areas to personnel. The following placement criteria are acceptable.

(a) The number and distribution of units should be chosen such that each unit will be sufficiently near a work location as to permit increased accuracy in the extrapolation of dose to personnel.

(b) The fixed units should be placed such that there is as little extraneous intervening shielding and obstruction as possible between the units and the potential accident area.

(c) If there are unusual shielding situations affecting work areas near a potential accident location, additional fixed units should be provided. Care should be exercised to assure that these units are distributed in close proximity to actual work locations.

(d) Personnel dosimeters should be worn and should be capable of providing spectrum and flux information to aid in extrapolating dose from fixed units to location of personnel.

(e) Ease of recovery after a nuclear accident should be considered in placement of the fixed units. Careful consideration should be given to the need for remote retrieval mechanisms.

(f) Consideration should be given to the type and number of units procured in order to achieve economic and efficient use of the unit.

d. Quality Factors to be Applied in Determining Rem Exposure. The exposure standards specified in this chapter are expressed in terms of rem, which implies that the absorbed dose (expressed in rads) should be multiplied by an appropriate weight factor (quality factor). The quality factors to be used for determining neutron exposures from known energies are provided in Figures XI-3 and XI-4.

e. Guidance for Emergency Exposure During Rescue and Recovery Activities.

(1) Purpose. The emergency action guidance promulgated in this part provides instructions and background information for use in determining appropriate actions concerning the rescue and recovery of persons and the protection of health and property during periods of emergency.

(2) General Considerations.

(a) The problem of controlling exposure to radiation during rescue and recovery actions is extremely complex. Performing rescue and recovery operations requires the exercise of prompt judgment to take into account multiple hazards and alternate methods of accomplishment. Sound judgment and flexibility of action are crucial to the success of any type of emergency actions. Although the guiding principle is to minimize the risk of injury to those persons involved in the rescue and recovery activities, the control of radiation exposures should be consistent with the immediate objective of saving human life, the recovery of a deceased victim, and the protecting of health and saving of property.

(b) To preclude the possibility of unnecessarily restricting action that may be necessary to save lives, these instructions do not establish a rigid upper limit of exposure but rather leave judgment up to persons in charge of emergency operations to determine the amount of exposure that should be permitted to perform the emergency mission.

(c) The official in charge must carefully examine any proposed action involving further radiation exposure by weighing the risks of radiation insults, actual or potential, against the benefits to be gained. Exposure probability, biological consequences related to dose, and the number of people involved are the essential elements to be evaluated in making a risk determination.

Neutron Energy	$\overline{QF}$	Neutron Flux Density
MeV		$cm^{-2}\ s^{-1}$
2.5×10^{-8} (thermal)	2	680
1×10^{-7}	2	680
1×10^{-6}	2	560
1×10^{-5}	2	560
1×10^{-4}	2	580
1×10^{-3}	2	680
1×10^{-2}	2.5	700
1×10^{-1}	7.5	115
5×10^{-1}	11	27
1	11	19
2.5	9	20
5	8	16
7	7	17
10	6.5	17
14	7.5	12
20	8	11
40	7	10
60	5.5	11
1×10^{2}	4	14
2×10^{2}	3.5	13
3×10^{2}	3.5	11
4×10^{2}	3.5	10

FIGURE XI-3

Mean quality factors, $\overline{QF}$*, and values of neutron flux density which in a period of 40 hours results in a maximum dose equivalent of 100 mrem.

*Maximum value of QF in a 30-cm phantom.

Radiation Type	Rounded QF
X rays, gamma rays, electrons or positrons, Energy >0.03 MeV	1
Electrons or positrons, Energy <0.03 MeV	1
Neutrons, Energy <10keV	3
Neutrons, Energy >10keV	10
Protons	1-10*
Alpha particles	1-20
Fission fragments, recoil nuclei	20

*Use the higher value for round-off or calculate by the methods of ICRP Publication 4.

FIGURE XI-4
PRACTICAL QUALITY FACTORS

(d) These instructions recognize that accident situations involving the saving of lives will require separate criteria from those of actions required to recover deceased victims or to save property. In the latter instances, the amount of exposure expected to be received by persons should be controlled as much as possible within occupational limits.

(3) Emergency Situations. Specific dose criteria and judgment factors are set forth for the three categories of risk-benefit considerations, i.e., actions involving the saving of human life, the recovery of deceased victims, and the protection of health and property.

(a) Saving of Human Life.

1 Attempts to rescue victims of a nuclear incident should be regarded in the same context as any other emergency action involving the rescue of victims, regardless of the type of hazard involved.

2 If it is determined that an individual may be alive within the affected area, the course of action to be pursued should be determined by the person onsite having the emergency action responsibility.

3 Exposure projections shall be determined by the person onsite having the emergency action responsibility. Exposure guidance should be based on an immediate evaluation of the situation. The decision making process should consider:

a Evaluation of the inherent risks:

i The reliability of the prediction of radiation injury cannot be greater than the reliability of the estimation dose. Therefore, consideration should be given to limits of error associated with the specific instruments and techniques used to estimate the dose rate. This is especially crucial when the estimated dose approximates 100 rems or more.

ii The exposure expected in performing the action shall be weighed in terms of the effects of acute whole-body exposure and entry of radioactive material into the body.

iii Current assessment of the degree and nature of the hazard, and the capability of reducing inherent risk

from that hazard through appropriate mechanism such as the use of protective equipment, remote manipulation equipment, or similar means.

4 In the course of making a decision to perform the action, the risk to rescue personnel should be weighed against the probability of success of the rescue action.

5 Any rescue action that may involve substantial personal risk should be performed by volunteers, and each emergency worker shall be advised of the known or estimated extent of such risk prior to participation.

(b) Recovery of Deceased Victims.

1 Accident situations involving recovery of deceased victims require criteria separate from those for saving lives. Since the element of time is no longer a critical factor, the recovery of deceased victims should be well planned. The amount of radiation exposure received by persons in recovery operations shall be controlled within existing occupational exposure guides.

2 In those situations where victims are located in areas inaccessible because of high direct radiation fields, and where the recovery mission would result in exposure in excess of occupational exposure standards, special remote recovery devices should be used to retrieve the bodies.

3 In special circumstances where it is impossible to recover bodies without the entry of emergency workers into the area, the occupation exposure standards contained in this chapter may be exceeded. However, the planned exposures of an individual participating in the recovery should not exceed 12 rem total for the year or 5 (N-18), whichever is the more limiting.

(c) Protection of Health and Property. Where the risk of the radiation hazard either bears significantly on the state of health of people or may result in loss of property, and immediate remedial action is required, the following criteria apply:

1 When the person in charge of emergency action onsite deems it essential to reduce a hazard potential to acceptable levels or to prevent a substantial loss of property, a planned exposure up to, but not to exceed, 12 rem for the year may be received by the individuals participating in the operation. The person in charge of emergency action under special circumstances could waive these limits and permit volunteers to receive an exposure up to, but not to exceed, 25 rem.

2 Where the potential risk of radiation hazard is such that life would be in jeopardy, or that there would be severe effects on health of the public or loss of property inimical to the public safety, the criteria for saving human life shall apply.

f. Guidance on Maintaining Exposures to As Low As Reasonably Achievable.

(1) Introduction. Exposures to radiation shall be maintained as low as reasonably achievable and within the guidelines provided in paragraphs 4a and b. Assurance that worker and public exposures do not exceed the exposure guidelines (e.g., 3 rem per quarter, 5 rem per year for radiation workers) is, in itself, insufficient in that Department policy is that operations shall be conducted in a manner to assure that radiation exposure to individuals and population groups is limited to the lowest levels reasonably achievable. The guidelines contained herein suggest several factors to consider in each operation to assure compliance with Department policy. They are by no means exhaustive. The DOE publication, "A Guide to Reducing Radiation Exposures to As Low As Reasonably Achievable (ALARA)," DOE/EV/1830-T5, represents a more complete guidance on useful practices and potential areas of concern in satisfying this policy. To the extent feasible, the considerations outlined in this document shall be implemented to insure a comprehensive approach toward assuring that radiation exposure is maintained as low as reasonably achievable. Basic to following these guidelines is the premise that exposures can be maintained as low as reasonably achievable through considerations in the design or modification to a facility and equipment, reducing the errors in radiation exposure assessments through the application of state-of-the-art instrumentation maintenance and calibration, and by the institution of appropriate procedures and training.

(2) Considerations Toward Maintaining Radiation Exposures As Low As Reasonably Achievable. When applying the following guidelines, changes in processes or modifications to existing facilities should be considered on the merits of the specific case.

Vertical line denotes change.

(a) Facility Considerations.

1 Design.

a Exposure rates in work areas should be reduced as low as reasonably achievable by proper facility design and equipment layout. Design factors to consider are: occupancy time, source terms, spacing, processes, equipment, and shielding. Onsite personnel exposure levels less than one-fifth of the permissible dose equivalent limits prescribed in this chapter should be used as a design objective.

b Primary means for assuring protection should be through physical safeguards, e.g., remote handling, equipment, shielding, etc. Administrative controls should be regarded as secondary means.

c The general concept in the design facility for purposes of high level contamination confinement should be primary, secondary, and tertiary confinement. Primary confinement would be the process enclosures and their ventilation and air cleaning systems, secondary confinement would be the operating area compartments and their ventilation and air cleaning systems, and the tertiary confinement would be the structure and its ventilation and air cleaning systems.

d Compartmentalization should be provided to isolate high risk areas.

e Decommissioning requirements should be considered in the design of a facility. The avoidance of rough surfaces, cracks, and crevices in potential contamination areas should be considered in this context.

f The use of protective coating in radiation areas should comply with the specifications contained in American National Standards Institute Standard N512-1974, "Protective Coating for Nuclear Industry."

g Interior surfaces, as well as layout of ducts and pipes, should be designed to minimize buildup of contamination and exposure to personnel, and to facilitate cleanup.

h Equipment and components requiring frequent servicing should be located in areas free of radiation or in the lowest practicable radiation field.

i Ventilation systems should be designed to assure control of air contaminants. Redundant equipment should be provided in all exhaust systems servicing contaminated and potentially contaminated areas. The system should permit easy safe access for servicing.

j Air cleaning systems should be designed to reduce plant releases and minimize vulnerability to adverse conditions such as fire or explosion. The design should also permit in-place testing of both online and standby filter installations. These tests should be performed as recommended in American National Standards Institute Standard N510-1980, "Testing of Nuclear Air Cleaning Systems."

k Liquid waste systems should be designed to confine or reduce releases to the environment offsite and onsite.

l Personnel and equipment traffic patterns should be well defined so as to minimize the potential spread of contamination. Entrances and exits should be designed, posted, and controlled to minimize transient or casual exposure.

2 Operating Equipment.

a All operating equipment including enclosures, glove boxes, conveyors, hoods, ventilation, and air cleaning systems should be routinely inspected to assure optimum performance from the safety viewpoint.

b For those facilities involving glove box operations, the following guidance applies:

i Double ring ports should be required for all glove box gloves.

ii Equipment located in glove boxes should be designed for in-place maintenance.

iii The inner surface of a glove box should be designed to permit easy, efficient decontamination. Since contamination buildup in a glove box is a large contributor to worker exposure, a routine schedule for inspection and decontamination of glove boxes should be established.

iv Air cleaning should be provided at the glove box exhaust port.

c Valve packing and gaskets should be selected on the basis of achieving optimum performance in order to minimize leakage and spillage of radioactive materials.

3 Monitoring and Protective Equipment.

a Ambient air and exhaust monitoring systems including readout and preset alarms should be located to permit rapid monitoring of airborne releases. Monitors should be selected, tested, and calibrated in accordance with the general guidance contained in American National Standards Institute Standard N13.1, "Guide to Sampling Airborne Radioactive Materials in a Nuclear Facility."

b Portable instrumentation should be available as appropriate. Scheduled tests and calibration should comply with the specifications contained in American National Standards Institute Standard N13/42 WG4, "Radiation Protection Instrumentation and Calibration-Final."

c Inhalation and ingestion should be minimized by proper use of state-of-the-art respiratory protection. The respiratory program shall comply with guidance contained in American National Standards Institute Standard Z88.2, "Respiratory Protection."

d To achieve optimum accuracy, personnel dosimeters should comply with the performance parameters contained in American National Standards Institute Standard N13.5, "Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X and Gamma Radiation," American National Standards Institute Standard N13.7, "Film Badge Performance, " and

American National Standards Institute Standard N13/42 WG 1 Final Draft 1979, "TLD - A Standard for Performance."

e Radiation monitoring systems (e.g., area monitors, effluent monitors, etc.) should be appropriately selected, installed, tested, and calibrated following the recommendations contained in American National Standards Institute Standard N13.10-1974, "Specification and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents."

f Protection systems should be reliable and capable of being tested in situ. The design of critical systems such as alarm systems shall provide for redundancy and independence to assure (1) that no single failure results in the loss of the protection function, and (2) that removal from service of any component does not result in loss of the redundancy.

g The emergency warning systems should be designed to comply with the performance specifications contained in American National Standards Institute Standard N16.2, "Criticality Accident Alarm," and American National Standards Institute Standard N2.3, "Immediate Evacuation Signal for Use in Industrial Facilities Where Radiation Exposure May Occur."

4 Procedures.

a Records of exposure data, contamination surveys, airborne and internal exposure data should be evaluated to determine whether exposures are being maintained as low as reasonably achievable. Where appropriate, procedures should be used to maintain exposures as low as reasonably achievable.

b Total man-rems should be estimated for large tasks and a total man-rem dose established before initiating the job.

c Approximate radiation levels should be posted in work areas.

d Contamination control procedures should be established for all jobs where contamination may be present. Supervision should assure that workers follow proper procedures in order to maintain their exposures as low as reasonably achievable.

e Special tools and temporary shielding should be used where practicable to reduce radiation exposures.

f Tasks should be completed with the fewest people in the radiation field consistent with safe operations. Procedures should be established to assure there is effective use of personnel and that personnel are not idle in the radiation area.

g Where appropriate, time and motion studies should be conducted to assure that workers in radiation fields complete assigned tasks with the minimum time consistent with safe operations.

h Objectives should include reducing exposure rates in worker locations rather than instituting a system of worker rotation to minimize exposure to individuals. Emphasis should be placed on worker efficiency.

i Worker locations should be properly evaluated on a routine basis to determine whether sufficient effort has been expended to assure that exposures are maintained as low as reasonably achievable. In the case of glove box operations, this would include a determination that box contamination buildup is minimized, shielding is optimum, and workers complete their tasks within a reasonable time.

j Buffer area control points should be clearly established and contain appropriate equipment and clothing to permit proper contamination control. Maintaining proper supervision in the area is essential to maintaining exposure as low as reasonably achievable.

k Procedures should be instituted to review periodically the potential for and actual release of radioactivity to the environment in gaseous and liquid effluents.

(b) Radiation Safety Management.

1 Training.

a Worker safety training programs should be established and conducted at a sufficient frequency to familiarize the worker with the fundamentals of health physics and the proper procedures for maintaining exposures and

plant releases as low as reasonably achievable. Training programs should be on a continuing basis to enable training of replacement personnel as well as retraining to assure that personnel remain proficient, and should include a means to determine that the trainees have attained the necessary qualification status. A radiation safety training program should include but not be limited to:

i Principles of design operation and maintenance of the plant, project equipment, or experiment.

ii Potential problem areas from the radiological viewpoint.

iii Basic characteristics of radiation and contamination.

iv Methods (procedures, equipment) for exposure and contamination control.

v Basic understanding of biological dose and methods of assessment.

vi Emergency procedures and systems.

b Operations supervision should have a good understanding of the radiological characteristics and potential safety problem areas associated with their program including all the training elements covered under paragraph 4f(2)(b)1 a above. This would permit a proper assessment of the adequacy of controls instituted to maintain exposures as low as reasonably achievable.

g. Internal Audits

(1) Internal audits shall be conducted of the radiation control program.

(2) In conducting such audits, the guidelines set forth in DOE 5482.1 shall be used.

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

(See notes at end of attachment)

Element (atomic number)	Isotope,*		soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area† Column 1 Air (uCi/ml)	Table II Uncontrolled Area† Column 2 Water (uCi/ml)
Actinium (89)	Ac	227	S	2×10^{-12}	6×10^{-5}	8×10^{-14}	2×10^{-6}
			I	3×10^{-11}	9×10^{-3}	9×10^{-13}	3×10^{-4}
	Ac	228	S	8×10^{-8}	3×10^{-3}	3×10^{-9}	9×10^{-5}
			I	2×10^{-8}	3×10^{-3}	6×10^{-10}	9×10^{-5}
Americium (95)	Am	241	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
			I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am	242m	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
			I	3×10^{-10}	3×10^{-3}	9×10^{-12}	9×10^{-5}
	Am	242	S	4×10^{-8}	4×10^{-3}	1×10^{-9}	1×10^{-4}
			I	5×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Am	243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
			I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am	244	S	4×10^{-6}	1×10^{-1}	1×10^{-7}	5×10^{-3}
			I	2×10^{-5}	1×10^{-1}	8×10^{-7}	5×10^{-3}
Antimony (51)	Sb	122	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
			I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
	Sb	124	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
			I	2×10^{-8}	7×10^{-4}	7×10^{-10}	2×10^{-5}
	Sb	125	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	3×10^{-8}	3×10^{-3}	9×10^{-10}	1×10^{-4}
Argon (18)	A	37	Sub	3×10^{-3}		1×10^{-4}	
	A	41	Sub	2×10^{-6}		4×10^{-8}	
Arsenic (33)	As	73	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	5×10^{-4}
			I	4×10^{-7}	1×10^{-2}	1×10^{-8}	1×10^{-4}
	As	74	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
			I	1×10^{-7}	2×10^{-3}	4×10^{-9}	5×10^{-5}
	As	76	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
			I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	As	77	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
			I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Astatine (85)	At	211	S	4×10^{-9}	2×10^{-5}	2×10^{-10}	2×10^{-6}
			I	3×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
Barium (56)	Ba	131	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
			I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ba	140	S	1×10^{-7}	8×10^{-4}	4×10^{-9}	3×10^{-5}
			I	4×10^{-8}	7×10^{-4}	1×10^{-9}	2×10^{-5}

*"Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.

†These values apply to individuals in uncontrolled areas. One-third of these values will be used for a suitable sample of the population.

NOTE: $\mu Ci/ml \times 10^{12} = pCi/m^3$; $\mu Ci/ml \times 10^3 = Ci/l$.

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		soluble (S): insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Berkelium (97)	Bk	249	S	9×10^{-10}	2×10^{-2}	3×10^{-11}	6×10^{-4}
			I	1×10^{-7}	2×10^{-2}	4×10^{-9}	6×10^{-4}
	Bk	250	S	1×10^{-7}	6×10^{-3}	5×10^{-9}	2×10^{-4}
			I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Beryllium (4)	Be	7	S	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
			I	1×10^{-6}	5×10^{-2}	4×10^{-8}	2×10^{-3}
Bismuth (83)	Bi	206	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
			I	1×10^{-7}	1×10^{-3}	5×10^{-9}	4×10^{-5}
	Bi	207	S	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
			I	1×10^{-8}	2×10^{-3}	5×10^{-10}	6×10^{-5}
	Bi	210	S	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
			I	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Bi	212	S	1×10^{-7}	1×10^{-2}	3×10^{-9}	4×10^{-4}
			I	2×10^{-7}	1×10^{-2}	7×10^{-9}	4×10^{-4}
Bromine (35)	Br	82	S	1×10^{-6}	8×10^{-3}	4×10^{-8}	3×10^{-4}
			I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Cadmium (48)	Cd	109	S	5×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
			I	7×10^{-8}	5×10^{-3}	3×10^{-9}	2×10^{-4}
	Cd	115m	S	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
			I	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
	Cd	115	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
			I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Calcium (20)	Ca	45	S	3×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
			I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Ca	47	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
			I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
Californium (98)	Cf	249	S	2×10^{-12}	1×10^{-4}	5×10^{-14}	4×10^{-6}
			I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}
	Cf	250	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
			I	1×10^{-10}	7×10^{-4}	3×10^{-12}	3×10^{-5}
	Cf	251	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
			I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
	Cf	252	S	6×10^{-12}	2×10^{-4}	2×10^{-13}	7×10^{-5}
			I	3×10^{-11}	2×10^{-4}	1×10^{-12}	7×10^{-5}
	Cf	253	S	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
			I	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
	Cf	254	S	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}
			I	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}
Carbon (6)	C	14	S	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	(CO_2)		Sub	5×10^{-5}		1×10^{-6}	
Cerium (58)	Ce	141	S	4×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
			I	2×10^{-7}	3×10^{-3}	5×10^{-9}	9×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		Soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Cerium (58) Cont'd.	Ce	143	S	3×10^{-7}	1×10^{-3}	9×10^{-9}	4×10^{-5}
			I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	Ce	144	S	1×10^{-8}	3×10^{-4}	3×10^{-10}	1×10^{-5}
			I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Cesium (55)	Cs	131	S	1×10^{-5}	7×10^{-2}	4×10^{-7}	2×10^{-3}
			I	3×10^{-6}	3×10^{-2}	1×10^{-7}	9×10^{-4}
	Cs	134m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
			I	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Cs	134	S	4×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
			I	1×10^{-8}	1×10^{-3}	4×10^{-10}	4×10^{-5}
	Cs	135	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	9×10^{-8}	7×10^{-3}	3×10^{-9}	2×10^{-4}
	Cs	136	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
			I	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
	Cs	137	S	6×10^{-8}	4×10^{-4}	2×10^{-9}	2×10^{-5}
			I	1×10^{-8}	1×10^{-3}	5×10^{-10}	4×10^{-5}
Chlorine (17)	Cl	36	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
			I	2×10^{-8}	2×10^{-3}	8×10^{-10}	6×10^{-5}
	Cl	38	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
			I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
Chromium (24)	Cr	51	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
			I	2×10^{-6}	5×10^{-2}	8×10^{-8}	2×10^{-3}
Cobalt (27)	Co	57	S	3×10^{-6}	2×10^{-2}	1×10^{-7}	5×10^{-4}
			I	2×10^{-7}	1×10^{-2}	6×10^{-9}	4×10^{-4}
	Co	58m	S	2×10^{-5}	8×10^{-2}	6×10^{-7}	3×10^{-3}
			I	9×10^{-6}	6×10^{-2}	3×10^{-7}	2×10^{-3}
	Co	58	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	5×10^{-8}	3×10^{-3}	2×10^{-9}	9×10^{-5}
	Co	60	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
			I	9×10^{-9}	1×10^{-3}	3×10^{-10}	3×10^{-5}
Copper (29)	Cu	64	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
			I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Curium (96)	Cm	242	S	1×10^{-10}	7×10^{-4}	4×10^{-12}	2×10^{-5}
			I	2×10^{-10}	7×10^{-4}	6×10^{-12}	2×10^{-5}
	Cm	243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	5×10^{-6}
			I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}
	Cm	244a	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
			I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
	Cm	245	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
			I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Cm	246	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
			I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		Soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Curium (96) Cont'd.	Cm	247	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
			I	1×10^{-10}	6×10^{-4}	4×10^{-12}	2×10^{-5}
	Cm	248	S	6×10^{-13}	1×10^{-5}	2×10^{-14}	4×10^{-7}
			I	1×10^{-11}	4×10^{-5}	4×10^{-13}	1×10^{-6}
	Cm	249	S	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}
			I	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}
Dysprosium (66)	Dy	165	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
			I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
	Dy	166	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
			I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
Einsteinium (99)	Es	253	S	8×10^{-10}	7×10^{-4}	3×10^{-11}	2×10^{-5}
			I	6×10^{-10}	7×10^{-4}	2×10^{-11}	2×10^{-5}
	Es	254m	S	5×10^{-9}	8×10^{-4}	2×10^{-10}	2×10^{-5}
			I	6×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-5}
	Es	254	S	2×10^{-11}	4×10^{-4}	6×10^{-13}	1×10^{-5}
			I	1×10^{-10}	4×10^{-4}	4×10^{-12}	1×10^{-5}
	Es	255	S	5×10^{-10}	5×10^{-4}	2×10^{-11}	3×10^{-5}
			I	4×10^{-10}	8×10^{-4}	1×10^{-11}	3×10^{-5}
Erbium (68)	Er	169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
			I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	Er	171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Europium (63)	Eu	152	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	(T/2=9.2 hrs)		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Eu	152	S	1×10^{-6}	2×10^{-3}	4×10^{-10}	8×10^{-5}
	(T/2=13 yrs)		I	2×10^{-8}	2×10^{-3}	6×10^{-10}	8×10^{-5}
	Eu	154	S	4×10^{-9}	6×10^{-4}	1×10^{-10}	2×10^{-5}
			I	7×10^{-9}	6×10^{-4}	2×10^{-10}	2×10^{-5}
	Eu	155	S	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
			I	7×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
Fermium (100)	Fm	254	S	6×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
			I	7×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Fm	255	S	2×10^{-8}	1×10^{-3}	6×10^{-10}	3×10^{-5}
			I	1×10^{-8}	1×10^{-3}	4×10^{-10}	3×10^{-5}
	Fm	256	S	3×10^{-9}	3×10^{-5}	1×10^{-10}	9×10^{-7}
			I	2×10^{-9}	3×10^{-5}	6×10^{-11}	9×10^{-7}
Fluorine (9)	F	18	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
			I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
Gadolinium (64)	Gd	153	S	2×10^{-7}	6×10^{-3}	8×10^{-9}	2×10^{-4}
			I	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Gd	159	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
			I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope, soluble (S); insoluble (I)			Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Gallium (31)	Ga	72	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
			I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Germanium (32)	Ge	71	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
			I	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
Gold (79)	Au	196	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
			I	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
	Au	198	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
			I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Au	199	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
			I	8×10^{-7}	4×10^{-3}	3×10^{-8}	2×10^{-4}
Hafnium (72)	Hf	181	S	4×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
			I	7×10^{-8}	2×10^{-3}	3×10^{-9}	7×10^{-5}
Holmium (67)	Ho	166	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
			I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Hydrogen (1)	H	3	S	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
			I	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
			Sub	2×10^{-3}		4×10^{-5}	
Indium (49)	In	113m	S	8×10^{-6}	4×10^{-2}	3×10^{-7}	1×10^{-3}
			I	7×10^{-6}	4×10^{-2}	2×10^{-7}	1×10^{-3}
	In	114m	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
			I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
	In	115m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
			I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	In	115	S	2×10^{-7}	3×10^{-3}	9×10^{-9}	9×10^{-5}
			I	3×10^{-8}	3×10^{-3}	1×10^{-9}	9×10^{-5}
Iodine (53)*	I	125	S	3×10^{-9}	2×10^{-5}	8×10^{-11}	2×10^{-7}
			I	2×10^{-7}	6×10^{-3}	6×10^{-9}	2×10^{-4}
	I	126	S	4×10^{-9}	3×10^{-5}	9×10^{-11}	3×10^{-7}
			I	3×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	I	129	S	8×10^{-10}	5×10^{-6}	2×10^{-11}	6×10^{-8}
			I	7×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
	I	131	S	4×10^{-9}	3×10^{-5}	1×10^{-10}	3×10^{-7}
			I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	I	132	S	1×10^{-7}	8×10^{-4}	3×10^{-9}	8×10^{-6}
			I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	I	133	S	2×10^{-8}	1×10^{-4}	4×10^{-10}	1×10^{-6}
			I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}

*In the derivation of the concentration guides for soluble forms of iodine in Table II, a 2 gram thyroid (infants) and daily intakes of 3×10^{4} ml of air and 1×10^{3} ml of water (fluid water plus water contents of foods) assumed.

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		Isotope, soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Iodine (53) Cont'd.	I	134	S	3×10^{-7}	2×10^{-3}	6×10^{-9}	2×10^{-4}
			I	3×10^{-6}	2×10^{-2}	1×10^{-7}	6×10^{-4}
	I	135	S	5×10^{-8}	4×10^{-4}	1×10^{-9}	4×10^{-6}
			I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Iridium (77)	Ir	190	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
			I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ir	192	S	1×10^{-7}	1×10^{-3}	4×10^{-9}	4×10^{-5}
			I	3×10^{-8}	1×10^{-3}	9×10^{-10}	4×10^{-5}
	Ir	194	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
			I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
Iron (26)	Fe	55	S	9×10^{-7}	2×10^{-2}	3×10^{-8}	8×10^{-4}
			I	1×10^{-6}	7×10^{-2}	3×10^{-8}	2×10^{-3}
	Fe	59	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
			I	5×10^{-8}	2×10^{-3}	2×10^{-9}	5×10^{-5}
Krypton (36)	Kr	85m	Sub	6×10^{-6}		1×10^{-7}	
	Kr	85	Sub	1×10^{-5}		3×10^{-7}	
	Kr	87	Sub	1×10^{-6}		2×10^{-8}	
	Kr	88	Sub	1×10^{-6}		2×10^{-8}	
Lanthanum (57)	La	140	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
			I	1×10^{-7}	7×10^{-4}	4×10^{-9}	2×10^{-5}
Lead (82)	Pb	203	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
			I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	Pb	210	S	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-7}
			I	2×10^{-10}	5×10^{-3}	8×10^{-12}	2×10^{-4}
	Pb	212	S	2×10^{-8}	6×10^{-4}	6×10^{-10}	2×10^{-5}
			I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
Lutetium (71)	Lu	177	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Manganese (25)	Mn	52	S	2×10^{-7}	1×10^{-3}	7×10^{-9}	3×10^{-5}
			I	1×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Mn	54	S	4×10^{-7}	4×10^{-3}	1×10^{-8}	1×10^{-4}
			I	4×10^{-8}	3×10^{-3}	1×10^{-9}	1×10^{-4}
	Mn	56	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Mercury (80)	Hg	197m	S	7×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-4}
			I	8×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Hg	197	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
			I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
	Hg	203	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
			I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
Molybdenum (42)	Mo	99	S	7×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
			I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		soluble (S); insoluble (I)	Table I Controlled Area		Table II Uncontrolled Area	
				Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)	Column 1 Air (uCi/ml)	Column 2 Water (uCi/ml)
Neodymium (60)	Nd	144	S	8×10^{-11}	2×10^{-3}	3×10^{-12}	7×10^{-5}
			I	3×10^{-10}	2×10^{-3}	1×10^{-11}	8×10^{-5}
	Nd	147	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
			I	2×10^{-7}	2×10^{-3}	8×10^{-9}	6×10^{-5}
	Nd	149	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
			I	1×10^{-6}	8×10^{-3}	5×10^{-8}	3×10^{-4}
Neptunium (93)	Np	237	S	4×10^{-12}	9×10^{-5}	1×10^{-13}	3×10^{-6}
			I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	Np	239	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	7×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
Nickel (28)	Ni	59	S	5×10^{-7}	6×10^{-3}	2×10^{-8}	2×10^{-4}
			I	8×10^{-7}	6×10^{-2}	3×10^{-8}	2×10^{-3}
	Ni	63	S	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
			I	3×10^{-7}	2×10^{-2}	1×10^{-8}	7×10^{-4}
	Ni	65	S	9×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Niobium (Columbium) (41)	Nb	93m	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	4×10^{-4}
			I	2×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Nb	95	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	1×10^{-7}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Nb	97	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
			I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
Osmium (76)	Os	185	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
			I	5×10^{-8}	2×10^{-3}	2×10^{-9}	7×10^{-5}
	Os	191m	S	2×10^{-5}	7×10^{-2}	6×10^{-7}	3×10^{-3}
			I	9×10^{-6}	7×10^{-2}	3×10^{-7}	2×10^{-3}
	Os	191	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
			I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Os	193	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
			I	3×10^{-7}	2×10^{-3}	9×10^{-9}	5×10^{-5}
Palladium (46)	Pd	103	S	1×10^{-6}	1×10^{-2}	5×10^{-8}	3×10^{-4}
			I	7×10^{-7}	8×10^{-3}	3×10^{-8}	3×10^{-4}
	Pd	109	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
			I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Phosphorus (15)	P	32	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
			I	8×10^{-8}	7×10^{-4}	3×10^{-9}	2×10^{-5}
Platinum (78)	Pt	191	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Pt	193	S	1×10^{-4}	3×10^{-2}	9×10^{-3}	9×10^{-4}
			I	3×10^{-7}	5×10^{-2}	1×10^{-3}	2×10^{-3}
	Pt	193m	S	7×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
			I	5×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)		Isotope	Isotope, soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Platinum (78) Cont'd.	Pt	197m	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
			I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
	Pt	197	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Plutonium (94)	Pu	238	S	2×10^{-12}	1×10^{-4}	7×10^{-14}	5×10^{-6}
			I	3×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu	239	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
			I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu	240	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
			I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu	241	S	9×10^{-11}	7×10^{-3}	3×10^{-12}	2×10^{-4}
			I	4×10^{-8}	4×10^{-2}	1×10^{-9}	1×10^{-3}
	Pu	242	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
			I	4×10^{-11}	9×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu	243	S	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
			I	2×10^{-6}	1×10^{-2}	8×10^{-8}	3×10^{-4}
	Pu	244	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
			I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-5}
Polonium (84)	Po	210	S	5×10^{-10}	2×10^{-5}	2×10^{-11}	7×10^{-7}
			I	2×10^{-10}	8×10^{-4}	7×10^{-12}	3×10^{-5}
Potassium (19)	K	42	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
			I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Praseodymium (59)	Pr	142	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
			I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Pr	143	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
			I	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
Promethium (61)	Pm	147	S	6×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
			I	1×10^{-7}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Pm	149	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
			I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Protactinium (91)	Pa	230	S	2×10^{-9}	7×10^{-3}	6×10^{-11}	2×10^{-4}
			I	8×10^{-10}	7×10^{-3}	3×10^{-11}	2×10^{-4}
	Pa	231	S	1×10^{-12}	3×10^{-5}	4×10^{-14}	9×10^{-7}
			I	1×10^{-10}	8×10^{-4}	4×10^{-12}	2×10^{-5}
	Pa	233	S	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
			I	2×10^{-7}	3×10^{-3}	6×10^{-9}	1×10^{-4}
Radium (88)	Ra	223	S	2×10^{-9}	2×10^{-5}	6×10^{-11}	7×10^{-7}
			I	2×10^{-10}	1×10^{-4}	8×10^{-12}	4×10^{-6}
	Ra	224	S	5×10^{-9}	7×10^{-5}	2×10^{-10}	2×10^{-6}
			I	7×10^{-10}	2×10^{-4}	2×10^{-11}	5×10^{-6}
	Ra	226	S	3×10^{-11}	4×10^{-7}	3×10^{-12}	3×10^{-8}
			I	5×10^{-11}	9×10^{-4}	2×10^{-12}	3×10^{-5}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		Soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Radium (88) Cont'd.	Ra	228	S	7×10^{-11}	8×10^{-7}	2×10^{-12}	3×10^{-8}
			I	4×10^{-11}	7×10^{-4}	1×10^{-12}	3×10^{-5}
Radon (86)	Rn	220	S	3×10^{-7}		1×10^{-8}	
	Rn	222	S	1×10^{-7}		3×10^{-9}	
Rhenium (75)	Re	183	S	3×10^{-6}	2×10^{-2}	9×10^{-8}	6×10^{-4}
			I	2×10^{-7}	8×10^{-3}	5×10^{-9}	3×10^{-4}
	Re	186	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
			I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Re	187	S	4×10^{-6}	4×10^{-2}	3×10^{-7}	3×10^{-3}
			I	5×10^{-7}	4×10^{-2}	2×10^{-8}	2×10^{-3}
	Re	188	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
			I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Rhodium (45)	Rh	103m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
			I	6×10^{-5}	3×10^{-1}	2×10^{-6}	1×10^{-2}
	Rh	105	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Rubidium (37)	Rb	86	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
			I	7×10^{-8}	7×10^{-4}	2×10^{-9}	2×10^{-5}
	Rb	87	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	7×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Ruthenium (44)	Ru	97	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
			I	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
	Ru	103	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
			I	8×10^{-8}	2×10^{-3}	3×10^{-9}	8×10^{-5}
	Ru	105	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Ru	106	S	8×10^{-8}	4×10^{-4}	3×10^{-9}	1×10^{-5}
			I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Samarium (62)	Sm	147	S	7×10^{-11}	2×10^{-3}	2×10^{-12}	6×10^{-5}
			I	3×10^{-10}	2×10^{-3}	9×10^{-12}	7×10^{-5}
	Sm	151	S	6×10^{-8}	1×10^{-2}	2×10^{-9}	4×10^{-4}
			I	1×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Sm	153	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
			I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Scandium (21)	Sc	46	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
			I	2×10^{-8}	1×10^{-3}	8×10^{-10}	4×10^{-5}
	Sc	47	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
			I	5×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
	Sc	48	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
			I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Selenium (34)	Se	75	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
			I	1×10^{-7}	8×10^{-3}	4×10^{-9}	3×10^{-4}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)		Isotope,	soluble (S): insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Silicon (14)	Si	31	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
			I	1×10^{-6}	6×10^{-3}	3×10^{-8}	2×10^{-4}
Silver (47)	Ag	105	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	8×10^{-8}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Ag	110m	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
			I	1×10^{-8}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Ag	111	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
			I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Sodium (11)	Na	22	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
			I	9×10^{-9}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Na	24	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
			I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Strontium (38)	Sr	85m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
			I	3×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
	Sr	85	S	2×10^{-7}	3×10^{-3}	8×10^{-9}	1×10^{-4}
			I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Sr	89	S	3×10^{-8}	3×10^{-4}	3×10^{-10}	3×10^{-6}
			I	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Sr	90	S	1×10^{-9}	1×10^{-5}	3×10^{-11}	3×10^{-7}
			I	5×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Sr	91	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
			I	3×10^{-7}	1×10^{-3}	9×10^{-9}	5×10^{-5}
	Sr	92	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
			I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Sulfur (16)	S	35	S	3×10^{-7}	2×10^{-3}	9×10^{-9}	6×10^{-5}
			I	3×10^{-7}	8×10^{-3}	9×10^{-9}	3×10^{-4}
Tantalum (73)	Ta	182	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
			I	2×10^{-8}	1×10^{-3}	7×10^{-10}	4×10^{-5}
Technetium (43)	Tc	96m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
			I	3×10^{-5}	3×10^{-1}	1×10^{-6}	1×10^{-2}
	Tc	96	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Tc	97m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
			I	2×10^{-7}	5×10^{-3}	5×10^{-9}	2×10^{-4}
	Tc	97	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
			I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Tc	99m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
			I	1×10^{-5}	8×10^{-2}	5×10^{-7}	3×10^{-3}
	Tc	99	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
			I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Tellurium (52)	Te	125m	S	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
			I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		Soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Tellurium (52) Cont'd.	Te	127m	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
			I	4×10^{-8}	2×10^{-3}	1×10^{-9}	5×10^{-5}
	Te	127	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
			I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Te	129m	S	8×10^{-8}	1×10^{-3}	3×10^{-9}	3×10^{-5}
			I	3×10^{-8}	6×10^{-4}	1×10^{-9}	2×10^{-5}
	Te	129	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
			I	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	Te	131m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
			I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
	Te	132	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
			I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Terbium (65)	Tb	160	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-5}
			I	3×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
Thallium (81)	Tl	200	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
			I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Tl	201	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
			I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Tl	202	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
			I	2×10^{-7}	2×10^{-3}	8×10^{-9}	7×10^{-5}
	Tl	204	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	3×10^{-8}	2×10^{-3}	9×10^{-10}	6×10^{-5}
Thorium (90)	Th	227	S	3×10^{-10}	5×10^{-4}	1×10^{-11}	2×10^{-5}
			I	2×10^{-10}	5×10^{-4}	6×10^{-12}	2×10^{-5}
	Th	228	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
			I	6×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
	Th	230	S	2×10^{-12}	5×10^{-5}	8×10^{-14}	2×10^{-6}
			I	1×10^{-11}	9×10^{-4}	3×10^{-13}	3×10^{-5}
	Th	231	S	1×10^{-6}	7×10^{-3}	5×10^{-8}	2×10^{-4}
			I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Th	232	S	3×10^{-11}	5×10^{-5}	1×10^{-12}	2×10^{-6}
			I	3×10^{-11}	1×10^{-3}	1×10^{-12}	4×10^{-5}
	Th-natural*		S	3×10^{-11}	3×10^{-5}	1×10^{-12}	1×10^{-6}
			I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-5}
	Th	234	S	6×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
			I	3×10^{-8}	5×10^{-4}	1×10^{-9}	2×10^{-5}
Thulium (69)	Tm	170	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
			I	3×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}

*A curie of natural thorium means the sum of 3.7×10^{10} dis/sec from Th 232 plus 3.7×10^{10} dis/sec from Th 228. One curie of natural thorium is equivalent to 9,000 kilograms or 19,850 pounds of natural thorium.

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—Continued

(See notes at end of attachment)

Element (atomic number)	Isotope		Soluble (S); insoluble (I)	Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Thulium (69) Cont'd.	Tm	171	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	5×10^{-4}
			I	2×10^{-7}	1×10^{-2}	8×10^{-9}	5×10^{-4}
Tin (50)	Sn	113	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
			I	5×10^{-8}	2×10^{-3}	2×10^{-9}	8×10^{-5}
	Sn	125	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
			I	8×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Tungsten (Wolfram) (74)	W	181	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
			I	1×10^{-7}	1×10^{-2}	4×10^{-9}	3×10^{-4}
	W	185	S	8×10^{-7}	1×10^{-3}	3×10^{-8}	1×10^{-4}
			I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	W	187	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
			I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Uranium (92)	U	230	S	3×10^{-10}	7×10^{-5}	1×10^{-11}	2×10^{-6}
			I	1×10^{-10}	1×10^{-4}	4×10^{-12}	5×10^{-6}
	U	232	S	1×10^{-10}	2×10^{-5}	3×10^{-12}	8×10^{-7}
			I	3×10^{-11}	8×10^{-4}	9×10^{-13}	3×10^{-5}
	U	233	S	5×10^{-10}	1×10^{-4}	2×10^{-11}	4×10^{-6}
			I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U	234	S	6×10^{-10}	1×10^{-4}	2×10^{-11}	4×10^{-6}
			I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U	235	S	5×10^{-10}	1×10^{-4}	2×10^{-11}	4×10^{-6}
			I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	U	236	S	6×10^{-10}	1×10^{-4}	2×10^{-11}	5×10^{-6}
			I	1×10^{-10}	1×10^{-3}	4×10^{-12}	3×10^{-5}
	U	238	S	7×10^{-11}	2×10^{-5}	3×10^{-11}	6×10^{-7}
			I	1×10^{-10}	1×10^{-3}	5×10^{-12}	4×10^{-5}
	U	240	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
			I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
	U-natural*		S	7×10^{-11}	2×10^{-5}	3×10^{-12}	6×10^{-7}
			I	6×10^{-11}	5×10^{-4}	2×10^{-12}	2×10^{-5}
Vanadium (23)	V	48	S	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
			I	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
Xenon (54)	Xe	131m	Sub	2×10^{-5}		4×10^{-7}	
	Xe	133	Sub	1×10^{-5}		3×10^{-7}	
	Xe	133m	Sub	1×10^{-5}		3×10^{-7}	
	Xe	135	Sub	4×10^{-6}		1×10^{-7}	
Ytterbium (70)	Yb	175	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
			I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}

*A curie of natural uranium means the sum of 3.7×10^{10} disintegrations per second from U 238 plus 3.7×10^{10} dis/sec from U 234 plus 1.7×10^{9} dis/sec from U 235. One curie of natural uranium is equivalent to 3,000 kilograms or 6,615 pounds of natural uranium.

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND –Continued

(See notes at end of attachment)

Element (atomic number)		Isotope, soluble (S); insoluble (I)		Table I Controlled Area Column 1 Air (uCi/ml)	Table I Controlled Area Column 2 Water (uCi/ml)	Table II Uncontrolled Area Column 1 Air (uCi/ml)	Table II Uncontrolled Area Column 2 Water (uCi/ml)
Yttrium (39)	Y	90	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
			I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	Y	91m	S	2×10^{-5}	1×10^{-1}	8×10^{-7}	3×10^{-3}
			I	2×10^{-5}	1×10^{-1}	6×10^{-7}	3×10^{-3}
	Y	91	S	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
			I	3×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Y	92	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
			I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Y	93	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
			I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Zinc (30)	Zn	65	S	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
			I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
	Zn	69m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
			I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Zn	69	S	7×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
			I	9×10^{-6}	5×10^{-2}	3×10^{-7}	2×10^{-3}
Zirconium (40)	Zr	93	S	1×10^{-7}	2×10^{-2}	4×10^{-9}	8×10^{-4}
			I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Zr	95	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	6×10^{-5}
			I	3×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
	Zr	97	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
			I	9×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.			Sub	1×10^{-6}		3×10^{-8}	
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.				3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}
Any single radionuclide not listed above which decays by alpha emission or spontaneous fission.				6×10^{-13}	4×10^{-7}	2×10^{-14}	3×10^{-8}

NOTE: In any case where there is a mixture in air or water of more than one radionuclide, the guide values, for purposes of this attachment, should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the guide otherwise established in this attachment for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture will not exceed "1" (i.e., "unity").

   EXAMPLE: If radionuclides A, B, and C are present in concentrations C_A, C_B, and C_C, and if the applicable CGs are CG_A, CG_B, and CG_C, respectively, then the concentrations should be limited so that the following relationship exists:

$$\frac{C_A}{CG_A} + \frac{C_B}{CG_B} + \frac{C_C}{CG_C} \leq 1$$

2. If either the identiy or the concentration of any radionuclide in the mixture is not known, the guide values for purposes of this attachment will be:

   a. For purposes of Table I, Col. 1, 6×10^{-13}

   b. For purposes of Table I, Col. 2, 4×10^{-7}

   c. For purposes of Table II, Col. 1, 2×10^{-14}

   d. For purposes of Table II, Col. 2, 3×10^{-8}

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in 2., above.

   a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration guide for the mixture is the guide specified in this attachment for the radionuclide in the mixture having the lowest concentration guide, or

   b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this attachment are not present in the mixture, the concentration guide for the mixture is the lowest concentration guide specified in this attachment for any radionuclide which is not known to be absent from the mixture, or

c

Element (atomic number) and isotope	Table I Controlled Area Column 1 Air (μCi/ml)	Table I Controlled Area Column 2 Water (μCi/ml)	Table II Uncontrolled Area Column 1 Air (μCi/ml)	Table II Uncontrolled Area Column 2 Water (μCi/ml)
If it is known that Sr 90, I 125, I 126, I 129, I 131 (I 133, Table II only) Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227 Ra 228, Th 230, Pa 231, Th 232, Th-nat, Cm 248, Cf 254, and Fm 256 are not present		9×10^{-8}		3×10^{-9}
If it is known that Sr 90, I 125, I 126, I 129 (I 131, I 133, Table II only) Pb 210, Po 210, Ra 223, Ra 226, Ra 228, Pa 231, Th-nat, Cm 248, Cf 254, and Fm 256 are not present		6×10^{-8}		2×10^{-9}
If it is known that Sr 90, I 129 (I 125, I 126, I 131, Table II only) Pb 210, Ra 226, Ra 228, Cm 248, and Cf 254 are not present		2×10^{-8}		6×10^{-10}
If it is known that (I 129, Table II only) Ra 226 and Ra 228 are not present		3×10^{-6}		1×10^{-7}
If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not present	3×10^{-9}		1×10^{-10}	
If it is known that alpha-emitters and Pb-210, Ac 227, Ra 228, and Pu 241 are not present	3×10^{-10}		1×10^{-11}	
If it is known that alpha-emitters and Ac 227 are not present	3×10^{-11}		1×10^{-12}	
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 248, Cf 249, and Cf 251 are not present	3×10^{-12}		1×10^{-13}	

4. If the mixture of radionuclides consists of uranium and its daughter products in ore dust prior to chemical processing of the uranium ore, the values specified below may be used in lieu of those determined in accordance with 1., above, or those specified in 2. and 3., above.

   a. For purposes of Table 1, Col. 1, 1×10^{-10} μCi/ml gross alpha activity; or 2.5×10^{-11} μCi/ml natural uranium; or 75 micrograms per cubic meter of natural uranium in air.

   b. For purposes of Table II, Col. 1, 3×10^{-12} μCi/ml gross alpha activity; or 8×10^{-13} μCi/ml natural uranium; or 3 micrograms per cubic meter of natural uranium in air.

5. For purposes of this note, a radionuclide may be considered as not present in a mixure if (a) the ratio of the concentration of that radionuclide in the mixture (C_A) to the concentration guide for that radionuclide specified in Table II of this annex (CG_A) does not exceed 1/10, i.e.,

$$\frac{C_A}{CG_A} \leq \frac{1}{10}$$

and (b) the sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed 1/4, i.e.,

$$\frac{C_A}{CG_A} + \frac{C_B}{CG_B} + \ldots \leq \frac{1}{4}$$

6. Conversion from μCi/cc to pCi/m^3 for air and pCi/l for water are as follows:

   a. Air-μCi/cc x 10^{12} = pCi/m^3

   b. Water-μCi/cc x 10^9 = pCi/l

7. Concentrations may be derived for unlisted radionuclides provided yearly dose limits in paragraph 6b(1) of this chapter and paragraph 6a(1) are used and the methods are consistent with those recommended by the Federal Radiation Council, National Council on Radiological Protection, and International Commission on Radiological Protection.

CHAPTER XII
PREVENTION, CONTROL, AND ABATEMENT OF ENVIRONMENTAL POLLUTION

1. PURPOSE. This chapter establishes requirements for Department of Energy operations to assure:

   a. Control of sources of environmental pollution.

   b. Compliance with Federal environmental protection laws and with Executive Order 12088.

2. REFERENCES.

   a. Executive Order 11870, Environmental Safeguards on Activities for Animal Damage Control on Federal Lands.

   b. Executive Order 12088, Federal Compliance with Pollution Control Standards.

   c. Reporting of Pollution Abatement Projects.

      (1) Office of Management and Budget Circular A-106, Reporting Requirements in Connection with the Prevention, Control, and Abatement of Environmental Pollution at Existing Federal Facilities.

      (2) Environmental Protection Agency Procedures for Reporting Pollution Abatement Projects for Federal Facilities.

3. RESPONSIBILITIES AND AUTHORITIES.

   a. The Director, Operational and Environmental Safety Division.

      (1) Coordinates Department of Energy operational environmental protection activities with other Federal, state, and regional agencies and authorities (e.g., Congress, the Office of Management and Budget, the Environmental Protection Agency).

      (2) Collects and evaluates information concerning Department of Energy operations affecting environmental quality.

      (3) Prepares Department of Energy pollution abatement plans and progress reports for submission to the Director of the Office of Management and Budget and the Administrator of the Environmental Protection Agency in accordance with the provisions of the Office of Management and Budget Circular A-106.

(4) Reports to the Council on Environmental Quality on Department of Energy pesticide use as requested.

b. Heads of Line Organizations.

(1) In accordance with the provisions of Executive Order 12088, submit to the Director, Operational and Environmental Safety Division, pollution abatement plans which provide for improvement in existing Department operations to meet applicable standards (see paragraph 5 below for details regarding the submission and content of the plans). Copies of the plans shall be sent to the appropriate Headquarters program division or office.

(2) Coordinates activities with regional, state, or local pollution control authorities.

(3) Advise the Director, Operational and Environmental Safety Division, promptly of any instructions, standards, or requirements issued or actions taken by regional, state, or local pollution control authorities that are likely to affect Department operations, including construction activities. (Copies of pertinent material or correspondence shall also be sent to the appropriate Headquarters program division or office).

4. REQUIREMENTS. Environmental protection requirements for Department operations include:

a. Performance of the design, development, construction, operation, surveillance, and maintenance of Department of Energy facilities and activities to assure protection of the public and the environment, and compliance with Executive Order 12088, and all applicable Federal, state, and local pollution control standards and requirements established pursuant to the environmental protection statutes referred to in Section 1-102 of the Executive Order.

b. Submission of pollution abatement plans (see paragraph 5 below) for projects necessary to upgrade existing Department operations to achieve compliance with applicable pollution control standards and requirements referred to in Section 1-102 of Executive Order 12088.

c. Cooperation with Environmental Protection Agency and state, interstate, and local agencies in the prevention, control, and abatement of environmental pollution in accordance with the requirements of Section 1-2 of Executive Order 12088.

d. Assurance that pest control programs for Department operations are conducted safely and in accordance with the requirements of Executive Order 11870, Environmental Safeguards on Activities for Animal Damage Control on Federal Lands, and the Federal Insecticide, Fungicide, and Rodenticide Act, as amended.

e. Control of use, storage, and handling of potential pollutants (e.g., solid fuels, flyash, petroleum products, chemicals, and biological agents) to avoid or to minimize the possibility of their accidental release and resultant damage to the environment. This includes appropriate preventive measures to entrap spillage or unplanned releases and emergency plans and procedures for containing, diverting, removing, or otherwise dealing with accidental pollution.

f. Control of radioactivity discharged to the environment to as low as reasonably achievable levels in accordance with Chapter XI of this Order, and with policies and guidance of the Federal Radiation Council and Environmental Protection Agency as referred to in Section 1-102(g) of Executive Order 12088.

g. Adherence to the procedures referred to in Section 1-7 of Executive Order 12088, for obtaining Presidential exemptions from applicable pollution control standards.

5. POLLUTION ABATEMENT PROJECTS. This paragraph specifies the instructions to be followed by Department of Energy line organizations in implementing the requirements, standards, and guidelines cited in this chapter.

a. Existing Department operations shall be upgraded as necessary to meet the requirements of Section 1-102 of Executive Order 12088. Pollution abatement projects shall be included in a fiscal plan in accordance with the requirements of Section 1-401 of Executive Order 12088 and any Office of Management and Budget instructions issued pursuant thereto, currently, Office of Management and Budget Circular A-106, and Environmental Protection Agency Procedures for Reporting Proposed Pollution Abatement Projects for Federal Facilities. In order that the Department of Energy plan may be prepared by Headquarters and submitted to the Administrator, Environmental Protection Agency by the dates specified, line organizations shall submit their reports semiannually on November 1 and May 1 pursuant to Office of Management and Budget Circular No. A-106 to the Director, Operational and Environmental Safety Division with copies to the program division or office responsible for funding the proposed projects. Negative reports are to be submitted by line organizations in those instances where there are no pollution abatement projects planned or underway.

b. Budget requests for design and construction shall include the funds necessary to comply with the environmental pollution control standards and requirements in paragraph 4 above.

c. Department of Energy operations shall develop and implement a pesticide program in accordance with the requirements set forth in the Federal Insecticide, Fungicide and Rodenticide Act, as amended, and Executive Order 11870.

d. Where differences arise regarding regional, state or local pollution control requirements or standards, line organizations shall initially seek to resolve such differences with the regional, state, or local agencies directly concerned. Assistance of the appropriate Environmental Protection Agency regional office may also be sought wnere their consultation or guidance may be helpful in resolving such questions. In the event differences of opinion as to the interpretation and application of such standards and requirements cannot be resolved satisfactorily, the facts, and the approach recommended by the line organization shall be forwarded to the Operational and Environmental Safety Division for action with a copy to the appropriate Headquarters program division or office.

e. Any request for a Presidential exemption shall comply with the limitations prescribed in Section 1-701 of Executive Order 12088. The request should be forwarded to the Director, Operational and Environmental Safety Division, with copies to the appropriate Headquarters program division or office and the Office of the General Counsel. Recommendations for Presidential exemptions will be developed by the line organization and transmitted to the Office of Management and Budget under the Secretary's signature in accordance with Office of Management and Budget guidance to be issued in this regard.

*U.S. GOVERNMENT PRINTING OFFICE: 1980-0-341-777/306

CHAPTER XIII

AVIATION SAFETY

1. PURPOSE. This chapter provides guidance and establishes procedures to assure that Department of Energy and Department of Energy Contractor aviation operations are conducted in the safest manner possible, and that, to the extent possible, passenger and hazardous cargo air carrying operations maintain a level of safety equivalent to that attained by United States air carriers operating under 14 CFR 121.

2. REFERENCES.

   a. Federal Aviation Administration Publication AC/150/5390-1 series, "Heliport Design Guide."

   b. Code of Federal Regulations.

      (1) 14 CFR 121, "Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft."

      (2) 14 CFR 135, "Air Taxi Operators and Commercial Operators."

      (3) 14 CFR 139, "Certification and Operations: Land Airports Serving CAB - Certificated Air Carriers."

      (4) 41 CFR 109, "Public Contracts and Property Management - Department of Energy."

      (5) 49 CFR 175, "Carriage by Aircraft."

3. DEFINITIONS.

   a. Aircraft. A device that is used or intended to be used for flight in the air, including heavier than air and lighter than air aircraft, airplanes, gliders, helicopters, rigid and nonrigid airships, and balloons.

   b. Aircraft Accident. An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all persons have disembarked and in which any person suffers death or serious injury as a result of being in or upon the aircraft or anything attached thereto, or in which the aircraft receives substantial damage.

   c. Aircraft Incident. Any deviation from the normal, planned, or expected aviation operation, if the deviation has adverse safety, health, or environmental effects or potential effects and is not classified as an accident.

d. Airport. An area of land or water that is used or intended to be used for the landing and takeoff of aircraft, including its buildings and facilities, if any.

e. Aviation Operations. Any operations of aircraft or airports, or the provision of any aviation support services thereto.

f. Charter Operations. The carrying in air commerce of any persons or property for compensation or hire, and the use of special mission aircraft.

g. Civil Aircraft. All aircraft other than public aircraft.

h. Flight Crewmember. A person assigned to perform flight duties or Department of Energy mission duties in an aircraft during flight time.

i. Ground Crew. All personnel assigned to aviation operations other than flight crewmembers and administrative personnel.

j. Heliport. An area, either at ground level or elevated on a structure, that is used for the landing and takeoff of helicopters.

k. Helipad. A minimum facility heliport without such auxiliary facilities as waiting room, hangar, parking, fueling, and maintenance.

l. Modern Aircraft. Aircraft whose performance capabilities, age, and ease of maintenance meet current state-of-the-art and technology for the type aircraft involved.

m. Passengers. Occupants of aircraft who do not have assigned flight duties or other duties related to the mission to which the aircraft is assigned.

n. Public Aircraft. Aircraft used only in the service of a government or political subdivision. This does not include any government-owned aircraft engaged in carrying persons or property for commercial purposes.

4. RESPONSIBILITIES AND AUTHORITIES

a. The Director, Operational and Environmental Safety Division:

(1) Functions as the principal advisor on aviation safety management and related technical matters to all Headquarters and field organizations with responsibility for aviation operations, and serves as the central point for coordination of aviation safety matters.

(2) Coordinates requests for the services of Department of Energy aviation consultants.

b. The Director of Administration. Functions as the responsible Headquarters Office for the overview of Federal aviation operations.

c. Heads of Line Organizations.

(1) May utilize sources of aviation safety advice, guidance, or review other than the Department of Energy aviation safety consultants. However, in the interest of an integrated, effective, and uniform approach to aviation safety matters, responsible Headquarters and field office authorities are urged to make maximum use of the services of the Department of Energy aviation safety consultants. Requests for the services of Department of Energy aviation consultants shall be forwarded to the Director, Operational and Environmental Safety Division for approval.

(2) May, in emergency situations, contact the Department of Energy aviation safety consultants directly for advice or assistance that is judged to be urgently needed. The Director, Operational and Environmental Safety Division, shall then be notified as soon as possible.

(3) On a timely basis, heads of field organizations shall provide the Director, Operational and Environmental Safety Division, with a summary of key findings, conclusions, and recommendations of aviation safety evaluations, reviews, periodic appraisals, reviews of planned aviation programs or activities, and aircraft accident and incident investigations conducted by the Department of Energy aviation safety consultants, together with their own comments and proposed actions. Copies of the above shall be provided by heads of field organizations directly to the responsible program office, and to the Director of Administration for Federal aviation operations.

5. REQUIREMENTS.

a. Aviation Operations Manuals.

(1) Organizations with direct responsibility for aviation operations shall prepare, promulgate, and keep current, manuals for the training, qualification, use, and guidance of flight, maintenance, ground, and management personnel in conducting aviation operations.

(2) The manuals shall be prepared in sections, e.g., aviation safety management, flight operations, aircraft and engine maintenance, airport operations, training, etc., and shall contain instruction, information, and description of equipment and facilities in such a manner and in sufficient detail to enable the personnel concerned to perform their duties and responsibilities with a high degree of quality and safety.

(3) 14 CFR 121.135, 135.21, and 135.23 shall be used as a guide to the preparation of aviation operation manuals, and 14 CFR 139.39 shall be used as a guide to the preparation of airport operation manuals.

(4) The manuals shall detail the management and operational plans, methods, procedures, and practices to be used to accomplish the requirements of this chapter.

b. Passenger and Classified or Hazardous Cargo Carrying Operations.

(1) Civil Aircraft. Civil aircraft that carry passengers, or classified or hazardous cargo, shall meet, as a minimum, the standards and requirements of 49 CFR 175, 14 CFR 135, and to the extent possible, 14 CFR 121.

(2) Public Aircraft. Public aircraft that carry passengers, or classified or hazardous cargo, shall meet the levels of safety prescribed by 14 CFR 121, to the extent possible. Heads of Field Organizations are responsible for making the determination of the extent to which it is possible to comply after consultation with the Director, Operational and Environmental Safety Division. The following minimum requirements shall be met:

(a) Modern aircraft, multiengined, shall be utilized.

(b) Flight crew shall include a minimum of two qualified pilots.

(c) Pilots-in-command shall hold valid Airline Transport Pilot ratings.

(d) Training programs shall meet, to the extent possible, the requirements of 14 CFR 121 for large aircraft (gross weight of 12,500 lbs. or greater) and 14 CFR 135 for small aircraft (gross weight under 12,500 lbs.) for both flight and ground personnel.

(e) All aircraft, except military aircraft, shall be certified by the Federal Aviation Administration.

(f) Certain special safety requirements may be necessary for air shipments of radioactive cargo and other special cargo.

(3) Any Aircraft Operating Under 49 CFR 175 Exemption shall not be used to carry passengers.

c. Private Aircraft Operations.

(1) The elective use of private aircraft for official travel by Department of Energy and Department of Energy contractor and subcontractor personnel does not come under the purview of this chapter.

(2) In granting permission for the use of Department of Energy aviation and airport facilities and services to private or other government aircraft operators, responsible Headquarters and field organization officials shall assure that such operations do not compromise the safety of Department of Energy and Department of Energy contractor personnel, Department of Energy facilities, the related general environment and general public, or the intent of this chapter.

d. Charter Operations.

(1) The use of charter operations by responsible Headquarters and field organization officials, or contractor officials, to whom proper authority has been delegated, shall require:

(a) That the use of such operations is necessary to meet the programmatic requirements, and

(b) The selection of the charter contractor that best meets the standards and requirements of paragraph b, above.

(2) In the selection of charter operators, the following criteria shall be carefully followed:

(a) Operator-owned aircraft, not leased aircraft, shall be used whenever possible;

(b) The pilots shall be full-time employees of the operator;

(c) Pilots shall have logged a minimum of 10 hours of flight time in the preceding 6 months in the make and model of aircraft to be flown;

(d) The charter operator and pilots shall be fully certified for the type of aircraft to be used;

(e) The charter operator shall have full control over the aircraft maintenance program;

(f) Aircraft shall be fully equipped and the pilot shall be certified for instrument flight;

(g) The copilot, when one is required, shall be instrument rated;

(h) The charter operator shall provide a suitable flight and ground crew training program for the safe handling of the types of materials and cargo to be transported; and

(i) The charter operator shall have the ability to secure any necessary exemption permits from the Federal Aviation Administration.

e. Aviation Contracts.

In the requirements development phase of contracts or agreements for the acquisition of specific aircraft by type, the responsible program director or field office manager shall coordinate with the Director, Operational and Environmental Safety Division at Department of Energy Headquarters, to assure that the selected aircraft type can perform mission requirements safely and meet the safety standards of this chapter. Contracts developed at field organizations for aviation support of assigned programs shall be coordinated with field organization safety divisions. Such contracts shall include requirements for preparation and maintenance of the aviation safety standards intended in this chapter including the requirements for maintaining current manuals for aviation safety management encompassing flight operations, aircraft maintenance, and administrative management.

f. Department of Energy Airports.

(1) Current manuals shall be maintained by responsible Department of Energy offices, contractors, or subcontractors governing the management and usage of airports, heliports, or landing strips under their jurisdiction.

(2) For the planning and operations of heliports and helipads, the Federal Aviation Administration publication AC 150/5390-1 Series, "Heliport Design Guide," shall be used as a guide.

(3) For the planning and operations of airports and landing strips to be used for fixed wing aircraft, including large aircraft and aircraft involved in passenger and classified or hazardous cargo carrying operations, 14 CFR 139 shall be used as a guide.

(4) Because of the varied and unique Department of Energy mission requirements, the adequacy of specific airport design and operational factors will be determined through the onsite appraisal process. Specific design and operational factors shall be included in the applicable airport operations manual to ensure that aviation operations are conducted in a manner consistent with applicable Federal, State, and local aviation safety regulations.

g. Surveillance.

(1) Cognizant organizations shall conduct continuing surveillance of all aviation operations and activities in accordance with Order DOE 5482.1.

(2) All Department of Energy and Department of Energy contractor aviation accidents and incidents shall be reported per Order DOE 5484.1 together with the corrective and followup actions taken.