

Draft Site-Wide Environmental Impact Statement for the Oak Ridge Y-12 Plant

December 2000

**Draft Site-Wide Environmental Impact
Statement for the Oak Ridge Y-12 Plant**

Volume I

Volume I

U.S.
Department
of
Energy



U.S. Department of Energy
Oak Ridge Operations Office

DOE/EIS-0309

**Draft Site-Wide
Environmental Impact Statement
for the Oak Ridge
Y-12 Plant**

Volume I

United States Department of Energy

December 2000

COVER SHEET

Responsible Agency: United States Department of Energy

Title: Draft Site-Wide Environmental Impact Statement for the Oak Ridge Y-12 Plant, Anderson County, Tennessee

Contact: For additional information on the Draft Site-Wide Environmental Impact Statement, write or call:

Gary S. Hartman
U.S. Department of Energy
Oak Ridge Operations Office
Post Office Box 2001
Oak Ridge, Tennessee 37831
Attention: Y-12 SWEIS
Telephone: (865) 576-0273

For general information on the DOE *National Environmental Policy Act* (NEPA) process, write or call:

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance
(EH-42)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
Telephone: (202) 586-4600,
or leave a message at (800) 472-2756

Abstract: The U.S. Department of Energy (DOE) is responsible for providing the Nation with nuclear weapons and ensuring that those nuclear weapons remain safe, secure, and reliable. As one of the DOE major production facilities, the Oak Ridge Y-12 Plant has been DOE's primary site for enriched uranium processing and storage, and one of the manufacturing facilities for maintaining the U.S. nuclear weapons stockpile. In response to the end of the Cold War and changes in the world's political regimes, the emphasis of the U.S. weapons program has shifted dramatically over the past few years from developing and producing new weapons to dismantlement and maintenance of a smaller, enduring stockpile. The *Stockpile Stewardship and Management Programmatic Environmental Impact Statement* [SSM PEIS], DOE/EIS-0236, issued in September 1996, evaluated alternatives for maintaining the safety and reliability of the nuclear weapons stockpile without underground nuclear testing or production of new-design weapons.

In the SSM PEIS Record of Decision (ROD), DOE decided to maintain the national security missions at the Y-12 Plant, but to downsize the Plant consistent with reduced requirements. These national security missions include (1) maintaining the capability and capacity to fabricate secondaries, limited life components, and case parts for nuclear response; (2) evaluating components and subsystems returned from the stockpile; (3) storing enriched uranium that is designated for national security purposes; (4) storing depleted uranium and lithium parts; (5) dismantling nuclear weapons secondaries returned from the stockpile; (6) processing uranium and lithium (which includes chemical recovery, purification, and conversion of enriched uranium and lithium to a form suitable for long-term storage and/or further use); and (7) providing support to weapons laboratories.

During the same time period as the SSM PEIS, DOE also prepared the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement* [S&D PEIS], DOE/EIS-0229, which was issued in December 1996. This S&D PEIS evaluated alternatives for the long-term storage of fissile material. In the S&D PEIS ROD, DOE decided that Y-12 would also store surplus enriched uranium pending disposition.

This Site-Wide Environmental Impact Statement (SWEIS) analyzes impacts for the overall Oak Ridge Y-12 Plant mission (No Action - Status Quo and No Action - Planning Basis Operations), and the proposed construction of new facilities for two of Y-12's mission components (i.e., Highly Enriched Uranium [HEU] Storage Mission and the Special Materials Mission). Options considered for storage include a new HEU Materials Facility at one of two candidate sites, and expansion of Building 9215. Three candidate sites are analyzed for a new Special Materials Complex for the Special Materials Mission at Y-12. DOE's preferred alternative (Alternative 4) is to construct and operate a new HEU Materials Facility and a new Special Materials Complex at Y-12. DOE has not yet identified a preferred site for these new facilities.

Included in the SWEIS is an evaluation of impacts on land uses, transportation, socioeconomics, geology and soils, hydrology, biological resources, air quality/noise, site facilities and support activities, waste management, and cultural resources. In addition, environmental justice, and radiological and hazardous chemical impacts during normal operations, and accidents to workers and the public are included in the assessment.

Public Comments: In preparing the Draft SWEIS, DOE considered comments received by mail or fax, submitted at scoping meetings, and transmitted via the Internet. The public comment period on the Draft SWEIS extends through February 5, 2001.

TABLE OF CONTENTS

Cover Sheet	
Table of Contents	i
List of Figures	ix
List of Tables	xi
Acronyms and Abbreviations	xv
Chemicals and Units of Measure	xviii
Conversion Chart	xxi
Metric Prefixes	xxii
CHAPTER 1: INTRODUCTION	1-1
1.1 Background/Overview	1-1
1.1.1 General	1-1
1.1.2 Stockpile Management Restructuring Initiative	1-3
1.1.3 Y-12 Site Integrated Modernization Program	1-3
1.1.4 Proposed Action and Scope	1-5
1.2 Alternatives Analyzed	1-8
1.3 Laws and Regulations and <i>National Environmental Policy Act</i> Strategy	1-10
1.4 Relationship of This Environmental Impact Statement with Other <i>National Environmental Policy Act</i> Reviews	1-11
1.4.1 Programmatic <i>National Environmental Policy Act</i> Reviews	1-11
1.4.2 Project-Specific <i>National Environmental Policy Act</i> Reviews	1-13
1.4.3 Oak Ridge Reservation <i>National Environmental Policy Act</i> Reviews	1-14
1.4.4 Other Documents	1-15
1.5 Time Period Considered in Analysis	1-16
1.6 Issue Identification Process	1-16
1.7 Results of Public Scoping	1-17
1.7.1 Major Scoping Comments	1-17
1.8 Organization of This Site-Wide Environmental Impact Statement	1-19
CHAPTER 2: PURPOSE OF AND NEED FOR U.S. DEPARTMENT OF ENERGY ACTION	2-1
2.1 Purpose and Need	2-1
2.2 U.S. Department of Energy Program Activities Performed at the Y-12 Site	2-2
2.2.1 Defense Programs	2-2
2.2.2 Environmental Management Programs	2-6
2.2.2.1 Waste Management	2-6
2.2.2.2 Environmental Restoration	2-6
2.2.3 Nuclear Nonproliferation and National Security	2-7
2.2.4 Nuclear Energy	2-7
2.2.5 Nondefense Research and Development Program	2-7
2.2.6 Work-for-Others Program	2-8
2.2.7 Technology Transfer Program	2-8

CHAPTER 3: DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES	3-1
3.1 Major Planning Assumptions and Basis of Analysis	3-1
3.1.1 No Action - Status Quo Alternative (Defense Programs Operations and Emissions)	3-3
3.1.2 No Action - Planning Basis Operations Alternative (Defense Programs Operations and Emissions)	3-3
3.2 Alternatives	3-4
3.2.1 Alternative 1A (No Action - Planning Basis Operations Alternative)	3-4
3.2.2 Alternative 1B (No Action - Planning Basis Operations Alternative)	3-5
3.2.2.1 Defense Programs	3-5
3.2.2.2 Waste Management	3-16
3.2.2.3 Environmental Restoration	3-24
3.2.2.4 Nuclear Nonproliferation and National Security	3-24
3.2.2.5 Nuclear Energy	3-25
3.2.2.6 Nondefense Research and Development Program	3-25
3.2.2.7 Work-for-Others Program	3-28
3.2.2.8 Technology Transfer Program	3-28
3.2.3 Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	3-28
3.2.3.1 Alternative 1B (No Action - Planning Basis Operations Alternative)	3-28
3.2.3.2 Alternative 2A (No Action - Planning Basis Operations Alternative Plus Construct and Operate a New HEU Materials Facility)	3-29
3.2.3.3 Alternative 2B (No Action - Planning Basis Operations Alternative Plus Upgrade Expansion of Building 9215)	3-42
3.2.4 Alternative 3 (No Action - Planning Basis Operations Alternative Plus Special Materials Mission Alternative)	3-47
3.2.4.1 Alternative 1B (No Action - Planning Basis Operations Alternative)	3-48
3.2.4.2 Construct New Special Materials Complex	3-48
3.2.5 Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex)	3-63
3.3 Potential Future Y-12 Site Integrated Modernization Projects	3-66
3.4 Alternatives Considered but Eliminated from Detailed Consideration	3-83
3.5 Comparison of Alternatives and Environmental Impacts	3-84
3.5.1 Land Use	3-84
3.5.2 Transportation	3-85
3.5.3 Socioeconomics	3-86
3.5.4 Geology and Soils	3-87
3.5.5 Water Resources	3-88
3.5.6 Biological Resources	3-92
3.5.7 Air Quality	3-93
3.5.8 Visual Resources	3-94
3.5.9 Noise	3-94
3.5.10 Site Infrastructure	3-95
3.5.11 Cultural Resources	3-96
3.5.12 Waste Management	3-97
3.5.13 Environmental Justice	3-98
3.5.14 Worker and Public Health	3-98

3.5.15	Facility Accidents	3-99
3.6	Preferred Alternative	3-130
CHAPTER 4:	AFFECTED ENVIRONMENT	4-1
4.1	Land Use	4-1
4.1.1	Land-Use Designations	4-1
4.1.2	Future Land Use and Leasing Agreements	4-9
4.2	Transportation	4-17
4.2.1	On-site Traffic	4-17
4.2.2	Off-site Traffic	4-17
4.2.3	Transportation of Materials and Waste	4-18
4.2.4	Other Transportation	4-18
4.3	Socioeconomics	4-18
4.3.1	Employment and Income	4-19
4.3.2	Population and Housing	4-21
4.3.3	Community Services	4-22
4.4	Geology and Soils	4-23
4.4.1	Physiography	4-23
4.4.2	Geology	4-23
4.4.3	Soils	4-29
4.5	Hydrology	4-29
4.5.1	Surface Hydrology	4-29
4.5.2	Groundwater	4-34
4.5.3	Y-12 Liquid Release	4-41
4.6	Biological Resources	4-42
4.6.1	Terrestrial Resources	4-42
4.6.2	Wetlands	4-50
4.6.3	Aquatic Resources	4-51
4.6.4	Threatened and Endangered Species	4-51
4.7	Air Quality and Climate/Noise	4-54
4.7.1	Meteorology and Climatology	4-54
4.7.2	Air Quality	4-56
4.7.2.1	Nonradiological Air Quality	4-56
4.7.2.2	Radiological Air Quality	4-61
4.7.3	Noise	4-64
4.8	Site Facilities and Support Activities	4-65
4.8.1	Defense Programs Facilities	4-66
4.8.1.1	Building 9212 Complex	4-66
4.8.1.2	Building 9206 Complex	4-66
4.8.1.3	Building 9215	4-67
4.8.1.4	Buildings 9204-2 and 9204-2E	4-67
4.8.1.5	Building 9204-4	4-67
4.8.1.6	Building 9720-12	4-68
4.8.1.7	Building 9201-5	4-68
4.8.1.8	Building 9720-5	4-68
4.8.1.9	Building 9995	4-68
4.8.1.10	Buildings 9119, 9983, and 9710-3	4-68
4.8.1.11	Building 9201-5W	4-69
4.8.1.12	Building 9201-5N	4-69
4.8.1.13	Buildings 9202 and 9203	4-69

4.8.1.14	Building 9996	4-69
4.8.1.15	Building 9201-1	4-69
4.8.2	Waste Management Facilities	4-69
4.8.2.1	Waste Storage at Y-12	4-70
4.8.2.2	Treatment of Waste at Y-12	4-74
4.8.2.3	Disposal of Waste at Y-12	4-76
4.8.3	Site Infrastructure	4-78
4.8.3.1	Roads and Railroads	4-78
4.8.3.2	Electrical Power	4-78
4.8.3.3	Natural Gas	4-78
4.8.3.4	Steam	4-79
4.8.3.5	Raw Water	4-79
4.8.3.6	Treated Water	4-79
4.8.3.7	Demineralized Water	4-79
4.8.3.8	Sanitary Sewer	4-80
4.8.3.9	Chilled Water	4-80
4.8.3.10	Industrial Gases	4-80
4.8.3.11	Telecommunications	4-81
4.9	Visual Resources	4-81
4.10	Cultural and Paleontological Resources	4-82
4.10.1	Cultural Resources	4-82
4.10.2	Paleontological Resources	4-85
4.11	Environmental Management	4-85
4.11.1	Waste Generation from Routine Operations	4-86
4.11.2	Waste Generation from Environmental Restoration Activities	4-87
4.11.3	Pollution Prevention	4-88
4.12	Occupational and Public Health and Safety/Radiation	4-92
4.12.1	Public Health	4-92
4.12.2	Worker Health	4-93
4.13	Environmental Justice	4-95
CHAPTER 5: ENVIRONMENTAL CONSEQUENCES		5-1
5.1	Land Use	5-2
5.1.1	Alternative 1A (No Action - Status Quo Alternative)	5-2
5.1.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-3
5.1.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-4
5.1.4	Alternative 3 (No Action - Planning Basis Operations Plus special Materials Mission Alternative)	5-5
5.1.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-6
5.2	Traffic and Transportation	5-7
5.2.1	Alternative 1A (No Action - Status Quo Alternative)	5-7
5.2.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-8
5.2.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-9
5.2.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)	5-10
5.2.5	Alternative 4 (No Action - Planning Basis operations Plus HEU Materials Facility Plus Special Materials Complex)	5-11

5.3	Socioeconomics	5-11
5.3.1	Alternative 1A (No Action - Status Quo Alternative)	5-11
5.3.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-12
5.3.3	Alternative 2 (No Action- Planning Basis Operations Plus HEU Storage Mission Alternative)	5-13
5.3.4	Alternative 3 (No Action- Planning Basis Operations Plus Construct and Operate a New Special Materials Complex)	5-14
5.3.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-14
5.4	Geology and Soils	5-15
5.4.1	Alternative 1A (No Action - Status Quo Alternative)	5-15
5.4.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-15
5.4.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-16
5.4.4	Alternative 3 (No Action- Planning Basis Operations Plus Special Materials Mission Alternative)	5-17
5.4.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-17
5.4.6	Mitigation	5-18
5.5	Hydrology	5-18
5.5.1	Surface Hydrology	5-18
5.5.1.1	Alternative 1A (No Action - Status Quo Alternative)	5-18
5.5.1.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-19
5.5.1.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternative)	5-21
5.5.1.4	Alternative 3 (No Action - Planning Basis Operation Plus Special Materials Mission Alternative)	5-21
5.5.1.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-22
5.5.2	Groundwater	5-22
5.5.2.1	Alternative 1A (No Action - Status Quo Alternative)	5-22
5.5.2.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-23
5.5.2.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-24
5.5.2.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)	5-25
5.5.2.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Material Facility Plus Special Materials Complex)	5-25
5.6	Biological Resources	5-25
5.6.1	Alternative 1A (No Action - Status Quo Alternative)	5-26
5.6.2	Alternative 1B (No Action- Planning Basis Operations Alternative)	5-26
5.6.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-28
5.6.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternatives)	5-29
5.6.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-29
5.6.6	Mitigation	5-30

5.7	Air Quality/Noise	5-30
5.7.1	Nonradiological Air Quality	5-30
5.7.1.1	Alternative 1A (No Action - Status Quo Alternative)	5-32
5.7.1.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-33
5.7.1.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-37
5.7.1.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)	5-38
5.7.1.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-39
5.7.2	Radiological Impacts	5-40
5.7.2.1	Alternative 1A (No Action - Status Quo Alternative)	5-40
5.7.2.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-40
5.7.2.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternative)	5-41
5.7.2.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)	5-42
5.7.2.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-42
5.7.3	Noise	5-42
5.7.3.1	Alternative 1A (No Action - Status Quo Alternative)	5-43
5.7.3.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-44
5.7.3.3	Alternative 2 and 3 (No Action - Planning Basis Operations Plus HEU Storage Mission and Special Materials Mission Alternatives)	5-44
5.7.3.4	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-47
5.8	Site Facilities and Support Activities	5-47
5.8.1	Alternative 1A (No Action - Status Quo Alternative)	5-48
5.8.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-48
5.8.3	Alternative 2 (no Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-48
5.8.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)	5-52
5.8.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-55
5.9	Visual Resources	5-56
5.9.1	Alternative 1A (No Action - Status Quo Alternative)	5-56
5.9.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-56
5.9.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-57
5.9.4	Alternative 3 (No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Mission Alternative)	5-57
5.10	Cultural and Paleontological Resources	5-58
5.10.1	Alternative 1A (No Action - Status Quo Alternative)	5-59
5.10.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-59

5.10.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-60
5.10.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)	5-62
5.10.5	Alternative 4 (No Action- Planning basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-63
5.10.6	Mitigation Measures	5-64
5.10.7	Paleontological Resources	5-66
5.11	Waste Management and Pollution Prevention	5-66
5.11.1	Waste Generated During Routine Operations Alternative 1A (No Action - Status Quo Alternative) and Alternatives 1B (No Action -Planning Basis Operations Alternative)	5-67
5.11.1.1	Alternative 1A (No Action - Status Quo Alternative)	5-68
5.11.1.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-68
5.11.2	Waste Generated by the Alternatives for the HEU Storage Mission and the Special Materials Mission	5-68
5.11.2.1	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-71
5.11.2.2	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Complex)	5-71
5.11.2.3	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Complex Plus Special Materials Complex)	5-72
5.11.3	Pollution Prevention/Mitigation	5-72
5.11.3.1	Alternatives 1A and 1B (No Action - Status Quo and No Action - Planning Basis Operations Alternatives)	5-72
5.11.3.2	Highly Enriched Uranium Storage Mission Alternatives and Special Materials Mission Alternatives	5-73
5.11.3.3	Design Mitigation Measures	5-73
5.12	Occupational and Public Health and Safety Impacts	5-74
5.12.1	Radiological Impacts	5-74
5.12.2	Hazardous Chemical Impacts	5-77
5.12.3	Detailed Evaluation: Beryllium	5-80
5.12.4	Worker Safety	5-82
5.13	Environmental Justice	5-84
5.13.1	Alternative 1A (No Action - Status Quo Alternative)	5-85
5.13.2	Alternative 1B (No Action - Planning Basis Operations Alternative)	5-85
5.13.3	Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)	5-85
5.13.4	Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternatives)	5-86
5.13.5	Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)	5-86
5.14	Accidents	5-86
5.14.1	Accident Screening	5-86
5.14.2	Methodology	5-87
5.14.3	Accident Scenarios	5-88
5.14.3.1	Wildfires	5-88

5.14.3.2	Site-wide Earthquakes	5-89
5.14.3.3	Facility Hazards	5-90
5.14.4	Accidents for the HEU Storage Mission and Special Materials Mission Alternatives Compared to the No Action - Status Quo Alternative	5-92
5.15	Resource Commitments	5-95
CHAPTER 6: CUMULATIVE IMPACTS		6-1
6.1	Methodology and Analytical Baseline	6-1
6.2	Potentially Cumulative Actions	6-2
6.2.1	TVA Plants	6-2
6.2.2	Y-12 Site Integrated Modernization Program	6-2
6.2.3	Lease of Parcel ED-1, ED-3, and Land and Facilities Within the ETPP	6-3
6.2.4	Construction and Operation of the Spallation Neutron Source	6-3
6.2.5	Management of Potentially Reusable Uranium Materials at the DOE Management Center	6-3
6.2.6	Surplus HEU Disposition Activities	6-5
6.2.7	Oak Ridge Area Infrastructure Upgrades and Expansions	6-5
6.3	Actions Considered But Not Included	6-6
6.3.1	Remediation of Contaminated Areas Within the Melton Valley Watershed	6-6
6.3.2	Institute for Neutron Sciences	6-6
6.3.3	The Joint Receipt and Storage of Uranium Materials from the Fernald Site	6-6
6.3.4	Alternative Strategies for the Long-term Management and Use of Depleted Uranium Hexafluoride UF ₆	6-6
6.3.5	Management of Potentially Reusable Uranium Materials at the DOE Management Center	6-7
6.3.6	Disposition of Stockpiled Mercury	6-7
6.3.7	Environmental Impact Statement - Proposed Route 475	6-7
6.3.8	Commercial Ventures	6-7
6.4	Cumulative Impacts by Resource Area	6-8
6.4.1	Land Use	6-9
6.4.2	Transportation	6-9
6.4.3	Socioeconomics	6-9
6.4.4	Water Resources	6-10
6.4.5	Air Resources	6-11
6.4.6	Utilities and Energy	6-11
6.4.7	Waste Generation	6-11
6.4.8	Public and Worker Health	6-12
CHAPTER 7: STATUTES, REGULATIONS, CONSULTATIONS, AND OTHER REQUIREMENTS		7-1
7.1	Regulatory Framework	7-1
7.2	Statutes and Regulations	7-2
7.2.1	Federal and State Environmental Statutes and Regulations	7-2
7.2.2	Other Pertinent Laws and Requirements	7-13
7.3	Consultation	7-13
CHAPTER 8: LIST OF PREPARERS AND CONTRIBUTORS		8-1
CHAPTER 9: INDEX		9-1

CHAPTER 10: REFERENCES 10-1

CHAPTER 11: GLOSSARY 11-1

CHAPTER 12: LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM
COPIES OF THIS STATEMENT WERE SENT 12-1

LIST OF FIGURES

Figure 1.1.1–1. Location of Oak Ridge Reservation, Principal Facilities, and Surrounding Area. 1-2

Figure 1.1.4–1. The Y-12 Site-Wide Environmental Impact Statement Area of Analysis. 1-6

Figure 1.1.4–2. Alternative 1A (No Action - Status Quo) Facility Location and Utilization at Y-12 1-7

Figure 1.4.1–1. Current DOE Stockpile Stewardship and Management Sites 1-12

Figure 3.2.2–1. Alternative 1B (No Action - Planning Basis Operations) Facilities Within the Y-12 SWEIS Area of Analysis. 3-6

Figure 3.2.2–2. Alternative 1B (No Action - Planning Basis Operations) Facility Utilization at Y-12 Plant. 3-7

Figure 3.2.2–3. Overview of the Y-12 Plant Enriched Uranium Parts Production Operations. 3-9

Figure 3.2.2–4. Overview of the Y-12 Plant Enriched Uranium Chemical Recovery Operations. 3-10

Figure 3.2.2–5. Overview of the Y-12 Plant Depleted Uranium Operations. 3-11

Figure 3.2.2–6. Buildings Affected by the Y-12 Plant Restructuring Initiative. 3-15

Figure 3.2.2–7. The Environmental Management Waste Management Facility Site Plan. 3-18

Figure 3.2.2–8. Cross Section of the Environmental Management Waste Management Facility Disposal Cell. 3-19

Figure 3.2.2–9. Y-12 Plant West End Borrow Area. 3-21

Figure 3.2.2–10. Locations of the Background Area and the Initial Test Plots within the Field Research Center, Contaminated Area at the Y-12 Plant. 3-26

Figure 3.2.3–1. Artist’s Rendering of Proposed Highly Enriched Uranium Materials Facility. 3-32

Figure 3.2.3–2. Site A for the Proposed Highly Enriched Uranium Materials Facility. 3-34

Figure 3.2.3–3. Highly Enriched Uranium Materials Facility Site A Construction Lay-Down Areas, New Parking Lot, and New Alignment of Bear Creek Road. 3-37

Figure 3.2.3–4. Site B for the Proposed Highly Enriched Uranium Materials Facility. 3-41

Figure 3.2.3–5. Highly Enriched Uranium Materials Facility Site B Construction Lay-Down Area and Temporary Parking Lot 3-43

Figure 3.2.3–6. Proposed Building 9215 Expansion Area. 3-45

Figure 3.2.4–1. Artist’s Rendering of Proposed Special Materials Complex. 3-53

Figure 3.2.4–2. Sites 1, 2, and 3 for the Proposed Special Materials Complex. 3-56

Figure 3.2.4–3. Special Materials Complex Construction Lay-Down Areas. 3-58

Figure 3.3–1. Potential Candidate Siting Areas for New Modernization Facilities at Y-12 Plant. 3-69

Figure 3.3–2. Candidate Site for a New Y-12 Steam Plant. 3-81

Figure 4.1.1–1. Oak Ridge Reservation, Tennessee, and Region 4-2

Figure 4.1.1–2. Original U.S. Department of Energy Land Purchase and Current Reservation Boundaries. 4-3

Figure 4.1.1–3. Research Areas and Forested Areas. 4-5

Figure 4.1.1–4. Public, Educational, and Recreational Opportunities. 4-8

Figure 4.1.2–1. New Future Use at Oak Ridge Reservation. 4-10

Figure 4.1.2–2. Watershed Areas on Oak Ridge Reservation. 4-13

Figure 4.1.2–3. Sludge Land Application Sites. 4-15

Figure 4.1.2–4. Active Waste Management Facilities and Environmental Restoration Projects. 4-16

Figure 4.2.1-1.	Road Network at Y-12 Site.	4-17
Figure 4.3-1.	Location of Oak Ridge Reservation and Surrounding Counties.	4-20
Figure 4.4.2-1.	Generalized Geological Map of the Oak Ridge Reservation.	4-24
Figure 4.4.2-2.	Stratigraphic Section in the Vicinity of the Upper East Fork Poplar Creek Characterization Area.	4-25
Figure 4.4.2-3.	Geology and Karst Features.	4-27
Figure 4.5.1-1.	Y-12 Plant Area Surface Water Features	4-31
Figure 4.5.1-2.	100- and 500-year Floodplains for Y-12.	4-33
Figure 4.5.2-1.	Summed Volatile Organic Compounds in Groundwater.	4-38
Figure 4.5.2-2.	Gross Alpha Activity in Groundwater at Y-12.	4-39
Figure 4.5.2-3.	Gross Beta Activity in Groundwater at Y-12.	4-40
Figure 4.6.1-1	Distribution of Plant Communities on the Oak Ridge Reservation.	4-43
Figure 4.7.1-1.	Wind Rose Data for Y-12.	4-55
Figure 4.7.2-1.	Locations of Ambient Air Monitoring Stations for Mercury Vapor and Uranium.	4-59
Figure 4.7.2-2.	Location of Oak Ridge Reservation Perimeter Air Monitoring Stations in the Vicinity of Y-12	4-63
Figure 4.13-1.	Minority Population in the Region of Influence.	4-97
Figure 4.13-2.	Low Income Population in the Region of Influence.	4-98
Figure 4.13-3.	City of Oak Ridge Census Tracts.	4-99
Figure 5.7.3-1.	Decibel Levels Compared to the Threshold of Human Audibility.	5-46
Figure 5.8.3-1.	Potentially Affected Facilities Due to Construction of Highly Enriched Uranium Materials Facility or Building 9215 Expansion.	5-51
Figure 5.8.4.1	Potentially Affected Facilities Due to Construction of HEU Facility or Building 9215 Expansion.	5-53
Figure 6.2.3-1	Locations of Parcels ED-1 and ED-3	6-4

LIST OF TABLES

Table 1.2-1.	Y-12 SWEIS Alternatives	1-9
Table 3.2.3-1.	Highly Enriched Uranium Materials Facility Construction Requirements and Estimated Waste Volumes for Site A or Site B	3-38
Table 3.2.3-2.	Highly Enriched Uranium Materials Facility Annual Operation Requirements and Estimated Waste Volumes	3-39
Table 3.2.3-3	Building 9215 Expansion Construction Requirements and Estimated Waste Volumes	3-46
Table 3.2.3-4.	Building 9215 Expansion Storage Facility Annual Operation Requirements and Estimated Waste Volumes	3-47
Table 3.2.4-1.	Special Materials Complex Construction Requirements and Estimated Waste Volumes for Site 1	3-59
Table 3.2.4-2.	Special Materials Complex Annual Operation Requirements and Estimated Waste Volumes for sites 1, 2, and 3	3-60
Table 3.2.4-3.	Special Materials Complex Construction Requirements and Estimated Waste Volumes for Site 2	3-64
Table 3.2.4-4.	Special Materials Complex Construction Requirements and Estimated Waste Volumes for Site 3	3-65
Table 3.3-1.	Summary of Potential Future Y-SIM Facilities	3-67
Table 3.3-2.	Summary of Y-SIM Planning Base for Utilities and Other Services	3-80
Table 3.5-1.	Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives	3-100
Table 4.1.1-1.	Biosolids Application Sites	4-7
Table 4.2.1-1.	Existing Average Daily Traffic Flows (Vehicles per Day) on Oak Ridge Reservation Serving Y-12	4-18
Table 4.3.1-1.	Employment by Sector (%)	4-19
Table 4.3.1-2.	Region of Influence Unemployment Rates (%)	4-21
Table 4.3.2-1.	Historic and Projected Population in the Region of Influence	4-21
Table 4.3.2-2.	Region of Influence Housing Characteristics (1990)	4-22
Table 4.4.2-1.	The Modified Mercalli Intensity Scale of 1931, With Approximate Correlations to Richter Scale and Maximum Ground Acceleration	4-28
Table 4.5.1-1.	Surface Water Quality, Upper East Fork Poplar Creek (Station 8 to Station 17) during Flow Augmentation, and Lower Bear Creek (BCK-0.63)	4-34
Table 4.6.1-1.	Common and Scientific Names of Some of the Nonthreatened and Nonendangered Plants and Animals Occurring On or In the Vicinity of the ORR	4-44
Table 4.6.1-2.	List of Potential Breeding Birds and Relative Abundance on the Oak Ridge Reservation	4-46
Table 4.6.4-1.	Federal- or State-Listed Threatened, Endangered, and Other Special Status Species Reported on the Oak Ridge Reservation	4-53
Table 4.7.2-1.	National Ambient Air Quality Standards and Tennessee Ambient Air Standards	4-58
Table 4.7.2-2.	Tennessee Department of Environment and Conservation Ambient Air Monitoring Data for 1999 in the Vicinity of Y-12/Oak Ridge Reservation	4-58
Table 4.7.2-3.	Results of Y-12 Ambient Air Mercury Monitoring Program	4-60
Table 4.7.2-4.	Uranium Mass in Ambient Air at Y-12, 1998	4-60
Table 4.7.2-5.	Actual vs. Allowable Air Emissions from the Oak Ridge Y-12 Steam Plant, 1998	4-61

Table 4.7.2–6.	Chemical Pollutant Emissions from Y-12 During 1998	4-61
Table 4.7.2–7.	Radionuclide Concentrations at Oak Ridge Reservation Perimeter Air Monitoring Stations During 1998	4-64
Table 4.7.3–1.	City of Oak Ridge Maximum Allowable Noise Limits Applicable to Oak Ridge Reservation	4-65
Table 4.11.1–1.	Summary of Waste Generation Totals by Waste Type in Kilograms (Cubic Meters) for Routine Operations at Y-12, ORNL, and ETTP	4-86
Table 4.11.2–1.	Summary of Cleanup/Stabilization Related Waste Generation by Waste Type in Kilograms (Cubic Meters) in 1998	4-87
Table 4.11.3–1.	Reduction in Waste Volumes at Y-12 from Total Operations in Kilograms (cubic meters)	4-89
Table 4.11.3–2.	Pollution Prevention and Waste Avoidance Accomplishments at Y-12 in 1998	4-90
Table 4.11.3–3.	Summary of Pollution Prevention Activities at Y-12, Oak Ridge National Laboratory and East Tennessee Technology Park in 1998	4-91
Table 4.12.1–1.	Potential Radiological Impacts to the Public Resulting from Normal Operation of Y-12	4-93
Table 4.12.2–1.	Y-12 Radiological Worker Annual Individual and Collective Radiation Doses	4-94
Table 4.12.2–2.	Annual Radiation Doses for All Monitored Y-12 Workers	4-95
Table 4.13–1.	Population Distribution by Race in Oak Ridge Census Tracts	4-96
Table 4.13–2.	Oak Ridge Families Living Below Poverty Level, by Census Tract (1989)	4-96
Table 5.2–1.	Nonradiological Unit-Risk Factors for Truck Transport	5-8
Table 5.2.2–1.	Annual Incident-Free Doses to Crew and Public and Accident Risk to Public Under Alternative 1B (No Action - Planning Basis Operations)	5-8
Table 5.2.2–2.	Annual Transportation Impacts for Y-12 Operations Under Alternative 1B (No Action- Planning Basis Operations Alternative)	5-9
Table 5.7.1–1.	Modeled Criteria Pollutant Concentrations from the Y-12 Steam Plant Under Alternative 1B (No Action - Planning Basis Operations Alternative)	5-34
Table 5.7.1–2.	Y-12 Facility Operations Maximum Boundary and On-Site Noncarcinogenic Hazardous Air Pollutant Chemical Concentrations	5-34
Table 5.7.1–3.	Y-12 Steam Plant Maximum Boundary Hazardous Air Pollutant Carcinogenic Chemical Concentrations	5-36
Table 5.7.1–4.	Y-12 Facility Operations Maximum Boundary and On-site Carcinogenic Hazardous Air Pollutant Chemical Concentrations	5-36
Table 5.7.1–5.	Maximum Boundary and On-site Chemical Concentrations from Special Materials Complex Operations	5-39
Table 5.7.2–1.	Radiological Doses for Collective Population for All Workers (Radiological and Nonradiological)	5-41
Table 5.7.3–1.	Permissible Noise Exposure	5-43
Table 5.7.3–2.	Peak Attenuated Noise Levels (in dBA) Expected from Operation of Construction Equipment	5-47
Table 5.8.1–1.	Y-12 Site Energy and Resource Requirements—Alternative 1A (No Action - Status Quo Alternative)	5-49
Table 5.8.2–1.	Y-12 Site Energy and Resource Requirements—Alternative 1B (No Action - Planning Basis Operations Alternative)	5-50

Table 5.8.3–1.	HUE Storage Mission Alternatives Construction Requirements	5-52
Table 5.8.3–2.	Annual Operation Requirements for the Y-12 Site No Action Alternative and the HEU Storage Mission Alternatives	5-52
Table 5.8.4–1	Special Materials Complex Construction Requirements.	5-54
Table 5.8.4–2	Annual Operations Requirements Special Materials Complex Annual Operations Requirements	5-54
Table 5.8.5–1	Y-12 Site Energy and Resource Requirements—No Action - Planning Basis Operations Plus the HEU Storage Mission and Special Materials Mission	5-55
Table 5.11.2–1.	Summary of Estimated Annual Waste Generation During Routine Operations at Y-12 by Alternative	5-69
Table 5.11.2–2.	Summary of Waste Generation from Construction and Associated Decontamination and Decommissioning and Environmental Restoration Activities During Implementation of the Action Alternatives . . .	5-70
Table 5.12.1–1.	Radiation Doses and Health Impact to the Public for the Baseline and the Proposed Alternatives	5-75
Table 5.12.1–2.	Radiological Health Effects for Workers for Major Production Operations Under Alternative 1B (No Action - Planning Basis Operations Alternative)	5-76
Table 5.12.1–3.	Radiation Doses and Health Impacts to Workers Under the HEU Storage Mission Alternatives	5-76
Table 5.12.2–1.	Y-12 Facility Operations Maximum Boundary Hazardous Air Pollutants Noncarcinogenic Chemical Hazard Quotients	5-77
Table 5.12.2–2.	Y-12 Facility Operations Maximum Boundary Hazardous Air Pollutants Carcinogenic Chemical Excess Cancer Risk	5-78
Table 5.12.2–3.	Y-12 Facility Operations Maximum On-Site Hazardous Air Pollutants Noncarcinogenic Chemical Hazard Quotients	5-78
Table 5.12.2–4.	Y-12 Facility Operations Maximum On-Site Hazardous Air Pollutants Carcinogenic Chemical Excess Cancer Risks	5-78
Table 5.12.2–5.	Y-12 Steam Plant Maximum Boundary Hazardous Air Pollutant Carcinogenic Chemical Concentrations	5-78
Table 5.12.3–1.	Y-12 Beryllium Operations Maximum Boundary Hazard Quotient	5-81
Table 5.12.3–2.	Y-12 Beryllium Operations Maximum Boundary Excess Cancer Risk	5-81
Table 5.12.3–3.	Y-12 Beryllium Operations Maximum On-Site Hazard Quotient	5-81
Table 5.12.3–4.	Y-12 Beryllium Operations Maximum On-Site Excess Cancer Risks	5-82
Table 5.12.4–1.	Y-12 4-Year Average (1995-1998) Illness/Injury Rate per 100 Workers	5-83
Table 5.12.4–2.	Calculated Nonfatal Injuries/Illnesses per Year for Y-12 Workforce by Alternative	5-83
Table 5.12.4–3.	Calculated Non-fatal Injuries/Illnesses for Construction of the HEU Materials Facility	5-83
Table 5.12.4–4.	Calculated Non-fatal Injuries/Illnesses for Construction of the Special Materials Complex	5-84
Table 5.14–1.	Summary of Beyond Design Basis Earthquake Composite Consequences for Y-12	5-94
Table 5.14–2.	Summary of Criticality Consequences for Y-12	5-94
Table 5.14–3.	Summary of Radiological Fire Consequences for Y-12	5-94
Table 5.15–1.	Commitment of Construction Resources for the Highly Enriched Uranium Storage Mission and Special Materials Mission Alternatives	5-97

Table 6.4.4–1.	Estimated Average Annual Radiological Doses and Resulting Health Effects to Off-site Population Due to Liquid Releases from Facilities in the Oak Ridge Area	6-10
Table 6.4.5–1.	Estimated Average Annual Radiological Doses and Resulting Health Effects to Off-site Population from Airborne Releases	6-11
Table 6.4.7–1.	Estimated Annual Volumes of Waste Generated by Actions in the Oak Ridge Area	6-12
Table 6.4.8–1.	Estimated Annual Radiological Impacts to Off-site Population and Facility Workers	6-13
Table 7.2.1–1.	Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic	7-3
Table 7.2.1–2.	Selected Department of Energy Directives	7-12
Table 7.2.2–1.	Agreements Between DOE-ORO and Other Regulatory Agencies	7-14
Table 7.3–1.	Applicable Laws and Executive Orders Y-12 Proposed Action and Alternatives	7-15

ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AEA	<i>Atomic Energy Act</i> (4-66)
AIHA	American Industrial Hygiene Association
ALARA	as low as reasonably achievable
AQCR	Air Quality Control Region
ASER	Annual Site Environmental Report
ATSDR	Agency for Toxic Substances and Disease Registry
BEIR	Biological Effects of Ionizing Radiation
BIO	Basis of Interim Operations
CAA	<i>Clean Air Act</i>
CAVIS	Continuous Automated Vault Inventory System
CDC	Center for Disease Control
CEDE	committed effective dose equivalent
CEDR	Comprehensive Epidemiologic Data Resources
CEQ	Council on Environmental Quality
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act</i>
CFC	chlorofluorcarbon
CFR	<i>Code of Federal Regulations</i>
CMTS	Central Mercury Treatment system (4-70)
CSMO	Central Scrap Management Office
CTBT	Comprehensive Test Ban Treaty
D&D	decontamination and decommissioning
DARA	Disposal Area Remedial Actions (4-67)
DCG	Derived Concentration Guideline
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Defense Programs
DSWM	Division of Solid Waste Management (4-66)
EA	environmental assessment
EBE	evaluation basis earthquake
EDE	effective dose equivalent
EEMTS	East End Mercury Treatment System
EFPC	East Fork Poplar Creek
EIS	environmental impact statement
EM	Environmental Management
EPA	Environmental Protection Agency
ES&H	environment, safety and health
ETTP	East Tennessee Technology Park (formerly the K-25 Site)
FFA	Federal Facility Agreement
FFCA	<i>Federal Facility Compliance Act</i> or Agreement
FONSI	finding of no significant impact
FR	<i>Federal Register</i>
FY	fiscal year
HAP	hazardous air pollutants
HEPA	high-efficiency particulate air
HEU	highly enriched uranium

HF	hydrogen fluoride
HI	hazard index
HQ	hazard quotient
HVAC	heating, ventilation, and air conditioning
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IRIS	Integrated Risk Information System
KOH	potassium hydroxide
LCF	latent cancer fatality
LDR	land disposal restrictions
LLW	low level waste
LMES	Lockheed Martin Energy Systems, Inc.
LOAEL	lowest observed adverse effect level
LOS	Level-of-Service
MACCS	MELCOR Accident Consequence Code System
MAR	material at risk
MEI	maximally exposed individual
MMES	Martin Marietta Energy Systems, Inc.
MSDS	Material Safety Data Sheet
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NDA	nondestructive assay
NEPA	<i>National Environmental Policy Act</i>
NERP	National Environmental Research Park
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NN	Nuclear Nonproliferation and National Security
NOAEL	no observed adverse effect level
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PC	Performance Categories
PEIS	programmatic environmental impact statement
PEL	permissible exposure limit
PIDAS	Perimeter Intrusion, Detection, and Assessment System
PSA	Project-Specific Analysis
PSD	Prevention of Significant Deterioration
R&D	research and development
RCRA	<i>Resource Conservation and Recovery Act</i>
REL	recommended exposure limit
RfC	Reference Concentration
RfD	Reference Dose
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision

ROI	region of influence
S&D	storage and disposition
S&M	surveillance and maintenance
SARA	<i>Superfund Amendments and Reauthorization Act</i>
SHPO	State Historic Preservation Officer
SNM	special nuclear material
SNS	Spallation Neutron Source
SSM	stockpile stewardship and management
STEL	short-term exposure limit
START	Strategic Arms Reduction Treaty
SST	safe-secure trailers
SWEIS	site-wide environmental impact statement
TCA	Tennessee Codes Annotated
TDEC	Tennessee Department of Environment and Conservation
TEEL	temporary emergency exposure limit
TEV	threshold emission values
TI	transportation index
TLV	threshold limit value
TRU	transuranic
TSCA	<i>Toxic Substances Control Act</i>
TSR	Tennessee State Route
TVA	Tennessee Valley Authority
TWA	time weighted average
TWRA	Tennessee Wildlife Resources Agency
UCNI	Unclassified Controlled Nuclear Information
UEFPC	Upper East Fork Poplar Creek
USACE	United States Army Corps of Engineers
U.S.C	United States Code
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VRM	Visual Resources Management
Y-12	Oak Ridge Y-12 Plant
Y-SIM	Y-12 Site Integrated Modernization
WETF	West End Treatment Facility
WIPP	Waste Isolation Pilot Plant

CHEMICALS AND UNITS OF MEASURE

AHF	anhydrous hydrogen fluoride
BTEX	benzene, toluene, ethylbenzene, and xylenes
Bq	Becquerel
C	Celsius
Ci	curie
CCl ₄	carbon tetrachloride
cm	centimeters
CFC	chlorofluorocarbons
CO	carbon monoxide
dB	decibel
dBA	decibel A-weighted
DCE	1, 2-dichloroethylene
F	Fahrenheit
ft	feet
ft ²	square feet
ft ³	cubic feet
ft ³ /s	cubic feet per second
g	grams
G	acceleration due to gravity
gal	gallons
GPD	gallons per day
gpm	gallons per minute
GPY	gallons per year
ha	hectares
hr	hour
in	inches
kg	kilograms
km	kilometers
km ²	square kilometers
KOH	potassium hydroxide
kV	kilovolts
kVA	kilovolt-ampere
kW	kilowatts
kWh	kilowatt hours
L	liters
lb	pounds
Li	lithium
LiD	lithium deuteride
LiH	lithium hydride
LiO	lithium oxide
m	meters
m ²	square meters
m ³	cubic meters
m/s	meters per second
Mbps	million bits per second
Mbtu	million British thermal unit
mCi	millicuries (one-thousandth of a curie)

mCi/mL	millicuries per milliliter
mg	milligram (one-thousandth of a gram)
mg/L	milligrams per liter
MGD	million gallons per day
MGY	million gallons per year
mi	miles
mi ²	square miles
MLD	million liters per day
MLY	million liters per year
mph	miles per hour
mrem	millirem (one-thousandth of a rem)
Mscf	million standard cubic feet
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatt hour
MWt	megawatt thermal
NaK	sodium potassium
NaOCl	sodium hypochlorite
NaOH	sodium hydroxide
nCi	nanocurie (one-billionth of a curie)
nCi/g	nanocuries per gram
NO ₂	nitrogen dioxide
NOX	nitrogen oxides
O ₃	ozone
Pb	lead
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
pCi	picocurie (one-trillionth of a curie)
pCi/L	picocuries per liter
PM ₁₀	particulate matter (less than 10 microns in diameter)
ppb	parts per billion
ppm	parts per million
psig	pounds per square gage
Ra	radium
rem	roentgen equivalent man
s	seconds
scf	standard cubic feet
scfd	standard cubic feet per day
scfm	standard cubic feet per minute
SO ₂	sulfur dioxide
SR	State Route
Sv	sievert
t	metric tons
TATB	triaminotrinitrobenzene
TC	technetium
TCA	1, 1, 1-trichloroethane
TCE	trichloroethylene
Th	thorium

TNT	trinitrotoluene
UF ₄	uranium tetrafluoride
UF ₆	uranium hexafluoride
yd ³	cubic yards
yr	year
μCi	microcurie (one-millionth of a curie)
μCi/g	microcuries per gram
μg	microgram (one-millionth of a gram)
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
μg/m ³	micrograms per cubic meter
μ	micron or micrometer (one-millionth of a meter)

CONVERSION CHART

To Convert Into Metric			To Convert Into English		
If You Know	Multiply By	To Get	If You Know	Multiply By	To Get
Length					
inch	2.54	centimeter	centimeter	0.3937	inch
feet	30.48	centimeter	centimeter	0.0328	feet
feet	0.3048	meter	meter	3.281	feet
yard	0.9144	meter	meter	1.0936	yard
mile	1.60934	kilometer	kilometer	0.62414	mile (Statute)
Area					
square inch	6.4516	square centimeter	square centimeter	0.155	square inch
square feet	0.092903	square meter	square meter	10.7639	square feet
square yard	0.8361	square meter	square meter	1.196	square yard
acre	0.40469	hectare	hectare	2.471	acre
square mile	2.58999	square kilometer	square kilometer	0.3861	square mile
Volume					
fluid ounce	29.574	milliliter	milliliter	0.0338	fluid ounce
gallon	3.7854	liter	liter	0.26417	gallon
cubic feet	0.028317	cubic meter	cubic meter	35.315	cubic feet
cubic yard	0.76455	cubic meter	cubic meter	1.308	cubic yard
Weight					
ounce	28.3495	gram	gram	0.03527	ounce
pound	0.45360	kilogram	kilogram	2.2046	pound
short ton	0.90718	metric ton	metric ton	1.1023	short ton
Force					
dyne	0.00001	newton	newton	100,000	dyne
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^9
mega-	M	1 000 000 = 10^6
kilo-	k	1 000 = 10^3
hecto-	h	100 = 10^2
deka-	da	10 = 10^1
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}