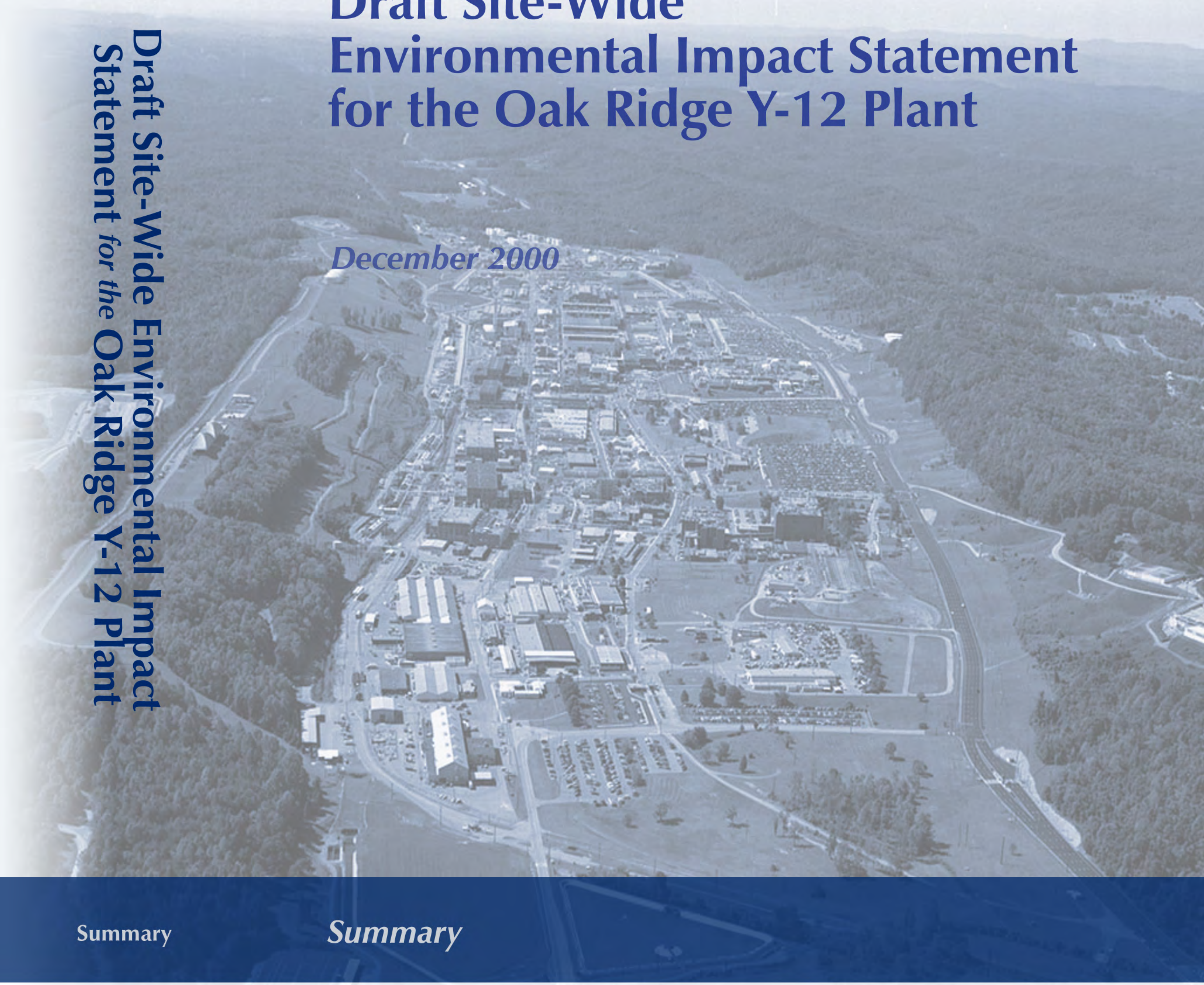
DOE/EIS-0309

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

December 2000



Summary

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

Summary

U.S. Department of Energy

U.S. Department of Energy
Oak Ridge Operations Office

DOE/EIS-0309

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United States Department of Energy

December 2000

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ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CRMP	Cultural Resource Management Plan
D&D	decontamination and decommissioning
DNFSB	Defense Nuclear Facilities Safety Board
DoD	Department Of Defense
DOE	U.S. Department of Energy
DP	Defense Programs
EIS	Environmental Impact Statement
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
ES&H	environment, safety and health
ETTP	East Tennessee Technology Park
FR	*Federal Register*
FY	Fiscal Year
ha	hectare
HEU	highly enriched uranium
LCF	latent cancer fatality
LLW	low-level waste
LMES	Lockheed Martin Energy Systems, Inc.
LOS	Level-of-Service
MEI	maximally exposed individual
NAAQS	National Ambient Air Quality Standard
NABIR	Natural and Accelerated Bioremediation Research
NEPA	*National Environmental Policy Act*
NN	Nuclear Nonproliferation and National Security
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places
NOI	Notice of Intent
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
ORO	Oak Ridge Operations
PCB	polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
PIDAS	Perimeter Intrusion Detection and Assessment System
R&D	research and development
ROD	Record of Decision
ROI	region of influence
S&D	Storage and Disposition
S-HEU	surplus highly enriched uranium
SHPO	State Historic Preservation Officer
SR	State Route
SSM	Stockpile Stewardship and Management
SWEIS	Site-Wide Environmental Impact Statement
TDEC	Tennessee Department of Environment and Conservation
TLV	Threshold Limit Value

UEFPC	Upper East Fork Poplar Creek
Y-12	Oak Ridge Y-12 Plant
Y-SIM	Y-12 Site Integrated Modernization

CHEMICALS AND UNITS OF MEASURE

AHF	anhydrous hydrogen fluoride
BTEX	benzene, toluene, ethylbenzene, and xylenes
Bq	Becquerel
C	Celsius
Ci	curie
$CC1_4$	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
MLY	million liters 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
NaOCI	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	uranu mtetraflouride
UF_6	uranium hexaflouride
VOC	volitile organic compound
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/m3	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		=	10^{-1}
centi-	c	0.1	=	10^{-2}
milli-	m	0.01	=	10^{-3}
micro-	μ	0.001	=	10^{-6}
nano-	n	0.000 001	=	10^{-9}
pico-	p	0.000 000 001	=	10^{-12}
femto-	f	0.000 000 000 001	=	10^{-15}
atto-	a	0.000 000 000 000 001	=	10^{-18}
		0.000 000 000 000 000 001		

SUMMARY

S.1 INTRODUCTION AND BACKGROUND

S.1.1 General

The Oak Ridge Y-12 Plant (Y-12) is one of three primary installations on the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) in Oak Ridge, Tennessee. Figure S.1.1–1 shows the location of the ORR. The other installations are the Oak Ridge National Laboratory (ORNL) and the East Tennessee Technology Park (ETTP) (formerly the Oak Ridge K-25 Site). Construction of Y-12 was started in 1943 as part of the World War II Manhattan Project. The early missions of the site included the separation of ^{235}U from natural uranium by the electromagnetic separation process and manufacturing weapons components from uranium and lithium.

Late Changes Affecting the Y-12 SWEIS

In the interim period between submitting the Draft Y-12 SWEIS for approval and the printing of the document for public release, a number of changes have occurred that affect some of the terminology used in the Y-12 SWEIS. Specifically, the changes involve:

- The National Nuclear Security Administration was established by Congress to manage the Nation's nuclear weapons complex. The National Nuclear Security Administration is a semi-autonomous agency within the Department of Energy. As one of the major production facilities within the nuclear weapons complex, Y-12 falls under the responsibility of the Y-12 Area Office as of October 1, 2000, under the new National Nuclear Security Administration. The National Nuclear Security Administration was created on March 1, 2000.
- Replacement of Lockheed Martin Energy Systems, Inc., by BWXT-Y12, L.L.C. as the M&O contractor for Y-12 on November 1, 2000.
- Change in the name of the Oak Ridge Y-12 Plant to Y-12 National Security Complex as of November 2, 2000.

Because these changes do not affect analyses present in the Y-12 SWEIS and in order to expedite public review, required revisions to the document will be made in the final version of the Y-12 SWEIS.

DOE is the Federal agency responsible for providing the Nation with nuclear warheads and ensuring that those weapons remain safe, secure, and reliable. As one of the DOE major production facilities, Y-12 has been the primary site for enriched uranium processing and storage, and one of the primary manufacturing facilities for maintaining the U.S. nuclear weapons stockpile. Y-12 also conducts, and/or supports, nondefense-related activities including environmental monitoring, remediation, and decontamination and decommissioning (D&D) activities of the Environmental Management (EM) Program; management of waste materials from past and current operations; research activities operated by ORNL; support of other Federal agencies through the Work-for-Others Program and the National Prototyping Center; and the transfer of highly specialized technologies to support the capabilities of the U.S. industrial base.

During a September 1994 Defense Nuclear Facilities Safety Board (DNFSB) technical staff review, weaknesses were identified in the Y-12 Plant Conduct of Operations program related to the criticality safety program. While these weaknesses did not represent a technical risk to facility workers, meaning that the required margins of safety were in place, they did indicate issues with training, document control, understanding of requirements, and procedures. After a full Y-12 Plant review, Plant management suspended all work in the Y-12 Plant that was not necessary to maintain regulatory compliance or the safety basis for the Plant (Stand - Down Status) until improvements could be implemented to the Conduct of Operations program at the Y-12 Plant. As of today, many but not all Y-12 Plant facilities and processes have returned to Operating Status (i.e., executing the work for which the process, facility, or system was designed) (DNFSB 1994).

Source: DOE 1996e.

FIGURE S.1.1–1.—*Location of Oak Ridge Reservation, Principal Facilities, and Surrounding Area*.

S.1.2 Changing Missions

In response to the end of the Cold War and changes in the world's political regime, 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. Even with these significant changes, however, DOE's responsibility for the nuclear weapons stockpile continues, and the President and Congress have directed DOE to continue to maintain the safety, security, and reliability of the stockpile.

To fulfill its Presidential and congressional directives, DOE prepared three programmatic environmental impact statements (PEISs) to determine how best to carry out its national security missions amid a changing political climate. To implement its programmatic decisions, DOE prepares site-wide and/or project specific *National Environmental Policy Act* (NEPA) reviews. This *Site-Wide Environmental Impact Statement* (SWEIS) *for the Oak Ridge Y-12 Plant* was prepared to review actions that could implement decisions made in Records of Decision (ROD) for the *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS), (DOE 1996e), the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement* (S&D PEIS) (DOE 1996h), and the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (S-HEU EIS) (DOE 1996b).

S.1.3 Proposed Action and Scope

The RODs from the SSM PEIS, the S&D PEIS, and the S-HEU EIS, form a starting point for the scope of actions that are included in this SWEIS. In the SSM PEIS ROD, DOE decided to maintain the national security missions at Y-12, but to downsize the Y-12 Plant consistent with reduced requirements. These national security missions include:

- Maintaining the capability to fabricate secondaries, limited life components, and case parts for nuclear weapons. Secondaries provide additional explosive energy release and are composed of lithium deuteride and other materials. Case parts are specifically designed containers for the major components of nuclear weapons.
- Evaluating components and subsystems returned from the stockpile
- Storing enriched uranium that is designated for national security purposes (also referred to as nonsurplus enriched uranium)
- Storing depleted uranium and lithium materials and parts
- Dismantling nuclear weapons secondaries returned from the stockpile
- 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 future use)
- Providing support to weapons laboratories

In the S&D PEIS ROD, DOE decided that Y-12 would also store surplus enriched uranium pending long-term disposition. In the S-HEU EIS ROD, DOE decided that Y-12 would be one of four sites for blending up to 85 percent of the Nation's surplus HEU to low enriched uranium for commercial use as fuel feed for nuclear power plants and dispose of the remaining low enriched uranium as low-level waste (LLW).

In accordance with the SSM and S&D PEIS RODs, DOE will provide the capability and capacity to maintain the Nation's stockpile in support of the U.S. Nuclear Weapons Program. Further, DOE will continue the processing and storage of enriched and depleted uranium, lithium compounds, and other materials and the manufacturing and assembly/disassembly mission assigned to Y-12 in the safest, most secure and most efficient manner practicable. In accordance with the S-HEU EIS ROD, Y-12 may blend surplus HEU to produce material for commercial use as fuel feed for nuclear power plants and dispose of the remaining material as LLW. Blend stock for this activity may include DOE surplus low enriched uranium and natural uranium or commercial natural uranium. These materials would be stored onsite on an interim basis to support blending of HEU. The Y-12 Plant currently blends small quantities of HEU with low enriched, depleted, or natural uranium to produce a metal or oxide product suitable for use in various reactor programs and for multiple supply orders to DOE customers. The Y-12 Plant does not have the capability to blend large quantities of HEU (i.e., tons/year). Facility upgrades or new building construction would be required to perform this process at Y-12. Further NEPA review would also be needed to initiate these facility upgrades or any new building construction.

The physical area of analysis for the Y-12 Plant in the Y-12 SWEIS is shown in Figure S.1.3–1. A detailed map of current facility utilization at Y-12 is provided in Figure S.1.3–2.

S.1.4 Development of the Y-12 SWEIS

The Y-12 SWEIS is a tiered document that follows the RODs from the SSM PEIS, the S&D PEIS, and the S-HEU EIS. In these RODs, DOE decided that the mission of Y-12 would not change and that Y-12 would continue to maintain the capability and capacity to fabricate nuclear weapons secondaries and limited life components and case parts in support of the U. S. Nuclear Weapons Program, and store nonsurplus HEU long-term and surplus HEU pending disposition. This SWEIS "tiered" NEPA review (i.e., site-specific analysis addressing on the issues specific to the Y-12 Plant to implement the decisions made in the broader PEISs) analyzes the potential environmental impacts associated with the various Y-12 proposed actions and alternatives for implementing these decisions.

S.1.5 Background

S.1.5.1 *Major Programs at Y-12*

The following summarizes the activities performed under the various ongoing DOE programs at Y-12.

Defense Programs. The Defense Programs (DP) activities performed at Y-12 include maintaining the capability to produce secondaries and radiation cases for nuclear weapons, storing and processing uranium and lithium materials and parts, dismantling nuclear weapons secondaries returned from the stockpile, and providing special production support to DOE weapons laboratories and to other DOE programs. To accomplish the storage mission, some processing of special nuclear materials may be required to recover materials from returned secondaries. In addition, Y-12 performs stockpile surveillance activities on the components it produces.

FIGURE S.1.3–1.—*The Y-12 Site-Wide Environmental Impact Statement Area of Analysis.*

FIGURE S.1.3–2.—*Alternative 1A (No Action - Status Quo Alternative) Existing Facility Location and Utilization at Y-12.*

The Weapons Stockpile Management Program structure at Y-12 includes:

- Core Stockpile Management

  - Nuclear Materials Management and Storage
  - Quality Evaluation and Surveillance
  - Weapons Dismantlement and Disposal
  - Stockpile Evaluation and Maintenance
  - Materials Recycle and Recovery
  - Modernization and Facility Transition
  - Enriched Uranium Operations
  - Nuclear Packaging Systems
  - Advanced Design and Production Technologies
  - Manufacturing Processes Program
  - Facility Program
  - Capital Program

- Materials Surveillance

- Y-12 Mission Support

A summary of each of the Core Stockpile Management Program components, the Materials Surveillance Program, and Y-12 Mission Support is provided in the following discussion.

Core Stockpile Management. The Core Stockpile Management operations at the Y-12 Plant include the principal Oak Ridge missions of the DOE's DP in support of nuclear weapons stockpile management. These missions are structured into 12 major component programs.

Nuclear Materials Management and Storage. The Nuclear Materials Management and Storage Program includes multidisciplinary initiatives in numerous facilities throughout Y-12. The program activities include (1) planning, designing, providing, and maintaining storage facilities and storage operations for the safe and secure storage of nuclear materials; (2) multiyear program planning to ensure nuclear weapons components and materials throughout the DOE Nuclear Weapons Complex are returned to Y-12 and prepared for interim or long-term storage; (3) nuclear materials planning, forecasting, and scheduling as a part of the Storage Program and as the integrator for multiple programs utilizing nuclear materials, such as Dismantlement, Stockpile Maintenance, Fissile Materials Disposition, Nuclear Nonproliferation and National Security, and Work-for-Others; (4) supporting development, design, and implementation of innovative and cost-saving technologies for storage, monitoring, and measurement of nuclear materials while reducing risks; (5) developing and maintaining technical standards for the storage of HEU, lithium, and canned subassemblies; (6) providing safeguards and security for Core Stockpile Management nuclear materials and facilities; (7) developing and implementing projects to disposition, monitor and maintain HEU in safe, optimum storage; and (8) providing interim storage of DOE surplus low enriched uranium, natural uranium, or commercial uranium for use as blendstock.

Quality Evaluation and Surveillance. The Quality Evaluation and Surveillance Program includes activities required to assess the integrity of the stockpile, including safety, reliability, design compatibility, and functionality of components over the life of each weapons system in the stockpile. Y-12 has the responsibility of the Quality Evaluation and Surveillance Program pertaining to the secondaries, case parts, shelf-life units, core samples, and other vital components.

Weapons Dismantlement and Disposal. The Weapons Dismantlement and Disposal Program provides the activities required for the dismantlement of weapon systems that are retired from the nuclear stockpile. Components are returned to Y-12 as weapon systems directly from the military or from the Pantex Plant after initial dismantlement. At Y-12, these components are stored in various storage facilities prior to further disassembly.

Stockpile Evaluation and Maintenance. The Stockpile Evaluation and Maintenance Program includes activities directed at continuing the fitness of nuclear weapon warheads in the enduring stockpile and producing weapon-related hardware to support DOE and U.S. Department of Defense (DoD) requirements.

Materials Recycle and Recovery. The Materials Recycle and Recovery Program supports the recovery of HEU and lithium from parts recovered from retired weapons programs and quality evaluation weapons teardowns, residue materials from manufacturing processes, lightly irradiated enriched uranium from other DOE sites or commercial and private facilities throughout the country, and wastes containing HEU generated from operations throughout Y-12.

Modernization and Facility Transition. The Modernization and Facility Transition Program supports the definition, development, and execution of activities required to support the missions and directives of the DOE at Y-12.

Enriched Uranium Operations. This program includes activities directly associated with the resumption of Enriched Uranium Operations and related support at Y-12 for production of nuclear weapons components

or other hardware that satisfies national priority requirements. The program also produces uranium products for other DOE programs and DOE customers (e.g., research reactors).

Nuclear Packaging Systems. The Y-12 Nuclear Packaging Systems Program provides for the activities required for safe, efficient, and economical packaging for transporting and storing general cargoes, radioactive materials, and other hazardous materials within and out of Y-12. The packaging program fully complies with DOE directives and Federal, state, tribal, and international regulations, requirements, and standards.

Advanced Design and Production Technologies. The Advanced Design and Production Technologies Program continues and accelerates the development and prototyping of advanced cost-effective and environmentally acceptable nuclear weapons production technologies and design processes required to maintain an affordable and reliable nuclear weapons stockpile.

Manufacturing Processes Program. The Manufacturing Processes Program for Y-12 consists of multiple projects and tasks, all of which are focused on supporting the existing and future manufacturing footprint, processes, and production requirements.

Facility Program. The Facility Program manages 13 production facilities (and the facility systems) that are key to the Core Stockpile Management Program. The Facility Program includes activities required for continuous operations of each facility and also includes specific facility upgrade projects related to non-routine repairs, maintenance or alteration of the facility and facility systems, and ES&H compliance.

Capital Program. The Capital Program manages the capital investments being made to the Y-12 Plant as either line-item projects, general plant projects, or general plant equipment activities. All major facility and process construction activities fall under this program.

Materials Surveillance. The Materials Surveillance Program operations involve handling, processing, storage, and accountability for weapons-grade and nonweapons-grade uranium.

Y-12 Mission Support. The Y-12 Mission Support activities involve functions related to, but not directly assignable to, programs within the Y-12 Site that are necessary for the Y-12 Plant to meet its mission.

Mission Support includes those functions necessary to provide the following: (1) maintain a minimum capability of processes within the production and support organizations of the Y-12 Plant; (2) ensure personnel are employed, trained, and equipped to perform their assigned jobs; (3) ensure operating and support organizations are managed; (4) and provide tasks that support Y-12 missions from a plant level (e.g., laundry, some utilities, and computer support).

Environmental Management. The Environmental Management (EM) activities at Y-12 include waste management and environmental restoration.

The Waste Management Program activities at Y-12 are divided into five functional areas: (1) pollution prevention, (2) waste treatment, (3) waste storage, (4) waste disposal, and (5) continuity of operations and program support. The Y-12 waste management activities address all types of facility waste: radioactive, polychlorinated biphenyl (PCB), hazardous, mixed (both radioactive and hazardous), sanitary, and industrial. The active waste management facilities at Y-12 involve over 35 facilities.

The DOE Oak Ridge Operations (ORO) Office manages environmental restoration investigation and remedial activities on the ORR, including Y-12. EM oversees and manages ORR remedial activities pursuant to the Federal Facilities Agreement for the ORR (DOE/OR-1014, January 1, 1992), serving as primary contact and coordinator with the regulators (the Tennessee Department of Environment and Conservation [TDEC] and the U.S. Environmental Protection Agency [EPA]) for implementing the Federal Facilities Agreement. There are several environmental restoration projects within the Y-12 area of analysis. These include the Bear Creek and Upper East Fork Poplar Creek watershed projects which have been merged and is now called the Y-12 Project. The environmental restoration projects are not expected to change as a result of the alternatives analyzed in the SWEIS. Ongoing environmental restoration activities have been analyzed and it is not expected that environmental restoration activities or actions which may be undertaken pursuant to the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) would change the alternatives considered in this SWEIS. In addition, the schedule for completion of activities would not change.

Nuclear Nonproliferation and National Security. The Nuclear Nonproliferation and National Security (NN) Program is responsible for the disposition of surplus fissile materials (surplus fissle materials were formally under the DOE Office of Materials Disposition). NN is also responsible for implementing a nuclear nonproliferation policy, bilateral nuclear treaties, and agreements with the International Atomic Energy Agency (IAEA). The National Security Program Office is responsible for supporting all NN nuclear and nonproliferation programs, verification activities, bilateral treaty support, and the interface role with the IAEA related to uranium. The HEU Disposition Project Office at Y-12 is responsible to NN for planning and technical support for surplus HEU disposition. In support of this mission, programs at Y-12 include Surplus HEU Management and Storage, and Blending of Surplus HEU, including storage and handling of low enriched uranium and natural uranium blendstock.

Nuclear Energy. Nuclear Energy, Science and Technology is responsible for maintaining the Nation's access to diverse energy sources as well as economic and technological competitiveness. Key activities include providing a nuclear power system for National Aeronautics and Space Administration space missions; serving the national need for a reliable supply of isotopes for medicine, industry, and research; conducting research and development (R&D) associated with the long-term operations of current nuclear power plants; exploring advanced nuclear energy technologies; and ensuring the safe operations of reactors in DOE laboratories. Y-12 facilities are used by Nuclear Energy, Science and Technology to support certain program activities.

Nondefense Research and Development. ORNL uses some Y-12 facilities to house and support the laboratory's R&D activities. ORNL facility uses at Y-12 include Life Sciences, Physical Sciences, Technology Development, Technical Services, and Support Services. Other facilities are used for multiple purposes.

The Engineering Technology Division has developed a unique capability in manufacturing technologies by integrating complementary resources within ORNL and Y-12. Within this complex the ORNL R&D capabilities in materials and processes are meshed with the manufacturing, fabrication, and inspection skills of Y-12. This combination of R&D, and manufacturing expertise has been combined with over 27,870 m^2 (300,000 ft^2) of manufacturing space and over 1,200 pieces of modern fabrication-related equipment to form the basis for the Oak Ridge Centers for Manufacturing Technology and the Y-12 National Prototyping Center, which is physically located within the east end of Y-12. The division has been the key integrator between Y-12 and ORNL. Capabilities include composites manufacturing technology, photonics, diagnostics, ultra precision manufacturing, coatings, energy conservation, and environmentally conscious manufacturing.

Science. The DOE Office of Science activities at Y-12 include the Field Research Center component of the ORNL NABIR Program (DOE 2000b) being implemented at Y-12, the ORNL Mouse House, and Fission Energy research activities.

Work-for-Others Program. The Work-for-Others Program draws on Y-12 capabilities in computer science, mathematics, statistics, physical sciences, social sciences, life sciences, technology development, and all engineering disciplines. The Work-for-Others Program objectives are to make the ORR's R&D and prototyping capabilities available to both Federal agencies (such as U.S. DoD, National Aeronautics and Space Administration, etc.) and the private sector to:

- Solve complex problems of national importance
- Improve present capabilities for future DOE programs
- Transfer technology to industry to strengthen the U.S. industrial base

The Work-for-Others Program at ORR has been and is currently involved in advanced work in the environmental, information management, materials, precision machining, hardware prototyping, and robotics technologies. These activities are carried out in various Y-12 facilities in conjunction with ongoing DOE DP activities.

Technology Transfer Program. The Technology Transfer Program is hosted by DOE and has as its goal to apply unique expertise, initially developed for highly specialized military purposes, to a wide range of manufacturing situations to support expansion of the capabilities of the U.S. industrial base. These activities are carried out in various Y-12 facilities in conjunction with ongoing DP activities.

S.1.5.2 *Stockpile Management Restructuring Initiative*

The ongoing Stockpile Management Restructuring Initiative project supports the plan for downsizing the Y-12 Plant consistent with the future secondary and case manufacturing mission defined by the SSM PEIS and ROD. The purpose of the Stockpile Management Restructuring Initiative project is to assist in preparing the Y-12 Plant for the future production mission requirements for nuclear weapons secondaries, case components, and other miscellaneous components, as well as providing a smaller, more cost-effective production size. The ongoing downsizing task is to minimize the number of major buildings required while maintaining the capability to perform the DP production mission.

S.1.5.3 *Y-12 Site Integrated Modernization Program*

In 1999, DOE Headquarters asked DOE-ORO and Lockheed Martin Energy Systems, Inc. (LMES) to determine what activities would be required to develop and implement a program to modernize Y-12's facilities and ensure its capability to meet future stockpile needs. Consistent with that request, the Y-12 Site Integrated Modernization (Y-SIM) Program was established to develop and is currently implementing plans for modernizing Y-12.

The envisioned modernized Y-12 Plant includes the eventual replacement or upgrade of all major production facilities that support the DP Mission. Whereas current operations are housed in multiple facilities scattered throughout the west end of the Y-12 Plant, the Y-SIM-envisioned Plant would consolidate operations into fewer, more efficient facilities. The ultimate goal is a modernized Y-12 Plant containing the following facilities:

- HEU Materials Facility for storage of assembled weapons secondaries and other forms of highly enriched uranium
- Special Materials Complex for production of special materials
- Enriched Uranium Manufacturing Facility
- Assembly/Disassembly/Quality Evaluation Facility for the assembly, disassembly, and surveillance of nuclear weapons secondaries
- Lithium Operations Complex for production of lithium hydride and lithium deuteride parts
- Depleted Uranium Operations Facility for production of depleted uranium parts and other nonnuclear components
- Other production support facilities
- Utility and infrastructure facilities

The extent of Y-12 modernization toward this desired goal is dependent upon many factors, including sustained funding. Construction of new facilities proposed by the Y-SIM Program would be accomplished through a series of Budget Line Item construction projects. The Y-SIM Program would improve Y-12 capabilities by:

- Improving worker protection through the use of engineered controls
- Improving safety, environmental, and security compliance through the use of modern facilities and advanced technologies
- Supporting responsiveness to the Science-based Stockpile Stewardship Program through increased flexibility and use of advanced technologies

- Reducing costs through lowered maintenance costs and improved operating efficiencies

For the HEU Materials Facility, the first component of the Y-SIM Program, the Highly Enriched Uranium Materials Facility Conceptual Design Report (Y-12 1999a) has been prepared and issued, the Project Execution Plan has been prepared, and activities have been performed to support an Independent Project Assessment and project validation to include it as a Fiscal Year (FY) 2001 Line Item Project. In addition, planning and designing of the Special Materials Complex have been expedited to bring this proposed new facility to construction in FY 2003. Alternatives for the siting, construction, and operation of the HEU Materials Facility and Special Materials Complex are included in this Y-12 SWEIS. The other potential Y-SIM Program production, production support, and utility and infrastructure facilities are still under early feasibility study and are not included as proposed projects in the Y-12 SWEIS. Further NEPA review would be required if these facilities are proposed and ripe for decision.

S.1.6 Public Scoping

S.1.6.1 *Issue Identification Process*

DOE published the Notice of Intent (NOI) to prepare the Y-12 SWEIS in the *Federal Register* on March 17, 1999 (64 FR 13179). Additional public notice of the proposed SWEIS and the schedule for public scoping meetings were provided through the placement of advertisements in local newspapers. The public scoping period began on that day and continued through May 17, 1999. DOE invited the public to submit comments during the scoping period by postal mail, electronic mail, fax, telephone, and through written and verbal comments submitted at the public scoping meetings.

Both afternoon and evening public scoping meetings were held in Oak Ridge, TN, on April 13, 1999. More than 345 people attended the two scoping meetings held at the Oak Ridge Community Conference Center at the Oak Ridge Mall.

A court reporter typed verbatim transcripts of the entire scoping meetings and an audiotape was made of the proceedings. Blank comment forms were available for those members of the public who preferred to provide written comments. Exhibits and handouts about the Y-12 Site, the Y-12 SWEIS, the NEPA process, and the NOI were available at each meeting. Technical representatives were present to answer questions.

DOE public reading rooms in the Oak Ridge area were provided copies of the public notices, written public comments, and the transcripts of the scoping meetings. A database was created to track written and oral comments received during the scoping period. A total of 574 people submitted 701 individual comments that were recorded in the database. The comments were characterized and grouped within 20 major issue categories.

S.1.6.2 *Results of Public Scoping*

DOE's disposition of the issues raised during public scoping for the Y-12 SWEIS was published in the Scoping Summary Report for the Site-Wide Environmental Impact Statement, Oak Ridge Y-12 Plant (DOE 1999h) and placed in the Oak Ridge area DOE Reading Rooms at the following locations:

DOE Public Reading Room
230 Warehouse Road
Building1916-T-2, Suite 300
Oak Ridge, Tennessee 37831

Oak Ridge Public Library
1401 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

The document can also be viewed on the DOE-ORO Home Page: http://www.oakridge.doe.gov.

S.1.6.2.1 *Major Scoping Comments*

DOE has considered all scoping comments in preparing the draft Y-12 SWEIS. The major issues identified by the public centered on the shutdown of the Y-12 Plant, Proposed Action and Alternatives, the Y-SIM Program, and the health and safety of workers and the public. The major issues are discussed further in this section and addressed throughout the SWEIS.

Of 701 total comments, 503 related to the SWEIS alternatives (a postcard campaign accounted for 461 of these comments), 67 addressed modernization, and 17 focused on occupational and public health. Of the remaining 114 comments, 62 addressed specific resource areas, while 52 were considered outside the scope of this SWEIS.

Shutdown of the Y-12 Plant. Some commentors opposed continuation of operations at the Y-12 Plant associated with weapons production. Several individuals stated that the production of nuclear weapons and materials should be halted immediately. Public health and safety related to Y-12 weapons production activities were also areas of concern.

The decision to continue the weapons production mission at Y-12 has already been made by DOE in the SSM PEIS ROD. Shuting down Y-12 is not a viable alternative at this time (see Section S.3.1.4). The need for nuclear weapons has already been determined by the President and Congress, and is an issue that is beyond the scope of the Y-12 SWEIS. The impacts on worker and public health and safety from Y-12 operations are included and analyzed in Chapter 5 of the SWEIS.

Proposed Action and Alternatives. Commentors expressed a variety of opinions and preferences on the alternatives addressed in the SWEIS. Comments focused on which alternatives should be implemented in modernizing the Y-12 Plant and the preferred alternative that should be selected by DOE.

Commentors expressed confusion as to the exact definition of No Action and how the SWEIS would analyze this alternative. Some commentors stated that a total halt to weapons production at Y-12 and shutdown of the facility should be considered as the No Action Alternative. Other commentors stated that the No Action Alternative was not a viable alternative as indicated in the NOI because the Y-12 Plant was needed to support the Nation's Nuclear Weapon Stockpile; however, the commentors noted that NEPA regulations require analysis of a No Action Alternative.

Some commentors stated that the Y-12 mission could be accomplished solely with consolidation and upgrade of existing facilities as analyzed in the SSM PEIS. Others stated that DOE should pursue the total modernization of the Y-12 Plant via all new construction. A number of comments were received through a postcard campaign that supported the modernization of the Y-12 Plant by using a combination of upgrades to existing facilities and construction of new facilities as appropriate. Commentors wanted specific buildings identified that would be upgraded or vacated due to construction, even if they were tentative designations.

DOE has considered all comments on alternatives for the Y-12 SWEIS and has addressed the major comments described above in the following manner.

Shutting down the Y-12 Plant is not a viable alternative as explained in the NOI issued on March 17, 1999 (64 FR 13179). DOE has already decided in the SSM PEIS and S&D PEIS RODs that the mission at Y-12 would continue (see Section 3.4 of the SWEIS). Therefore, the No Action - Planning Basis Operations Alternative analyzed in this SWEIS addresses the continuation of Y-12 historic missions. This alternative reflects the Y-12 Plant operations at planned weapons production support levels (see Section S. 3.1.3). A No Action - Status Quo Alternative, which is basically the status of Y-12 Plant in 1998, is also presented in the SWEIS to show the potential increase in production levels and potential impacts under the No Action - Planning Basis Operations Alternative and other alternatives. The No Action - Status Quo Alternative does not meet Y-12 mission requirements and is not considered reasonable because most Y-12 Plant operations were not operating in 1998 as a result of the 1994 stand-down of Y-12.

The Y-12 Plant consolidation efforts analyzed in the SSM PEIS are included in the Stockpile Management Restructuring Initiative (see Section S.1.5.2) which implements the plan for downsizing the Y-12 Plant. The potential impacts of consolidation and limited upgrade are included under the No Action - Planning Basis Operations (see Section 3.2.1.1 of the SWEIS) and consistent with the SSM PEIS ROD. Because of the age of Y-12 facilities, new requirements for natural phenomena and worker health standards, and limited budgets, upgrade alone is not considered a reasonable approach to continue the Y-12 Plant mission and meet long-term workload requirements.

Construction of an all new Y-12 Plant is not considered an alternative in the SWEIS. The Y-SIM Program, which is the foundation for an all new Y-12 Plant proposal, is a long-term process and most projects are not developed to the extent that they can be proposed and analyzed under NEPA at this time. However, new construction alternatives to support the Y-12 Plant HEU Storage Mission and the Special Materials Mission are included in the SWEIS (see Section S.3.2.3 and S.3.2.4). DOE's preferred alternative is Alternative 4 (i.e., DOE's preferred alternative for the HEU Storage Mission is to construct and operate a new HEU Materials Facility. The preferred alternative for the Special Materials Mission at Y-12 is to construct and operate the new Special Materials Complex.) A preferred site for each of these facilities will be identified in the Final Y-12 SWEIS.

Y-12 Site Integrated Modernization Program. Many commentors expressed concern about the advanced age of the Y-12 facilities because many of the buildings are more than 40 years old. These commentors stated that the facilities should be modernized to reduce operating costs and to enhance environment, safety and health (ES&H) requirements. Some commentors expressed concern about the potential budget impacts of modernization on EM activities and pointed out that it is more difficult to assign a cost to such things as environmental issues and health and safety.

It also was the opinion of many commentors that modernization of Y-12 should not be delayed and should be conducted in an integrated way. Alternatively, one commentor opposed any modernization of nuclear processes and facilities and suggested several sub-alternatives for modernization and consolidation for those activities associated only with dismantling weapons and processing and storage of HEU.

As explained in Section S.1.5.3, the Y-SIM Program is a long-term process designed to modernize the Y-12 Plant in an integrated way so as not to disrupt the assigned weapons mission support activities or jeopardize the Y-12 weapons production capabilities. The parts of modernization that can be analyzed at this time are included in the SWEIS (i.e., the HEU Storage Mission Alternatives and the Special Materials Mission Alternatives; see Sections S.3.2.3 and S.3.2.4). The potential future modernization projects, such as the Enriched Uranium Manufacturing Facility are described in Section 3.3 of the SWEIS, but are not analyzed as proposed projects in the SWEIS. All modernization projects, as well as EM activities, are subject to congressional budget appropriations and changes.

Alternatives that eliminate components of the mission at Y-12 (i.e., weapons production and support activities) are not viable alternatives since they would not continue the current Y-12 mission, nor would such alternatives be consistent with the SSM PEIS ROD (see Section S.3.1.4).

Worker and Public Health and Safety. Comments related to worker and public health and safety stated that the SWEIS should address enriched uranium, beryllium, and other radiological and hazardous materials. This included the request that the SWEIS discuss analysis of off-site exposure to uranium-contaminated dust, potential hazard to workers due to external gamma and possible criticality reactions from storage of enriched uranium, and a chronic beryllium disease management plan.

The SWEIS analyzes potential worker and public health impacts associated with criteria pollutants, hazardous air pollutants and radiological air pollutants in Section 5.12 of this SWEIS. Criticality accidents are addressed in Section 5.14 and Appendix D of the SWEIS. Appendix D.6 presents summaries on past or ongoing beryllium studies associated with Y-12 workers and the public.

S.2 PURPOSE AND NEED

The end of the Cold War resulted in the curtailment of new nuclear weapons design and production programs, a significant reduction in funding for maintaining the nuclear weapons stockpile, and the adoption of a comprehensive ban on nuclear testing. Y-12, the oldest of the Nation's nuclear weapons production facilities, now faces significant and diverse new challenges in its national security mission.

As discussed in S.1.2, DOE has prepared several PEISs to determine how best to carry out its national security requirements in the post-Cold War era. Based on those PEISs, DOE has made a number of decisions related to the long-term storage and disposition of fissile material, the maintenance of national security missions, and assurance of the safety and reliability of the nuclear weapons stockpile. In accordance with these programmatic decisions, Y-12 will continue to play an integral role in the continuance of DOE's programs supporting the Nation's nuclear defense. The purpose of DOE's action is to implement the programmatic decisions previously announced in the ROD's for the SSM PEIS and the S&D PEIS.

During the Cold War, new weapons programs provided capital investment in the DOE weapons production plants, supporting development of new technologies and construction of new and updated facilities. The end of the Cold War, together with a shrinking defense budget, halted the regular infusion of capital and technology into the plants. This situation has resulted in an 80 percent reduction in annual capital investments at the Y-12 Site and significantly increased the Y-12 Plant's maintenance backlog. Today, Y-12 is using 1980s or older processes and technologies to perform its missions. The situation at Y-12 is one in which DOE is faced with the following choices: continue to pursue expensive stop-gap repair operations or invest sufficient capital in Y-12 to modernize technologies and facilities.

The primary purpose of this SWEIS is to document a baseline for Y-12 mission operations and to evaluate the reasonable alternatives for implementing the programmatic decisions previously announced in the RODs for the SSM PEIS and the S&D PEIS. In those PEIS RODs, DOE determined that the current mission will remain at Y-12. DOE has also determined that the existing Y-12 facilities are old, over-sized, inefficient, not cost-effective, and do not maximize the attainment of ES&H goals. Consequently, this SWEIS evaluates reasonable alternatives for modernizing the HEU Storage Mission and Special Materials Mission at Y-12 to maximize efficiency, cost-effectiveness, and ES&H goals.

The purpose and need for the proposed HEU Storage Facility and the proposed Special Materials Complex are presented below.

HEU Storage Mission. The purpose of DOE's proposed action is to consolidate and modernize the HEU storage operations at Y-12 in accordance with the S&D PEIS ROD. By consolidating HEU in a new modern facility, Y-12 would be able to meet its HEU storage mission in a more efficient manner; improve nuclear materials security and accountability; and enhance worker, public, and environmental safety. DOE's action is needed because existing HEU storage facilities at Y-12 are in buildings that already are 35-55 years old and require significant maintenance and funding to maintain operations and security protocol. In addition, some of the buildings in which storage facilities are located do not meet current standards for natural phenomenon events (e.g., tornado and seismic occurrences).

Special Materials Mission. The purpose of DOE's proposed action is to modernize special materials operations to meet projected nuclear weapons stockpile requirements in accordance with the SSM PEIS ROD and meet more protective beryllium exposure limits for workers. The action is needed because the existing processes and facilities at Y-12 needed to support production of special materials have deteriorated to the point that DOE can no longer be assured of their operational reliability. In addition, DOE must meet more stringent American Conference of Governmental Industrial Hygienists (ACGIH) exposure limits for suspended beryllium in air of 0.2 Fg/m^3. The new exposure limits cannot be met using existing Y-12 facilities without excessive administrative controls and personal protective equipment which would reduce production efficiencies and jeopardize meeting nuclear weapons stockpile mission support requirements. DOE's action would ensure efficient production of adequate quantities of special materials for all anticipated scenarios considered in the nuclear weapons stockpile for the next 50 years, and reduce the health risk to workers and the public.

S.3 Y-12 SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT ALTERNATIVES

S.3.1 Development of Alternatives

The DOE NEPA strategy for the SSM and the S&D Programs consists of multiple phases. The first phase was to prepare PEISs (now completed) to support program-wide decisions. In the second phase, DOE would prepare any necessary site-wide and/or project-specific NEPA documents required to implement any programmatic decisions. This Y-12 SWEIS is the next step for DOE's NEPA strategy for Y-12. As such, the proposed actions in this SWEIS are consistent with previous DOE decisions in the PEIS RODs to continue to operate and downsize Y-12, and to store nonsurplus and surplus enriched uranium. This Y-12 SWEIS takes the mission decisions made in the SSM and S&D PEIS RODs and analyzes the potential environmental impacts associated with the various alternatives for implementing these decisions.

The alternatives presented in the Y-12 SWEIS have evolved, and in the process changed significantly from those identified in the NOI on March 17, 1999. Internal DOE scoping, which formed the alternatives in the NOI, focused on the modernization of the Y-12 Plant. In this respect, alternatives (i.e., Upgrade Alternative, New Construction Alternative, and Upgrade/New Construction Alternative) centered on upgrades and new construction at the Y-12 for DOE to accomplish the mission assigned to Y-12 based on SSM PEIS and S&D PEIS ROD decisions. During preparation of the Y-12 SWEIS it became apparent that these alternatives were too broad, not well defined, and lacked in data needed to analyze the potential impacts. A reevaluation of the DOE proposed action for the Y-12 Plant resulted in the current alternatives analyzed in the Y-12 SWEIS. The new alternatives focus on two of Y-12 Plant's mission components, the HEU Storage Mission and the Special Materials Mission.

S.3.1.1 *Major Planning Assumptions*

The planning assumptions and considerations that form the basis of the analyses and impact assessments presented in the SWEIS are listed below.

- ***Assumption 1:*** The mission at Y-12 will not change and is consistent with the decisions reached in the SSM PEIS ROD and the S&D PEIS ROD. All alternatives are based on this assumption. Two No Action Alternatives are presented in the Y-12 SWEIS: No Action - Status Quo and No Action - Planning Basis Operations. The No Action - Status Quo Alternative represents the current level of operations, i.e., the operations of Y-12 at the current (1998) level reported in the Annual Site Enviromental Report (ASER) issued in 1999. Approximately 40 percent of operations associated with DP's assigned mission were operational ready in 1998 (following the Y-12 Plant stand-down in 1994). About 10 percent of actual operating capacity was achieved. As discussed in the "Forty Most Asked Questions Concerning CEQ's NEPA Regulations," (46 FR 18026, as amended), "No Action" may also mean "no change" from current management directions. Accordingly, this SWEIS also evaluates a No Action - Planning Basis Operations Alternative for the Y-12 Site that presents the continuation of historical mission operations at the Y-12 Plant consistent with the RODs from the SSM and S&D PEIS. The No Action - Planning Basis Operations Alternative includes the resumption of all remaining weapons program operations at Y-12 which have been in stand-down since 1994. No major upgrades or new construction of DP facilities to maintain weapon program capabilities or capacity are included under the No Action - Planning Basis Operations Alternative. The No Action - Planning Basis Operations Alternative does incorporate ongoing upgrades to existing facilities that address action items or findings from past reviews (e.g., HEU vulnerability or health and safety studies) to resolve the findings.

- ***Assumption 2:*** To modernize Y-12's current mission capabilities and address long-term ES&H requirements, DOE is proposing new facilities for the HEU Storage Mission and Special Materials Mission at Y-12. Various alternatives for these two new facilities, the HEU Materials Facility and the Special Materials Complex, are analyzed in this SWEIS. These proposed projects are independent actions to each other (i.e. decision making for one project does not influence, and is not influenced by, decision making for the other project).

  Other potential modernization projects in the early planning stages have been developed to the extent practical and are described in Section 3.3 of the SWEIS. The potential impacts of these projects are addressed qualitatively and are included in the cumulative impacts in Chapter 6 of the SWEIS. These potential future projects would be addressed under separate NEPA review when conceptual design information is available and the time is appropriate to make a decision on the need for a specific facility.

- ***Assumption 3:*** The non-DP missions at Y-12 conducted by the Nuclear Energy, Nuclear Nonproliferation and National Security, Work-for-Others, and Technology Transfer programs are not expected to change significantly from the No Action - Status Quo Alternative over the next 10 years and would be the same as described in Chapter 2 and reflected in the current affected environment shown in Chapter 4 of the SWEIS. These missions are consistent with the missions already analyzed in the SSM PEIS, S&D PEIS, and the S-HEU EIS and are not expected to change. Budgeting and long-range planning for these programs indicate no major upgrades or new construction are proposed for these missions. To the extent that these missions do change or additional buildings or facilities are needed, they will undergo the appropriate NEPA analysis once sufficient data are available with which to assess the potential environmental impacts associated with such proposals.

- ***Assumption 4:*** NN missions at Y-12 involve the management of surplus HEU, including blending small quantities (i.e., kg/year) of HEU with low enriched uranium or natural uranium to produce a metal or oxide product suitable for use in various reactor programs, and for multiple supply orders to DOE customers. The HEU blending operations using existing Y-12 facilities and processes are included in the No Action - Planning Basis Operations Alternative.

- ***Assumption 5:*** Large volume (tons/year) down-blending of HEU at Y-12 has been considered by NN and analyzed under NEPA in the S-HEU EIS, but no projects to implement the activities (upgrade existing functions or new construction) have been proposed. Therefore, potential impacts of this down-blending are not included under No Action. However, the potential impacts from down-blending large quantities of HEU at Y-12 as described in the S-HEU EIS have been included in Chapter 6 (Cumulative Impacts) of this Y-12 SWEIS. Impacts of projects to upgrade or construct facilities will be analyzed when those projects are identified.

- ***Assumption 6:*** DP is currently storing ^{233}U in Building 3019 (Radiological Development Facility) at the ORNL. This facility is the ^{233}U National Repository and has been an ongoing operation at ORNL since 1982. The storage and disposition of this ^{233}U is not included in the scope of analysis for the Y-12 SWEIS because the material is not associated with Y-12's missions or located at the Y-12 Plant. The storage and disposition of this ^{233}U is currently planned for a separate NEPA review in the future. The planned NEPA review is expected to consider the status of the existing storage facility, the characterization of the material in storage (e.g., useful material or waste), the potential for beneficial uses of the material, the treatment of ^{233}U material prior to disposal, and the possible alternatives for relocation and storage. The potential use of Y-12 facilities or processes for treatment and/or storage of ^{233}U would be analyzed, if determined to be a viable candidate site for these actions, in the subsequent NEPA review.

- ***Assumption 7:*** Project construction material lay-down areas have been identified for the proposed HEU Materials Facility, the Upgrade Expansion of Building 9215, and the Special Materials Complex. Potential impacts associated with these lay-down areas are discussed in the SWEIS under each alternative. The identified sites of the construction lay-down areas are considered to be the best locations for each project based on project engineering cost and efficiencies; and their reasonable proximity to the actual construction sites. An optional construction material lay-down area may be available. The potential site is the current permanent MK Ferguson (on-site General Contractor) construction lay-down area located on Old Bear Creek Road west of the S-3 Parking Lot, as shown in Figure 3.2.1-1. Other than erection of a fence to separate the area into two areas (one for MK Ferguson materials and one for SWEIS project materials) there would be no additional major site preparations. Since the site is an operating construction material lay-down area, there would be no additional environmental impacts with the use of the site. However, availability of the MK Ferguson site for proposed HEU Storage Mission or Special Materials Mission project construction support is uncertain, therefore, the impacts of this potential option are not presented in the SWEIS. If the MK Ferguson construction lay-down area were available and used for the HEU Storage Mission or Special Materials Mission Alternatives construction projects, the potential impacts discussed in the SWEIS associated with the identified construction lay-down areas would not occur.

S.3.1.2 *No Action - Status Quo Alternative (Defense Programs Operations and Emissions)*

The DNFSB mandated stand-down of the Y-12 Plant in 1994 essentially curtailed most Y-12 weapons program support activities. Because operations still have not resumed to full levels, the 1998 environmental conditions and operations described in Chapter 4 of the SWEIS do not reflect a fully functional Y-12 Plant performing its assigned mission at required and planned work levels.

In 1998, approximately 40 percent of the types of Y-12 Plant operations needed to support Y-12 mission requirements had achieved operational readiness from the 1994 stand-down, and about 10 percent of Y-12 Plant operational capacity was being used. Most of the 10 percent operating capacity during 1998 resulted from the continued operation of a few critical operations at Y-12 that were required to maintain the nuclear weapons stockpile. Therefore, the environmental monitoring and environmental surveillance information described in Chapter 4, reflect only a small part of the typical operating conditions (i.e., as occured prior to the 1994 stand-down and will resume in the near future). To aid the reader in identifying the differences between operations and environmental conditions as they are now compared to what they will be under a fully operational Y-12, a No Action - Status Quo Alternative is provided in the SWEIS. The No Action - Planning Basis Operations Alternative (discussed below) provides a second benchmark for comparison to the action alternatives. The No Action - Status Quo Alternative, which is basically a continuation of the status of Y-12 in 1998, is presented in the SWEIS to show the potential increase in production levels and potential impacts under the No Action - Planning Basis Operations Alternative and other alternatives described in Section S.3.2. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it does not meet Y-12 mission requirements.

S.3.1.3 *No Action - Planning Basis Operations Alternative (Defense Programs Operation and Emissions)*

The Y-12 Plant has not operated at required and planned operation levels since the stand-down in September 1994. Additionally, enriched uranium metal operations performed in Building 9212 were shut down prior to the stand-down for modification in 1989. The modifications were completed but not before the stand-down prevented their restart. Since all required Y-12 DP mission functions have not been operating, existing Y-12 conditions for the most part do not represent a fully operational Y-12 Plant performing assigned mission operations at required levels to support the nuclear weapons stockpile. Therefore, an estimate of planned Weapons Program and Y-12 Plant workload schedules was compared to historical Y-12 Plant operations prior to the 1994 stand-down to estimate the DP planning basis operations requirements and potential emissions for use as a second No Action Alternative (i.e., No Action - Planning Basis Operations) in the Y-12 SWEIS for the 10-year planning period (Garber 2000).

The major production-related operations at the Y-12 Plant during the late 1980s involved enriched and depleted (or natural) uranium. These operations would resume and would continue under the No Action - Planning Basis Operations Alternative. Other activities conducted in that time period involving weapons materials included weapons disassembly, joint test assembly production, quality evaluation, and special production. These other activities have not been suspended and would continue through 2010. The contribution of these other program activities to uranium emissions and other effluents is very small relative to enriched and depleted uranium operations. While weapons dismantlement is expected to increase during the next 10 years, Y-12 Plant DP effluents and resource requirements should not vary appreciably from current baseline levels.

During the 1987 timeframe, enriched uranium recovery operations in Building 9212 were performed on a 3 shift-a-day, 7 day-a-week operation (21 shifts). Recovery operations in Building 9206 were also functioning at full capacity. An estimated 50 percent of the 1987 uranium operations emissions were from production operations and the remaining 50 percent were from enriched uranium recovery operations.

Weapons Program activity levels have been projected for the period 2001-2010 from the Stockpile Life Extension Program and other Y-12 Plant workload schedules. The weapons activity levels for this period were then associated with the respective enriched uranium production and recovery activities. The activity level for weapons production, quality evaluation, and special productions is estimated to be approximately 30 percent of the activity level at Y-12 experienced in 1987. Enriched uranium recovery operations during the period 2001-2010 is expected to be at levels equal to 1987 using 21-shift (3 shift-a-day, 7 day-a-week) operations. Therefore, uranium emission levels expected during the period 2001-2010 for enriched uranium recovery is estimated to be equal to 50 percent of the total uranium emissions for 1987. Enriched uranium emissions due to other weapons production activities are estimated to be 30 percent of the remaining 50 percent of the total uranium emissions for 1987. Thus the annual enriched uranium emissions and other process effluents from the Y-12 Plant for the period 2001-2010 are estimated to be 65 percent of the Y-12 Plant levels experienced in 1987. This estimate is considered a bounding case because of various process and facility improvements that have been incorporated at Y-12 since 1987, and because actual production levels will fluctuate over the 2001-2010 time period.

Depleted uranium and non- enriched uranium operations and emissions involving weapons materials are also expected to be at 30 percent of the levels experienced at Y-12 in 1987 except for Lithium Recovery Operations. During the period 2001-2010, Lithium Recovery Operations are expected to return to 100 percent of the levels experienced at Y-12 in 1987.

S.3.1.4 *Alternatives Considered But Eliminated From Detailed Consideration*

DOE is the Federal agency responsible for providing the Nation with nuclear warheads and ensuring that those weapons remain safe, secure, and reliable. By law, DOE is required to support the Nuclear Weapons Stockpile Plan. To do this, DOE must maintain a nuclear weapons production, maintenance, and surveillance capacity consistent with the President's Nuclear Weapons Stockpile Plan. For the proposed action (Continued Operation of Y-12 Missions), the following alternatives were considered but eliminated from detailed study for the reasons stated.

Site Closure with Complete Environmental Restoration. Members of the public have in the past, and during public scoping for the SWEIS, stated that DOE should analyze shutting down all operations at Y-12, deactivating some or all of the facilities, and cleaning up the Site for other potential uses. DOE has already considered these suggestions in previous DOE programmatic NEPA documents, specifically the SSM PEIS and the S&D PEIS. DOE recognizes that Y-12 has unique capabilities and diverse roles supporting a variety of national programs, and that there is an essential near-term need to manage and maintain the safety and stability of the existing nuclear materials inventory. In addition, the National Security Strategy for a New Century, issued by the White House in October 1998, emphasizes the need to "ensure the continued viability of the infrastructure that supports U.S. nuclear forces and weapons." Until relieved of its mission to support the enduring nuclear weapons stockpile by the President and Congress, DOE must maintain its DP operations at the Y-12 Plant. Accordingly, the DOE view at this time is that a decision to shut down or further reduce Y-12 missions within the timeframe of the SWEIS would be highly unlikely and an unreasonable alternative.

Construction of an All New, Smaller Y-12 Plant. Some members of the public proposed that DOE analyze building an all new Y-12 Plant (implementing all of the Y-SIM Program projects), cleaning up the vacated facilities, and encouraging reindustrialization of the old Y-12 Site.

The long-term planning for the Y-12 Plant is being addressed in the Y-SIM Program; however, this program spans 30 years or more and includes many potential production, support, and infrastructure projects (see Section S.1.5.3). The new, smaller and more modern Y-12 envisioned by the Y-SIM Program is only conceptual at best. Although some components of the program are more defined and further along in the planning process, there is no proposal or data to support analyses of a "new" Y-12. Components of the program are prioritized based on Y-12 mission requirements and ES&H needs and are subject to limited funding levels. Therefore, creating an all new Y-12 Plant would be highly unlikely, financially remote, and unsupported by design information and data for analysis to be considered a reasonable alternative.

Upgrade Existing Facilities for Special Materials Missions. DOE considered the feasibility of renovating existing facilities needed to meet special materials operation requirements as part of the Y-SIM Program. The review indicated that extensive and costly renovation of the facilities would be required to meet ES&H and mission requirements. The existing special materials facilities range from 27 to more than 50 years old and incur significant maintenance and operating costs while failing to meet future missions and safety requirements. Although renovation of some existing facilities is possible to meet capability, capacity, and ES&H requirements, other facilities cannot be upgraded. Those facilities that can be upgraded would incur extensive costs and inefficiencies because of the use of multiple aging facilities. Facilities that cannot be upgraded must be replaced by new facilities or newly constructed operations areas in existing buildings. Even though requirements could be satisfied, inefficiency from the use of multiple facilities, duplication of support services, and continued degradation of the structural integrity of old buildings and infrastructure renders this a nonviable alternative.

S.3.2 Alternatives

Because all operations at the Y-12 Plant have not regained operational readiness from the stand-down of the Y-12 Plant in 1994, the existing Y-12 activities and environmental conditions do not reflect a true No Action for the Y-12 Site for comparison of action alternative impacts. Therefore two No Action Alternatives are presented in the SWEIS: No Action - Status Quo and No Action - Planning Basis Operations. The No Action - Status Quo Alternative, which is basically the status of Y-12 in 1998, is presented in the SWEIS to show the increase in production levels and potential impacts under the No Action - Planning Basis Operations Alternative and the other alternatives. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it would not meet Y-12 mission requirements. The No Action - Planning Basis Operations Alternative represents a Y-12 Plant operated at full planned and required work levels.

Alternatives analyzed in the Y-12 SWEIS include the No Action - Planning Basis Operations Alternative for the mission at Y-12 and site-specific alternatives for two of Y-12's mission components (i.e., HEU Storage Mission and Specials Materials Mission). Table S.3.2-1 shows the Y-12 SWEIS Alternatives. There are two options for the Y-12 HEU Storage Mission: (1) construct and operate a new HEU Materials Facility, and (2) construct and operate an Upgrade Expansion to existing Building 9215. Under the new HEU Materials Facility construction option, two siting alternatives are analyzed (i.e., Sites A and B).

For the Special Materials Mission at Y-12, the alternative analyzed is to construct and operate a new Special Materials Complex. Three candidate sites are analyzed for construction and operation of the Special Materials Complex (i.e., Sites 1, 2, and 3).

Implementation of any of the action alternatives for the HEU Storage Mission or Special Materials Mission would result in the potential for surplus DP facilities and the possible transitioning to EM for cleanup and D&D. Appendix A.1 of the SWEIS describes the Y-12 Plant facility transition process in detail. Estimated D&D wastes from vacated HEU storage facilities and special materials operation facilities are provided in Section 5.11.2 of the SWEIS.

S.3.2.1 *Alternative 1A (No Action - Status Quo Alternative)*

The No Action - Status Quo Alternative represents the current level of operations at Y-12 as reflected by the most recent monitoring data (1998) for the Y-12 Site and reported in the ASER issued in 1999. Although approximately 40 percent of the types of operations associated with DP's assigned mission were operational ready in 1998 (following the Y-12 Plant stand-down in 1994), the Y-12 Plant was only operating at 10 percent capacity. This state/condition is used in the SWEIS as a basis for comparison of the impacts associated with the No Action - Planning Basis Operations Alternative and the other alternatives that reflect full Y-12 DP mission operations at required levels and recently approved projects by EM and ORNL at Y-12. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it would not meet Y-12 mission needs and would not reflect DOE's decision in the SSM PEIS ROD (61 FR 68014) to maintain and downsize the DP mission at Y-12.

S.3.2.2 *Alternative 1B (No Action - Planning Basis Operations Alternative)*

Under the Alternative 1B (No Action - Planning Basis Operations Alternative), Y-12 would continue historic nuclear weapons program missions. The No Action - Planning Basis Operations Alternative reflects the implementation of the DOE decision in the SSM PEIS ROD (61 FR 68014) to maintain the DP national security mission at Y-12, but to downsize the Plant consistent with reduced requirements. This includes DP capabilities to produce and assemble uranium and lithium components, to recover uranium and lithium materials from the component fabrication process and disassembled weapons, to produce secondaries, cases, and related nonnuclear weapons components, to process and store enriched uranium and to supply enriched uranium, lithium, and other material products; EM activities at Y-12 related to environmental monitoring, remediation, deactivation and decontamination, and management of waste materials from past and current operations; Office of Science activities operated by ORNL; and DP support of other Federal agencies through the Work-for-Others Program, the National Prototype Center, and the transfer of highly specialized technologies to support the capabilities of the U.S. industrial base. The No - Action Planning Basis Operations Alternative also includes activities to store surplus enriched uranium pending disposition in accordance with the S&D PEIS ROD (62 FR 3014).

TABLE S.3.2–1.—*Y-12 SWEIS Alternatives*

Y-12 Mission	Alternative 1A No Action - Status Quo Alternative (Partial stand-down operation)
	Alternative 1B **No Action - Planning Basis Operations Alternative** (Continue historic mission operations)
HEU Storage Mission	**No Action (Same as Alternative 1B)** (Continue HEU storage in existing facilities) **Alternative 2A** **No Action - Planning Basis Operations Plus Construct and Operate New HEU Materials Facility** (Site A or Site B) **Alternative 2B** **No Action - Planning Basis Operations Plus Upgrade to existing Building 9215**
Special Materials Mission	**No Action (Same as Alternative 1B)** (Continue special materials operations in existing facilities with limited capabilities) **Alternative 3** **No Action - Planning Basis Operations Plus Construct and Operate New Special Materials Complex** (Site 1, Site 2, or Site 3)
Both HEU Storage Mission and Special Materials Mission	**No Action (Same as Alternative 1B)** (Continue historic HEU storage and special materials operations in existing facilities) **Alternative 4** **No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility and a New Special Materials Complex**

Nondefense-related program activities under No Action - Planning Basis Operations Alternative include the construction and operation of a new CERCLA waste disposal cell (referred to as the Environmental Management Waste Management Facility) to accommodate wastes resulting from environmental remediation, and the implementation of a new Office of Science Field Research Center project at Y-12. The Environmental Management Waste Management Facility would be constructed in Bear Creek Valley just west of the Y-12 Plant in an area currently designated for waste management activities.

Design elements of the Environmental Management Waste Management Facility include site development, the above-ground engineered disposal cell, and support facilities. The total disposal cell capacity is 273,000 m^3 (357,000 yd^3) for the low-end conceptual design and 1.3 million m^3 (1.7 million yd^3) for the high-end design. Figure S.3.2.2–1 shows the Environmental Management Waste Management Facility Site Plan.

A large volume of clay-rich soil would be needed from a borrow area in the vicinity of the disposal facility for construction of the geologic buffer, base liner, temporary covers during operations, and cap. The Y-12 West End Borrow Area contains a suitable volume and quality of material to meet the construction needs for the disposal unit. This facility is located on Chestnut Ridge, immediately south of Bear Creek Road and approximately 0.62 km (1 mi) east of State Route (SR) 95. The Y-12 West End Borrow Area would be expanded from its current area of 7.1 ha (17.5 acres) to between 12 and 15 ha (29 and 36 acres), depending on the waste volume scenario.

The Field Research Center component of the Office of Science NABIR Program would also be located in Bear Creek Valley near the S-3 Ponds. The Y-12 Field Research Center site would include a 98-ha (243-acre) previously disturbed contaminated area and a 163-ha (440-acre) background area. The contaminated area which is within the Y-12 SWEIS analysis area would be used for conducting experiments on contaminated groundwater and subsurface sediments. The background area which is outside of the Y-12 SWEIS analysis area would provide for comparison studies in an uncontaminated area. Initially, test plots of less than 0.4 ha (1 acre) would be constructed in proximity to the S-3 Ponds Site parking lot (Figure S.3.2.2–2).

The types of activities that could occur at the Field Research Center can be categorized into passive and active site characterization, obtaining research-quality samples, and in-situ research. The activities at the Field Research Center would be undertaken in an area limited to less than an acre and a depth of 23-m (75-ft).

Passive subsurface characterization activities are described as nonintrusive (e.g., ground-penetrating radar, electromagnetics, and resistivity) and intrusive (e.g., seismic tomography, direct push penetrometer, creation and use of injection/extraction wells). Active characterization can be defined as the addition of some substance (e.g., air, nontoxic chemical tracers such as bromide, or a gas tracer such as helium or neon) to the subsurface under controlled conditions. Approximately 40 in-situ research activities would be conducted over the 10-year life of the Field Research Center.

S.3.2.3 *Alternative 2 (No Action - Planning Basis Operations Alternative Plus HEU Storage Mission Alternatives)*

This alternative includes the No Action - Planning Basis Operations Alternative plus an HEU storage facility. Options considered for HEU storage include a new HEU Materials Facility at one of two proposed sites (i.e., Sites A and B), and expansion of Building 9215. Candidate sites for the new HEU Materials Facility are located on the west end of the Y-12 Plant in the West Portal Parking Lot (Site A) and in the area of the Y-12 Scrap Metal Yard (Site B). The proposed HEU Materials Facility would be a single-story concrete structure covered by an earthen berm. The new HEU Materials Facility, would enable Y-12 to safely and securely store Categories I and II HEU, including canned subassemblies that contain HEU; and HEU in metal and oxide form in cans that is part of the strategic reserve or excess inventories. Scrap materials that contain HEU awaiting recovery (Central Scrap Management Office scrap metal oxide and other miscellaneous compounds that are being returned from other DOE facilities and university programs) will be stored in existing facilities until reprocessed to an acceptable form. The expansion of Building 9215 would be a new two-story concrete and steel structure attached to the north end of the building. A discussion of each of the alternatives and the candidate sites for the proposed new HEU Materials Facility is provided in the following sections.

Source, Tetra Tech, Inc./DOE 1998a.

FIGURE S.3.2.2–1.—*The Environmental Management Waste Management Facility Site Plan.*

Source Tetra Tech, Inc./DOE 1999.

FIGURE S.3.2.2–2.—*Location of the Background Area and the Initial Test Plots within the Field Research Center, Contaminated Area at the Y-12 Plant.*

S.3.2.3.1 *Alternative 2A (No Action - Planning Basis Operations Alternative Plus Construct and Operate a New HEU Materials Facility)*

The proposed HEU Materials Facility would be a single structure with a total footprint of approximately 12,077 m^2 (130,000 ft^2). The HEU Materials Facility would replace the use of existing storage vaults and facilities located within existing Y-12 buildings. All operations associated with HEU storage would be transferred to the new HEU materials facility. Existing storage facilities would be declared surplus, used for other activities, or turned over to EM for D&D based on facility transition process review. The HEU Materials Facility would be used for long-term storage of Categories I and II HEU that is not "in process." In process HEU is material that is actually being used in manufacturing and is tied up in equipment or being handled within manufacturing facilities or part of processing activities. The new facility would provide the capacity to store approximately 14,000 cans and 14,000 drums (208-L [55-gal] equivalents) of HEU, a surge capacity area for an additional 4,000 drums, and a storage area for material currently under international safeguards. The facility would be covered by an earthen berm. Figure S.3.2.3–1 shows the proposed HEU Materials Facility.

HEU Materials Facility Candidate Sites

Site A. Site A for the proposed HEU Materials Facility is in the Y-12 West Portal Parking Lot, just north of Portal 16. This site is outside but adjacent to the existing Perimeter Intrusion Detection and Assessment System (PIDAS). Figure S.3.2.3–2 shows the location of Site A relative to other buildings at Y-12. The West Portal Parking Lot is close to the existing HEU processing complex and represents a large level site with minimal site preparation requirements. Site A preparation involves site design, relocation of existing utilities (e.g., lights, towers, and underground pipelines), construction of an addition to the Polaris Parking Lot, extension of utilities to the new facility site, modifications to an existing portal, removal of nearby office trailers, and modification of a cooling tower. The PIDAS would need to be extended to encompass this area after the HEU Materials Facility was completed.

Site B. Site B for the proposed HEU Materials Facility is located in the area of the Y-12 Scrap Metal Yard. The site is south of Building 9114, west of the western-most portion of the Y-12 PIDAS and north of Portal 33 and Second Street. Figure S.3.2.3–2 shows the location of Site B relative to other buildings at Y-12. The Old Bear Creek Road is the western boundary of the proposed Site B.

Site B preparation would involve site design and relocation of existing utilities (e.g., lights, underground water lines, storm sewers, steam lines), a portion of the Old Bear Creek Road, numerous structures, office trailers, and a portion of the Y-12 Scrap Metal Yard. The PIDAS would need to be extended to encompass this area after the HEU Materials Facility was completed. A sector of the existing PIDAS would need to be modified to install a vehicular entry gate for the new facility.

S.3.2.3.2 *Alternative 2B (No Action - Planning Basis Operations Alternative Plus Upgrade Expansion of Building 9215)*

Under this alternative, the storage of HEU would be accommodated through the expansion of the existing Building 9215. The building expansion, 8,918 m^2 (96,000 ft^2) would be approximately 48 by 90 m (160 by 300 ft) with two floors and would be sized to handle all of the long-term storage requirements anticipated for Y-12 similar to that described for the proposed new HEU Materials Facility. A modest amount of in-process storage associated with processing activities in Buildings 9212 and 9215 would continue.

Source: LMES 2000b.

FIGURE S.3.2.3–1.—*The Proposed New Highly Enriched Uranium Materials Facility.*

Source: tetra Tech, Inc./LMES 2000b.

FIGURE S.3.2.3–2.—*Sites A and B for the Proposed Highly Enriched Uranium Materials Facility.*

The proposed site for construction of the Building 9215 expansion is a parcel of land located west of Buildings 9212 and 9998 and north of Building 9215 as shown in Figure S.3.2.3–3. This parcel has no major permanent structures and is currently occupied by trailers and temporary facilities. The proposed site is on high ground within the PIDAS, not susceptible to flooding or stormwater runoff. The expansion of Building 9215 for HEU storage would require approximately 0.8 ha (2 acres) to accommodate the construction activities and the building expansion footprint. Personnel in the existing trailers would be relocated and the trailers would be removed and salvaged, other temporary facilities would be relocated and utilities and other infrastructure modified to support the construction activities and operation of the new expansion.

S.3.2.4 *Alternative 3 (No Action - Planning Basis Operations Alternative Plus Special Materials Mission Alternative)*

This alternative includes the No Action - Planning Basis Operations Alternative plus a new Special Materials Complex at one of three candidate sites. The proposed action is to construct and operate a new Special Materials Complex which would enable Y-12 to ensure efficient production of adequate quantities of special materials for all anticipated scenarios considered for the enduring nuclear weapons stockpile while providing for improved worker health and safety. A key component of the proposed Special Materials Complex is the construction of a new Beryllium Facility to house all beryllium production operations at Y-12. Facility design would incorporate strategies that replace the current administrative safety and health controls and personal protective equipment with engineered controls. A discussion of the alternatives and the candidate sites for the proposed new Special Materials Complex is provided in the following sections.

S.3.2.4.1 *No Action - Planning Basis Operations Alternative Plus Construct and Operate New Special Materials Complex*

The proposed Special Materials Complex shown in Figure S.3.2.4–1 would house a number of separate processing operations and the support facilities to serve each. These operations would be housed in distinct areas to ensure that the safety basis of the operation of each is independent of the other operation. Included in the Special Materials Complex would be:

- Beryllium production operations at Y-12
- A facility for purification of special materials
- A manufacturing/warehouse facility to produce special materials and provide for storage of new materials and parts
- An isostatic press for forming blanks for machining
- A core support structure to house common support functions for the complex

The facilities would be attached to one another with weather-protected walkways to facilitate the flow of materials.

FIGURE S.3.2.3–3.—*Proposed Building 9215 Expansion Area.*

Source: tetra Tech, Inc./LMES 2000b.

Special Materials Complex Candidate Sites

Site 1. Site 1 for the proposed Special Materials Complex is approximately 8 ha (20 acres) and is located northwest of Building 9114 and on the north side of Bear Creek Road. The Site is situated on the drainage divide of the East Fork Poplar Creek and Bear Creek watersheds. Approximately 50 percent of the Site is currently cleared at the base of Pine Ridge and the other 50 percent is wooded on the slope of the ridge. The site area has been used for a construction lay-down area in the past. Potential construction problems associated with legacy contamination from prior operations support activities are not expected. This Site is outside the existing Y-12 Plant PIDAS. Figure S.3.2.4–2 shows the location for Site 1 relative to other buildings at Y-12. Site 1 represents a large Site with no permanent building structures and minimal infrastructure. The topography of the Site would require a moderate amount of earthwork to prepare the Site for construction.

Site 1 preparation for the proposed new Special Materials Complex involves site design, relocation of some existing utilities (e.g., underground pipelines, communications lines, and power lines), and extension of utilities to the new facilities. The PIDAS would not be expanded for this facility, since it is a nonnuclear facility. A fence would be erected to control access.

Site 2. Site 2 for the proposed Special Materials Complex is approximately 4 ha (10 acres) and is located at the Y-12 Scrap Metal Yard southeast of Building 9114 and east of the westernmost portion of the Y-12 PIDAS fence. Figure S.3.2.4–2 shows the location of Site 2 relative to other buildings at Y-12.

Site 2 preparation would include site design, relocation of existing utilities (e.g., lights, underground water lines, storm sewers, steam lines), two structures, and a portion of the Y-12 Scrap Metal Yard. The existing Y-12 Plant PIDAS would not be affected since Site 2 is entirely within the PIDAS. However, a security fence would be erected to isolate the work during construction.

Site 3. Site 3 for the proposed Special Materials Complex (see Figure S.3.2.4–2) is the same site as Site B for the proposed HEU Materials Facility described earlier. The previous discussion of construction activities associated with the HEU Materials Facility would also apply to the construction of the proposed Special Materials Complex at Site 3, except that the PIDAS would not be expanded for the nonnuclear Special Materials Complex facilities.

S.3.2.5 *Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex)*

This alternative includes the No Action - Planning Basis Operations Alternative plus construction and operation of a New HEU Materials Facility at one of two proposed sites and construction and operation of a New Special Materials Complex at one of three proposed sites.

Source: LMES 2000c.

FIGURE S.3.2.4–1.—*The Proposed Special Materials Complex.*

Source: Tetra Tech, Inc./LMES 2000c.

FIGURE S.3.2.4–2.—*Sites 1, 2, and 3 for the Proposed Special Materials Complex.*

S.4 AFFECTED ENVIRONMENT

The ORR, of which Y-12 is a part, is in eastern Tennessee (see Figure S.1.1–1). Y-12 is approximately 40 km (25 mi) west of Knoxville. Y-12 covers about 1,457 ha (3,600 acres) bounded by Pine Ridge to the north, Scarboro Road to the east, and Bethel Valley Road to the south. Y-12 extends west to Mount Vernon Road and then west down Bear Creek Valley to the security fence near the Roane/Anderson County border. Approximately 5,300 employees work at Y-12.

Y-12, which was created in 1943, is a heavily industrialized area (Figure S.4–1). All alternatives described in the SWEIS, including the possible construction of new facilities to implement DOE's stated missions, would occur within existing industrialized or previously disturbed areas at Y -12.

The ORR encompasses about 13,968 ha (34,516 acres) of contiguous land owned by DOE in the Oak Ridge area. The majority of ORR land lies within the corporate limits of the city of Oak Ridge (246 ha [608 acres], west of the ETTP, in Roane County, is outside the city limits). The residential section of Oak Ridge forms the northern boundary of the reservation. The Tennessee Valley Authority's (TVA's) Melton Hill and Watts Bar reservoirs on the Clinch and Tennessee rivers form the southern and western boundaries of ORR. The population of the 10-county region surrounding the ORR is about 798,925, with 5 percent of its labor force employed on the reservation. Other towns near to the reservation include Oliver Springs, Clinton, Karns, Lenoir City, Farragut, Kingston, and Harriman. Knoxville, the major metropolitan area nearest Oak Ridge, is located about 40 km (25 mi) to the east and has a population of about 167,535. Except for the city of Oak Ridge, the land within 8 km (5 mi) of the ORR is semirural and is used primarily for residences, small farms, and cattle pasture. Fishing, boating, water skiing, and swimming are popular recreational activities in the area.

Primary roads on the ORR serving Y-12 include TSRs 95, 58, 62, and 170 (Bethel Valley Road), and Bear Creek Road. All are public roads except Bear Creek Road which traverses the ORR. Average daily traffic on ORR and area roads serving Y-12 ranges from 3,200 vehicles per day on West Bear Creek Road (Level-of- Service A) to 28,320 vehicles per day on TSR 62 from TSR 170 to TSR 95 (Level of Service E). Major off site area roads for long-distance transport of materials and waste include I-40, I-75, and I-81.

The ROI where more than 90 percent of the ORR workforce resides is a four county are in Tennessee comprised of Anderson, Knox, Loudon, and Roane Counties. In 1997, almost 40 percent of the ORR workforce resided in Knox County, 29 percent in Anderson County, 16 percent in Roane County, and 6 percent in Loudon County. The remaining 9 percent of the workforce resides in the other counties across Tennessee, none of which is home to more than 3 percent of the workforce (DOE 1999f).

ROI employment grew from 231,822 in 1990 to 268,748 in 1995, and continued to grow totaling 269,466 in 1998. The ROI labor force totaled 278,866 in 1998. The ROI unemployment rate was 3.4 percent in 1998. The unemployment rate in Tennessee was 4.2 percent in 1998 (BLS 1999). Per capita income in the ROI was $23,520 in 1997, while the per capita income in Tennessee was $22,699 (BEA 1999). Y-12 employs approximately 8,900 workers, including DOE employees and contractors. As a whole, DOE employees and contractors number more than 13,700 in Tennessee, primarily in the ROI.

Between 1990 and 1998, ROI population growth increased 1.1 percent annually while the state population increased 1.4 percent annually. Population in all counties in the ROI is projected to continue to grow at a somewhat slower rate between 1998 and 2020. Knox County is the largest county in the ROI with a 1998 population of 366,846. Loudon County is the smallest county in the ROI with a total population of 39,052.

FIGURE S.4–1.—*Aerial View Looking West of the Y-12 Plant at Oak Ridge Reservation, Tennessee.*

Source: LMES 2000a.

Biological resources at Y-12 include terrestrial resources, wetlands, aquatic resources, and threatened and endangered (T&E) species. Within the fenced, developed portion of Y-12, grassy and devegetated areas surround the entire facility. Buildings and parking lots dominate the landscape in Y-12, with limited vegetation present (ORNL 1992a). Fauna within the Y-12 area is limited by the lack of large areas of natural habitat.

A Biological Monitoring and Abatement Program was established in conjunction with the NPDES permit issues to Y-12 in 1992. The program includes toxicity monitoring, bioaccumulation studies, biological indicator studies, and ecological surveys. Toxicity testing and bioaccumulation studies indicate that the exposure of aquatic organisms in UEFPC to toxicants has been steadily decreasing as a result of remedial activities such as implementations of flow management and continuing mercury reductions at Y-12 (LMER 1999a).

The climate of the region may be broadly classified as humid continental. The mean annual temperature for the Oak Ridge area is 14.0EC (57.2EF). The coldest month is usually January, with temperatures averaging about 2.2EC (36EF). July is typically the hottest month of the year, with temperatures averaging 24.9EC (76.8EF). The 1998 average temperature as measured at the meteorological towers on the ORR was 15.8EC (60.4EC).

Winds in the Oak Ridge area are controlled in large part by the valley-and-ridge topography. Prevailing winds are either up-valley (northeasterly) daytime winds or down-valley (southwesterly) nighttime winds. Wind speeds are less than 11.9 km/hour (7.4 mph) 75 percent of the time; tornadoes and winds exceeding 30 km/hour (18.5 mph) are rare. Air stagnation is relatively common in eastern Tennessee (about twice that of western Tennessee). An average of about two multiple-day air stagnation episodes occurs annually in eastern Tennessee, to cover an average of about 8 days per year. August, September, and October are the most likely months for air stagnation episodes.

Average rainfall on the ORR in 1998 as measured at the meteorological towers was 128.4 cm (50.6 in). Precipitation in the region is greatest in the winter months (December through February). The driest periods generally occur during the fall months, when high pressure systems are most frequent.

Y-12's heavily industrialized development is consistent with BLM's VRM Class 5. Structures at Y-12 are mostly low profile reaching heights of three stories or less, with the expectation of the East and West meteorological towers. Viewpoints affected by DOE facilities are primarily associated with the public access roadways, the Clinch River/Melton Hill Lake and the bluffs on the opposite side of Clinch River. Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric condition. Y-12 missions activities are consistent with BLM's VRM Class 5 classification for developed areas of ORR.

Major noise emission sources within Y-12 include various industrial facilities, equipment and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most Y-12 industrial facilities are at a sufficient distance from the Y-12 boundary so noise levels at the boundary from these sources would not be distinguishable from background noise levels.

The acoustic environment along the ORR boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with the day-average sound level in the range of 35 to 50 dBA. Areas near the ORR within the city of Oak Ridge are typical of a suburban area, with the average day-night sound level in the range of 53 to 62 dBA. The primary source of noise at the ORR boundary and at residences located near roads is traffic.

All waters drained from the ORR eventually reach the Tennessee River via the Clinch River, which forms the southern and western boundaries of the ORR. Because the ORR lies within the Ridge and Valley

Province, it is composed of a series of drainage basins or troughs containing many small streams that feed into the Clinch River rather than one simple stream valley. Each of the major facilities on the ORR lies within a separate drainage basin or watershed, and surface water at each of the plants drains into a tributary or series of tributaries, streams, or creeks, eventually reaching the Clinch River. East Fork Poplar Creek (EFPC), which discharges into Poplar Creek east of the ETTP, originates within the Y-12 Plant near the former S-3 Ponds and flows northeast along the south side of the Y-12 Plant. Various Y-12 Plant wastewater discharges to the upper reaches of EFPC from the late 1940s to the early 1980s left a legacy of contamination (e.g., mercury, polychlorinated biphenyls [PCBs], uranium) that has been the subject of water quality improvement initiatives over the past 10 to 15 years. Bear Creek also originates within the Y-12 Plant with headwaters near the former S-3 Ponds where the creek flows southwest. Bear Creek is mostly affected by stormwater runoff, groundwater infiltration, and tributaries that drain former waste disposal sites in the Bear Creek Valley Burial Groundwater Waste Management Area.

Two geologic units on the ORR, designated as the Knox Group and the Maynardville Limestone of the Conasauga Group, both consisting of dolostone and limestone, constitute the Knox Aquifer. The Knox Aquifer is the primary source of groundwater to many streams (base-flow), and most large springs on the ORR receive discharge from the Knox Aquifer. The remaining geologic units on the ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) constitute the ORR Aquitards, which consist mainly of siltstone, shale, sandstone, and thinly bedded limestone of low to very low permeability.

The Y-12 area includes a proposed historic district which encompasses the original Y-12 Plant and consists of 92 contributing buildings and structures. Two buildings in the Y-12 Plant have been proposed for National Historic Landmark status as individual properties. Much of the Y-12 Plant has been disturbed by past activities and the potential for discovery of archaeological resources eligible for listing on the NRHP is considered low. The remaining undisturbed areas are not considered likely locations for significant archaeological resources (DuVall and Associates 1999). One pre-World War II structure has been determined eligible for listing on the NRHP. No Native American traditional use areas or religious sites are known to be present in the Y-12 area and no artifacts of Native American religious sigificance are known to exist have or to have been removed from the Y-12 area (Souza 1997). Seven cemeteries associated with Euro-American use of the area prior to World War II are likely to have religious or cultural importance to descendants and the local community. No other traditional, ethnic or religious resources have been identified in the Y-12 area.

Routine waste at Y-12 is primarily generated from DP operations including dismantling and storing of nuclear weapons components, material and component manufacturing and production, and supporting ORNL research projects. Waste is also generated from support operations on the ORR, such as medical services, vehicle maintenance activities, general office work, construction activities, monitoring activities, and environmental restoration activities. The major waste types generated at Y-12 from routine operations include LLW, mixed-LLW, hazardous waste, and nonhazardous waste.

Mixed LLW and LLW in solid form are currently stored on-site at the Y-12 Plant pending treatment and storage. Disposal of radioactive waste generated at Y-12 has been restricted by either a lack of on-site facilities or by administrative barriers to approval of transporting and disposing of radioactive waste off site since on-site disposal ceased in the 1980's. As a result, significant quantities of LLW and mixed LLW have accumulated in storage at the Y-12 Plant. Limited quantities of accumulated, legacy mixed LLW and LLW are being shipped off site for treatment and disposal because some approvals have been obtained to use existing DOE or licensed-commercial facilities. The bulk of the waste remains stored at the Plant. Liquid LLW and mixed LLW are either treated on site and disposed of, or treated and subsequently managed as solids.

RCRA-permitted units for the storage and treatment of hazardous waste are available to support routine operations at Y-12. Adequate permitted and approved off-site facilities are available to meet any additional treatment requirements and for disposal of the hazardous waste. Sanitary and process waste liquids are treated by the city of Oak Ridge sewage treatment plant or Y-12 treatment facilities. Current facilities have a combined capacity to handle approximately 10 times the liquid waste volumes generated by current operations. The resultant solids are disposed of with other nonhazardous waste in existing, permitted landfills with an adequate capacity to handle projected waste volumes. Landfill V, a sanitary/industrial landfill at Y-12, accepts general refuse and asbestos, medical (non-infectious), and other special waste as approved on a case-by-case basis by the state regulatory authorities. Landfills VI and VII are permitted for disposal of construction and demolition waste and have ample disposal capacity for well beyond the Y-12 SWEIS 10-year planning period

In 1998, the potential MEI dose from Y-12 operations was 1.9 mrem. Atmospheric releases from Y-12 operations results in a dose of 0.53 mrem. Radioactivity in liquid effluents from ORR results in an MEI dose of 1.44 mrem. The MEI dose standard for all pathways is 100 mrem per year. The standard for airborne releases is 10 mrem per year and applies to the sum of doses from all airborne pathways (inhalation, submersion in a plume, exposure to radionuclides deposited on the ground surface, and consumption of foods contaminated as a result of deposition of radionuclides). Both the airborne and all pathway EDEs for the MEI are significantly below these limits. Additionally, DOE standards include a limit of 4 mrem per year to the MEI from the drinking water pathway. Of the estimated MEI dose of 2.1 mrem per year, 0.4 is from the drinking water pathway which is well below the 4 mrem limit.

Based on 1990 census data, the population within 80 km (50 mi) of Y-12 is approximately 880,000. In 1998 the collective EDE to that population (i.e., the total dose received by all 880,000 people) was 4.3 person-rem from atmospheric releases at Y-12. Populations drinking water from various water treatment plants downstream of Y-12 potentially received a collective dose equivalent of 1.8 person-rem. These doses from air and liquid releases represent approximately 0.002 percent of the collective dose received from naturally occurring sources of radiation. Based on a dose to risk conversion factor of 5.0×10^{-4} fatal cancers per person-rem (ICRP 1991), the collective EDE of 6.13 person-rem could result in less than one additional latent cancer death within the population.

The average annual dose to an involved worker at Y-12 during 1998 was 11.4 mrem. The dose to the involved workforce of 3,563 radiation workers was estimated to be 40.6 person-rem.

Workers exposed to radiation have a risk of 0.0004 per person-rem of contracting a fatal cancer (ICRP 1991 and NCRP 1993). Based on this dose to risk conversion factor, the entire exposed population of Y-12 radiation workers could expect to receive an additional 0.016 cancer deaths due to their 1998 exposure. Thus, as with the public, the annual radiation dose to Y-12 workers results in a calculated cancer fatality risk that is extremely small in comparison to the natural incidence of fatal cancer.

Chemicals used at Y-12 that are of particular concern due to their extensive use in plant operations and the nature and the potential adverse health effects from exposure include mercury, beryllium, PCBs, polycyclic aromatic hydrocarbons, and volatile organic compounds. In addition to the risks from these chemicals, workers at Y-12 are at risk from potential industrial accidents, injuries, and illnesses due to everyday operations.

Approximately 880,000 people live within a 80-km (50-mi) radius of ORR. Minorities compose 6.1 percent of this population. In 1990, minorities composed 24.1 percent of the population nationally and 17 percent of the population in Tennessee. There are no federally recognized Native American groups within 80 km (50 mi) of the Y-12 Plant. The percentage of persons below the poverty level is 16.2 percent, which is slightly higher than the 1990 national average of 13.1 percent but much lower than the statewide figure of 30 percent (Census 1990).

The Scarboro community is a primarily minority community located approximately 1 km (0.5 mi) north of Y-12. This community has been included in a number of epidemiological health studies conducted by an independent group overseen by the Tennessee Department of Health. Mercury health studies have shown that estimates for mercury intake for Scarboro residents exceeded standards for inhalation of mercury during the years of peak mercury release in the late 1950s. Impacts of uranium releases to the air on the community between 1944 and 1995 were analyzed to determine if cancer risks from uranium releases are elevated for this community. The analyses reported career screening indexes that were slightly lower than the investigators decision guide for carcinogens, but with a great deal of uncertainty.

The Health Studies Report of PCB releases from the ORR prior to the early 1970's concluded that some fishermen at the Clinch River and Watts Bar Reservoir have eaten enough fish from these sources to affect their health, including excess cancers, but estimates of how many have been affected are not possible at this time. Further studies were recommended, including studies of fish and turtle consumption, PCB blood levels in people consuming fish, PCB levels in core samples from the Clinch River and the Watts Bar Reservoir, PCB levels in the soils near EFPC, and PCB levels in cattle grazing near the creek. There are no populations in the area completely dependent on consumption of these fish from the Clinch River and the Watts Bar Reservoir for subsistence.

S.5 COMPARISON OF ALTERNATIVES AND ENVIRONMENTAL IMPACTS

This comparison of potential environmental impacts is based on the information in Chapter 4, Affected Environment, and analyses in Chapter 5, Environmental Consequences of the SWEIS. Its purpose is to present the impacts of the alternatives in comparative form. Table S.5–1 (located at the end of this section) presents the comparison summary of the environmental impacts for construction and operation associated with No Action - Planning Basis Operations Alternative and alternatives for the HEU Storage Mission and Special Materials Mission evaluated in this SWEIS. The No Action - Status Quo Alternative is presented in Table S.5–1 as a benchmark for comparison of the impacts associated with the No Action - Planning Basis Operations Alternative and other alternatives that reflects full Y-12 DP mission operations at required levels, and activities by EM and the Office of Science at Y-12. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it would not meet Y-12 mission needs. The following sections summarize the potential impacts by resource area.

S.5.1 Land Use

Construction. No new DP facilities or major upgrades to existing DP facilities would occur under the No Action - Planning Basis Operations Alternative. Potential land disturbance associated with construction of the Environmental Management Waste Management Facility and activities of the Office of Science Field Research Center would be approximately 31 to 47 ha (77 to 116 acres) and 4 ha(10 acres), respectively. The land disturbance would occur in areas that are already disturbed and designated for waste management and industrial use.

Potential land disturbance associated with the alternatives for the HEU Storage Mission range from 0 ha (No Action) to 5 ha (construct HEU Materials Facility). The Upgrade Expansion of Building 9215 would potentially disturb less than 1 ha. The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility would potentially disturb up to 56 ha during construction. The Upgrade Expansion of

Building 9215 Plus the No Action - Planning Basis Operations Alternative would disturb up to 52 ha(128 acres).

Construction of the Special Materials Complex would potentially disturb between 0 ha (No Action) and 8 ha (20 acres) (Site 1). Site 2 and Site 3 locations for the proposed Special Materials Complex would disturb approximately 5 ha. Except for a 2-ha (5- acre) portion of Site 1 which is covered by trees, all proposed sites are located in previously disturbed areas of Y-12 that are designated for industrial use. The clearing of the forest cover on Site 1 would result in a land use change for that area. The No Action - Planning Basis Operations Alternative Plus the Special Materials Complex would potentially disturb up to 59 ha (146 acres) and 56 ha (138 acres) for Sites 2 and 3.

The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility and the Special Materials Complex would disturb up to 64 ha (158 acres) during construction activities.

Operation. Under the No Action - Planning Basis Operations Alternative, the Environmental Management Waste Management Facility and the Field Research Center activities would require approximately 14 to 25 ha (35 to 62 acres) and less than 4 ha (10 acres) of land, respectively. These activities are consistent with ORR land use plans.

The potential permanent land requirement for the HEU Storage Mission alternatives range from 0.5 ha for the Upgrade Expansion of Building 9215 to 4 ha for the HEU Materials Facility. There would be no difference in land requirements between Site A or Site B for the HEU Materials Facility. Operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would be consistent with current ORR land use plans, and Oak Ridge End-Use Working Group recommendations (PEC 1998). The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility would result in potential permanent land requirements of up to 33 ha (82 acres) for operations. The Upgrade Expansion of Building 9215 Plus No Action - Planning Basis Operations Alternative would require up to 29.5 ha (73 acres).

Operation of the Special Materials Complex would require 4 ha of land. There would be no difference in land requirement between Sites 1, 2, or 3. Operation of the Special Materials Complex would be consistent with current ORR land use plans, and Oak Ridge End-Use Working Group recommendations (PEC 1998). The No Action - Planning Basis Operations Alternative Plus the Special Materials Complex would result in a potential permanent land requirement of up to 33 ha (82 acres) for operations.

The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility and the Special Materials Complex would result in a potential permanent land requirement of up to 37 ha (91 acres) for operations.

S.5.2 Transportation

Construction. Under the No Action - Planning Basis Operations Alternative, approximately 75 additional vehicles per day would use area roads to support construction of the Environmental Management Waste Management Facility. Less than 10 vehicles per day would be added to area traffic for the Field Research Center activities. The additional construction-related traffic for these two activities would have a negligible impact on area roads and traffic. The Level-of-Service (LOS) on area roads would not change under this alternative from the No Action - Status Quo Alternative.

Construction-related traffic for the HEU Storage Mission Alternative would range from 0 (No Action) to 165 additional worker vehicles per day to support construction of the HEU Materials Facility at either site or the Upgrade Expansion of Building 9215. In addition, three to eight trucks per day would be expected to bring construction materials to the project site. The No Action - Planning Basis Operations Alternative Plus the construction of the HEU Materials Facility would potentially add 258 vehicles per day on area roads. The additional construction-related traffic would have a minor impact on area roads and traffic because most project traffic would occur at off-peak travel periods.

Construction-related traffic for the Special Materials Mission Alternative would range from 0 (No Action) to 157 additional worker vehicles per day to support construction of the Special Materials Complex at any of the 3 sites. An additional five trucks per day would bring construction materials to the project site. The No Action - Planning Basis Operations Alternative Plus Construction of the Special Materials Complex would potentially add 247 vehicles per day on area roads. The additional construction-related traffic would have a minor impact on area roads and traffic because most project traffic would occur at off-peak travel periods.

Operation. Under the No Action - Planning Basis Operations Alternative, an additional 28 vehicles per day and 6 vehicles per day would be expected from operation of the Environmental Management Waste Management Facility and the Field Research Center activities, respectively. Because a majority of this traffic would occur on the Y-12 Site, the additional traffic would have a negligible impact on area roads and traffic.

Radiological materials and waste transportation impacts associated with the Environmental Management Waste Management Facility would include routine and accidental doses of radioactivity. The risks associated with radiological materials transportation would be less than 0.1 fatality per year. The risks associated with radiological waste transportation would be less than 0.1 fatality per year.

Operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would result in no additional work traffic since the existing workforce would be used. The No Action - Planning Basis Operations Alternative plus the operation of HEU Materials Facility or the Upgrade Expansion of Building 9215 would result in approximately 34 additional vehicles per day on area roads. The additional traffic would not change the LOS on area roads. There would be a one-time relocation of stored HEU to the new facility (HEU Materials Facility or the Upgrade Expansion of Building 9215) which would require approximately 3,000 on-site truck trips to complete.

Radiological materials and waste transportation impacts would include routine and accidental doses of radioactivity. The risks associated with routine radiological materials transportation would be less than 0.1 fatality per year. The risks associated with radiological waste transportation would be less than 0.01 fatality per year. The one-time relocation of stored HEU to the new HEU Materials Facility or the Upgrade Expansion of Building 9215 would result in less than 0.001 fatality.

Operation of the Special Materials Complex would result in no additional worker traffic since the existing workforce would be used. The No Action - Planning Basis Operations Alternative plus the operation of the Special Materials Complex would result in approximately 34 additional vehicles per day on area roads. The additional traffic would not change the LOS on area roads. There would be no additional radiological materials and waste transportation impacts associated with the Special Materials Complex since the facilities do not use radioactive materials.

S.5.3 Socioeconomics

Construction. A peak construction workforce of approximately 100 would be needed for the Environmental Management Waste Management Facility, and less than 10 would be needed for the Field Research Center activities included under the No Action - Planning Basis Operations Alternative. The workforce increase represents less than one percent of the No Action - Status Quo ORR workforce and would have no substantial benefit or negative impact on the socioeconomics of the Oak Ridge area or regional economy.

The construction of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would have a negligible impact on the socioecomonics of the Oak Ridge area or regional economy. Both projects would have a peak construction workforce of 220 workers and generate a total of 460 jobs (220 direct and 240 indirect) in the Region of Influence (ROI). This represents an increase of 0.2 percent in the No Action - Status Quo Alternative ROI employment. The existing ROI labor force is sufficient to accommodate the labor requirements and no change to the level of community services provided in the ROI is expected.

The No Action - Planning Basis Operations Alternative plus the construction of a new HEU Materials Facility or Upgrade Expansion of Building 9215 would require a total of approximately 330 construction workers. A total of 690 jobs (330 direct and 360 indirect) would be generated. This would increase the No Action - Status Quo Alternative ROI employment by approximately 0.2 percent. The total No Action - Status Quo Alternative ROI income would increase by approximately $17.8 million, or 0.1 percent.

The construction of the Special Materials Complex would have a peak construction workforce of 210 workers and generate a total of 440 jobs (210 direct and 230 indirect) in the ROI. This represents an increase of 0.2 percent in ROI employment. The existing labor force is sufficient to accommodate the labor requirements, and no change in the level of community services provided in the ROI is expected. The Special Materials Complex construction would have a negligible impact on the socioeconomics of the Oak Ridge area or regional economy.

The No Action - Planning Basis Operations Alternative plus the construction of a new Special Materials Complex would result in a total of approximately 320 construction workers. A total of 670 jobs (320 direct and 350 indirect) would be generated. This would increase the No Action - Status Quo Alternative ROI employment by approximately 0.2 percent. The total No Action - Status Quo Alternative ROI income would increase by approximately $17.2 million, or 0.1 percent.

The construction periods of the HEU Materials Facility and Special Materials Complex could overlap with the construction activities included under the No Action - Planning Basis Operations Alternative. In that case, there would be a greater construction workforce at Y-12 at one time, resulting in a greater increase in ROI employment, and income in any one year. The peak construction employment could reach approximately 540 direct employees, generating a total of 1,130 jobs (540 direct and 590 indirect). This would be an increase of approximately 0.4 percent in No Action - Status Quo Alternative ROI employment and would result in an increase in ROI income of almost $30 million, or 0.2 percent. These changes would be temporary, lasting only the duration of the construction period. The existing ROI labor force could likely fill all of the jobs generated by the increased employment and expenditures. Therefore, there would be no impacts to the ROI's population or housing sector. Because there would be no change in the ROI population, there would be no change to the level of community services provided in the ROI.

Operation. Under the No Action - Planning Basis Operations Alternative, potential benefits of employment associated with the Environmental Management Waste Management Facility or the Field Research Center activities would be very small. Approximately 25 workers and 6 workers, respectively, would be needed for the two activities. Workers for the Environmental Management Waste Management Facility would be drawn from the local workforce. Some of the workforce associated with the Field Research Center would be researchers from outside the ROI. Visiting staff and scientists would contribute in a beneficial manner to the local economy, but the impact would be negligible.

The operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would result in no change in the No Action - Status Quo Alternative ROI employment, income, or population. The anticipated operation workforce of 30 for the HEU Materials Facility and 49 for the Upgrade Expansion of Building 9215 would come from existing employees. Operation of the Special Materials Complex would not result in any change in workforce requirements since existing workers would staff the facilities. No impacts to ROI employment, income, or population are expected.

Because both the HEU Materials Facility and the Special Materials Complex would be staffed by the existing Y-12 workforce during operations, there would be no change from the No Action-Status Quo Alternative or No Action - Planning Basis Operations Alternative Y-12 workforce and no impacts to ROI employment, income, or population.

S.5.4 Geology and Soils

Construction. The Environmental Management Waste Management Facility and the Field Research Center activities included under the No Action - Planning Basis Operations Alternative would result in a potential increase in soil erosion at the construction sites. However, soil impacts are expected to be small with proposed design controls. No impacts to geology are expected.

Construction of the HEU Materials Facility at Site A would result in a potential increase in soil erosion from the lay-down area and new parking lot. Detention basins and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected because the facility is above ground and foundation construction would not disturb bedrock. Site B soil erosion impacts would be negligible with appropriate standard construction control measures. The Upgrade Expansion of Building 9215 would have negligible soil erosion impacts with standard construction control measures. No geology impacts are expected at Site B or at the Building 9215 expansion construction sites because the facility is above ground and foundation construction would not disturb bedrock.

Construction of the Special Materials Complex at Site 1 would result in a potential increase in soil erosion from the lay-down area and project site land clearing. Detention basins, silt fences, and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected because the facility is above ground and foundation construction would not disturb bedrock

Activities included under the No Action - Planning Basis Operations Alternative Plus the Construction of the HEU Materials Facility and the Special Materials Complex would result in a potential increase in soil disturbance and soil erosion from construction activities. Appropriate mitigation, including detention basins, runoff control ditches, silt fences, and protection of stockpiled soils would minimize soil erosion and impacts. No impacts to geology are expected because all new facilities would be above ground structures and foundation construction would not disturb bedrock.

Operation. Under the No Action - Planning Basis Operations Alternative, minor soil erosion impacts are expected from the Environmental Management Waste Management Facility. Detention basins, runoff control ditches, and cell design components would minimize impacts. The Field Research Center would have no impacts on geology and soils with standard construction-type soil erosion control measures.

The HEU Storage Mission Alternatives and Special Materials Mission Alternatives would have no impact on geology or soils during operation because of site design and engineered control measures.

The No Action - Planning Basis Operations Alternative Plus the Operation of the HEU Materials Facility and Special Materials Complex would have no impact on geology and minimal soil impacts. Appropriate facility site design and engineered control measures (e.g., detention basins) would be used to minimize soil erosion impacts.

S.5.5 Water Resources

Construction

Surface Hydrology. Under the No Action - Planning Basis Operations Alternative, surface water usage at the Y-12 Plant would increase slightly from the No Action - Status Quo Alternative (20.8 MLD [5.5 MGD]) to (21.2 MLD [5.6 MGD]). This would represent less than a 2 percent increase in raw water use. The Environmental Restoration Program would continue to address surface water contamination sources and, over time, improve the quality of water in both UEFPC and Bear Creek, the two surface water bodies most directly impacted by activities at the Y-12 Plant.

The Environmental Management Waste Management Facility in eastern Bear Creek Valley activities are included under the No Action - Planning Basis Operations Alternative. Potential short-term impacts to surface water resources could result from sediment loading to surface water bodies or migration of contaminants. Land clearing and construction activities would expose varying areas depending on the ultimate size of the facility. Best management practices, including standard erosion controls such as siltation fences and buffer zones of natural riparian vegetation, during construction activities would minimize the potential impacts to surface water resources. Some impacts to surface water would be expected. Tributary NT-4 would be rerouted and partially eliminated during construction at the East Bear Creek Valley site. Construction and rerouting of NT-4 would impact some areas of wetland (approximately 0.4 ha [1 acre]) which will be mitigated as part of a wetlands mitigation plan for all CERCLA activities in Bear Creek Valley (DOE 1999j).

The No Action - Planning Basis Operations Alternative also includes activities of the Field Research Center at the Y-12 Site. The primary activities of the Field Research Center at Y-12 comprise subsurface injections of possible treatment additives into the groundwater at the contaminated area. Although only small volume injections are planned, it is possible that the groundwater additives might pass through the subsurface and reach the surface waters of Bear Creek. However, previous experiences with larger tracer injections near Bear Creek (DOE 1997a) and close monitoring of environmental conditions at the contaminated area suggest that the impacts to surface waters are predictable and would be minor.

Y-12 Plant surface water withdrawals and discharges would not increase substantially during construction of the HEU Materials Facility whether at construction Sites A or B or during the Upgrade Expansion of Building 9215. Construction water requirements are very small and would not raise the average daily water use for the Y-12 Plant. During construction, stormwater control and erosion control measures would be implemented to minimize soil erosion and transport to UEFPC. Neither of the proposed construction sites (Sites A or B) or the upgrade expansion site (Building 9215) is located within either the 100-year or 500-year floodplains.

Surface water withdrawals and discharges would not increase substantially during construction of the Special Materials Complex. Construction water requirements are very small and would not raise the average daily water use for the Y-12 Plant. During construction, stormwater control and erosion control measures would be implemented to minimize soil erosion and transport to surface water (UEFPC). None of the proposed sites (Sites 1, 2, or 3) are located within either the 100-year or 500-year floodplains.

Groundwater. All water for the No Action - Planning Basis Operations Alternative would be taken from the Clinch River, with no plans for withdrawal from groundwater resources. All process, utility, and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with NPDES permits.

Groundwater resources could be degraded by the Environmental Management Waste Management Facility in the short-term by contaminant releases from the surface or disposal cell that migrate to groundwater. Contaminant sources include construction materials (e.g., concrete and asphalt), spills of oil and diesel fuel, releases from transportation or waste handling accidents, and accidental releases of leachate from the disposal cell. Compliance with an approved erosion and sedimentation control plan and a spill prevention, control, and countermeasures plan would mitigate potential impacts from surface spills. Engineered controls and active controls, including the leachate collection system, would drastically reduce the potential for impact to groundwater resources that could result from contaminant migration from the disposal cell. Construction and operation of the disposal cell would result in few or no overall short-term impacts to groundwater resources.

Long-term, the design, construction, and maintenance of the new disposal facility would prevent or minimize contaminant releases to groundwater. These control elements would include a multilayer cap to minimize infiltration, synthetic and clay barriers in the cell liner, a geologic buffer, and institutional controls that would include monitoring and groundwater use restrictions. If releases were detected during the period of active institutional controls, mitigative measures would be implemented to protect human health and the environment. Long-term impacts to groundwater quality resulting from the disposal cell are expected to be insignificant. Research activities of the Field Research Center at the Y-12 Site would focus on injections of additives to the groundwater at both the background and contaminated areas. Although the additives would modify the chemistry of the groundwater in the immediate study area, injections of additives would be so small that impacts would be limited to the immediate study areas.

Groundwater would be extracted in the Field Research Center contaminated area at Y-12 as part of characterization-related hydraulic tests. In addition, groundwater sample collection would increase. However, groundwater extractions associated with major hydraulic tests would collect no more than 76,000 L (20,000 gal) of groundwater per year (DOE 2000b). Sampling activities in years with no major hydraulic testing would collect no more than 7,600 L (2,000 gal) of groundwater. All extracted groundwater would be collected and treated in on-site facilities prior to surface water discharge to meet existing NPDES permit limits.

All water for construction of the HEU Materials Facility would be taken from the Clinch River as part of the normal water uses at the Y-12 Plant. Some groundwater may be extracted during construction activities at either construction site (Sites A or B) or during the Upgrade Expansion of Building 9215 to remove water from excavations. Based on the results of the Remedial Investigation of UEFPC (DOE 1998b), groundwater extracted from excavations at Site A and in the area of the Upgrade Expansion of Building 9215 probably would not be contaminated. Groundwater extracted from excavations at Site B would probably be contaminated with VOCs, metals, and radionuclides from the nearby former S-3 Ponds and the Y-12 Scrap Metal Yard (DOE 1998b). Minimal impacts to groundwater quality are expected because regardless of site, extracted groundwater would be collected and treated in on-site treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water; no plans exist for routine withdrawal from groundwater resources.

All water for construction of the Special Materials Complex would be taken from the Clinch River as part of the normal water uses at the Y-12 Plant. Some groundwater may be extracted during construction activities to remove water from excavations. Based on the historical site use and the results of the Remedial Investigation of the UEFPC (DOE 1998b), groundwater extracted from excavations at Site 1 probably would not be contaminated. Groundwater extracted from excavations at Sites 2 and 3 would be the same as that described for the HEU Materials Facility Site B. The groundwater is contaminated with VOCs, metals, and radionuclides from the nearby former S-3 Ponds and the Y-12 Scrap Metal Yard (DOE 1998b). Minimal impacts to groundwater quality are expected because regardless of site, extracted groundwater would be collected and treated in on-site treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water.

Under the No Action - Planning Basis Operations Alternative plus the construction of the HEU Materials Facility and Special Materials Complex, no groundwater would be used for construction activities. Some groundwater may be extracted during construction from excavation and field research activities. Depending on the construction site, extracted groundwater may be contaminated with VOCs, metals, and radionuclides. Minimalimpacts to groundwater and groundwater quality are expected because extracted groundwater would be collected and treated in on-site treatment facilities to meet discharge limits of the NPDES permit prior to release to surface water.

Operation

Surface Hydrology. Under the No Action - Planning Basis Operations Alternative, surface water usage at the Y-12 Plant would increase slightly from No Action - Status Quo (20.8 MLD [5.5 MGD]) to (21.2 MLD [5.6 MGD]). This would represent less than a 2 percent increase in raw water use.

HEU storage operations, whether located in a new HEU Materials Facility or in the Upgrade Expansion of Building 9215, would require an estimated 550,000 L per year to 720,000 L per year (146,000 GPY to 190,000 GPY), a small percentage of the No Action - Status Quo Alternative Y-12 Plant water usage of approximately 5,680 MLY (1,500 MGY).

The No Action- Planning Basis Operations Alternative Plus the HEU Materials Facility or the Upgrade Expansion of Building 9215 would increase water use requirements by approximately 140 MLY (37 MGY) from the 5,678 MLY (1,500 MGY) water use under No Action - Status Quo Alternative. This represents an increase of approximately 2.5 percent. Sufficient excess water capacity exists to accommodate the additional 140 MLY (37 MGY). No adverse impacts to surface water resources or surface water quality are expected because all discharges would be maintained to comply with NPDES permit limits.

Operations of the Special Materials Complex would require an estimated 59 MLY (15.5 MGY) (approximately 53 MLY [14 MGY] for cooling tower make-up water and 6 MLY [1.5 MGY] for processes). This would be approximately 1 percent of No Action - Status Quo Alternative Y-12 Site water usage of 5,680 MLY (1,500 MGY). This water use would potentially be offset by the vacating of operations in existing special materials operations facilities. No adverse impacts to surface water or surface water quality are expected because all discharges would be monitored to comply with the NPDES permit limits.

The No Action - Planning Basis Operations Plus the Special Materials Complex would increase water use requirements by approximately 197 MLY (52 MGY) from the 5,678 MLY (1,500 MGY) water use under No Action - Status Quo Alternative. This represents an increase of approximately 3.5 percent. Sufficient excess water capacity exists to accommodate the additional 197 MLY (52 MGY). No adverse impacts to surface water resources or surface water quality are expected because all discharges would be monitored to comply with NPDES permit limits.

Under Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex), surface water withdrawals and discharges would increase slightly. Water requirements would increase by approximately 197.5 MLY (52.2 MGY) from the 5,678 MLY (1,500 MGY) water usage under the No Action - Status Quo Alternative. This represents an increase of 3.5 percent. Historical water use by Y-12 has been as high as, 8,328 MLY (2,200 MGY). Sufficient excess water capacity exists to accommodate the additional 197.5 MLY (52.2 MGY) increase. No adverse impacts to surface water or surface water quality are expected because all discharges would be monitored to comply with the NPDES permit limits.

Groundwater. All water for the No Action - Planning Basis Operations Alternative would be taken from the Clinch River, with no plans for withdrawal from groundwater resources at the Environmental Management Waste Management Facility. Sampling at the Field Research Center would remove a minimal amount (7,570L [2,000 gal]) a year for research purposes. All process, utility, and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with existing permits.

All water for operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would be taken from the Clinch River. As a storage facility, there would be no process water; utility and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with the existing permits.

All water for operation of the Special Materials Complex would be taken from the Clinch River. No plans exist for groundwater withdrawal to support operation of the Special Materials Complex. Utility and sanitary wastewater would be treated prior to discharge into the UEFPC in accordance with the existing NPDES permits.

Under Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex), no groundwater would be used for operations of facilities. No plans exist for routine withdrawal from groundwater resources; and utility and sanitary wastewater would be treated prior to discharge in accordance with permits.

S.5.6 Biological Resources

Construction. Under Alternative 1B (No Action - Planning Basis Operations Alternative), potential impacts to terrestrial, wetlands, and threatened/endangered species are expected. Land clearing activities for the Environmental Management Waste Management Facility and soil borrow area would remove grassland, old field habitat, forest habitat, and a 0.4-ha (1-acre)- wetland. Potential threatened/endangered species affected by construction activities include the Tennessee endangered pink lady slipper and Tennessee threatened tuberculed rein-orchid and carolina quillwort. There would be a minor impact on terrestrial resources from Field Research Center activities because test plots would be located in areas where site clearing and past construction have occurred.

Construction of the HEU Materials Facility at Site A would potentially impact terrestrial resources and three wetlands (0.4 ha [1 acre]) at the materials lay-down and new parking lot areas due to land clearing activities. No impact to aquatic resources or threatened/endangered species is expected at Site A. Impacts to biological resources from construction of the HEU Materials Facility at Site B or the Upgrade Expansion of Building 9215 are not expected because these areas have been previously disturbed and do not contain habitat sufficient to support a biologically diverse species mix.

If the Special Materials Complex is constructed at Site 1, approximately 4 ha (10 acre) of terrestrial habitat would be eliminated and wildlife would be dislocated and/or disturbed. Two man-made wetlands (0.4 ha [1 acre]) would potentially be impacted due to construction land clearing and sedimentation from the construction site. No impacts to aquatic or threatened/endangered species are expected at Site 1. If the Special Materials Complex is constructed at Site 2 or Site 3, no impacts to biological resources are expected because of the highly disturbed and industrialized nature of these sites and the minimal biological resources present.

Operation. Under the No Action - Planning Basis Operations Alternative, minor impacts to terrestrial resources are expected due to operation noise and human activities associated with the Environmental

Management Waste Management Facility and soils borrow area. No impacts to wetlands, aquatic, or threatened/endangered species are expected. The Field Research Center operations activities would have a minor impact on terrestrial resources due to noise and human activity but would have no impacts on aquatic, wetlands, or threatened/endangered species.

Operation of the HEU Materials Facility, the Special Materials Complex, or the Upgrade Expansion of Building 9215 would not impact biological resources because they would be located in previously disturbed or heavily industrialized portions of the Y-12 Site that do not contain habitat sufficient to support a biologically diverse species mix.

Activities associated with the Environmental Management Waste Management Facility and the Field Research Center activities under the No Action - Planning Basis Operations Alternative, and construction and operation of the HEU Materials Facility and Special Materials Complex is anticipated to disturb natural habitat as discussed above during land cleaning activities for new facilities. If the HEU Materials Facility is constructed at Site A potential impact may occur to three man-made wetlands approximately 0.4 ha (1 acre) in size. Additionally, construction of the Environmental Management Waste Management Facility would require rerouting of 330 m (1,000 ft) of NT-4, and the associated wetland, approximately 0.4 ha (1 acre) in size, would be impacted by potential construction related sediment and loss of adjacent wooded areas.

S.5.7 Air Quality

Construction. Under The No Action - Planning Basis Operations Alternative, construction of the Environmental Management Waste Management Facility and the Field Research Center activities would potentially have an impact on the project areas due to fugitive dust emissions. However, engineered controls, such as the application of water or chemical dust suppressants and seeding of soil piles and exposed soils, would be implemented to minimize fugitive dust emissions. Based on the activities and the dust control measures, DOE expects that dust emissions at the Y-12 Site boundary would be below the PM_{10} NAAQS at the DOE boundary and only negligible levels of airborne dust would be expected at the nearest residential area.

Construction of the HEU Materials Facility at Site A and Site B would result in small fugitive dust impacts in the construction area. Site A construction activities would generate slightly more fugitive dust emissions because of more earth moving activities associated with the materials lay-down area and new parking lot. If the expansion to Building 9215 is constructed, small fugitive dust impacts in the construction area would be expected. Effective control measures commonly used to reduce fugitive dust emissions include wet suppression, wind speed reduction using barriers, vehicle speed, and chemical stabilization. Necessary control measures would be applied to ensure that PM_{10} concentrations remain below applicable standards.

Construction of the Special Materials Complex at Site 1, Site 2, or Site 3 would generate fugitive dust emissions which would have a small impact in the construction area. Site 1 construction would generate more fugitive dust emissions than Site 2 or Site 3 due to the larger scale of land clearing and earth moving activities to prepare the site for construction. All fugitive dust emissions would not exceed applicable standards when dust suppression methods are used.

Operation. Under the No Action - Planning Basis Operations Alternative, nonradiological air pollutant concentration would be well within established criteria under normal operations. Radiological dose to the MEI and off-site population under the No Action - Planning Basis Operations Alternative would increase from the No Action - Status Quo Alternative due to the restart of all Y-12 mission operations. The dose to the MEI (1,080 m [3,543 ft] from Y-12) would increase from 0.53 mrem/yr (under the No Action - Status Quo Alternative) to 4.5 mrem/yr, and the dose to the population within 80 km (50 mi) would increase from 4.3

person-rem/yr (under the No Action - Status Quo Alternative) to 33.7 person-rem/yr. Statistically, this equates to 0.017 latent cancer fatality for each year of Y-12 normal operation.

The impacts under Alternative 2A (No Action - Planning Basis Operations Alternative Plus Construct and Operate a New HEU Materials Facility) and Alternative 2B (No Action - Planning Basis Operations Alternative plus Upgrade Expansion of Building 9215) would remain unchanged from the No Action - Planning Basis Operations Alternative impacts (i.e., 4.5 millirem per year for the MEI, and 33.7 person-rem for the off-site population). The collective dose to the workers (35) under Alternative 1B (No Action - Planning Basis Operations Alternative) for the existing HEU Storage Mission is 0.74 person-rem. The collective dose to workers due to relocation of existing stored HEU to the new HEU storage facility is 5.25 person-rem. The collective dose to workers (14) during normal operations due to storage of HEU in the HEU Materials Facility is 0.29 person-rem.

There would be no radiological material associated with the Special Materials Complex operation. No change from the No Action - Planning Basis Operations Alternative radiological emissions described above at Y-12 are expected.

Under Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex), the collective dose to workers at the Y-12 Plant would be the same as Alternative 1B (No Action - Planning Basis Operations Alternative). There would be a slight decrease in HEU storage mission worker collective dose from 0.74 person-rem to 0.29 person-rem if the HEU Materials Facility would be constructed and operated. This reduction is due to the decrease in number of workers from 35 under the No Action - Planning Basis Operations Alternative to 14 workers for the new HEU Materials Facility. The overall collective Y-12 worker dose however would not change from the 59.48 person-rem under the No Action - Planning Basis Operations Alternative because of the increased production levels and radiological emissions associated with enriched uranium operations. The Special Materials Complex is a non-rad facility and does not handle radioactive materials.

The MEI and population dose within 80 km (50 mi) of the Y-12 Site under this alternative would be the same as Alternative 1B (No Action - Planning Basis Operations Alternative). The dose received by the hypothetical MEI is 4.5 mrem/yr. The collective population dose would be 33.7 person-rem. This would be a substantial increase from the the No Action - Status Quo Alternative dose to the MEI and population of 0.53 mrem/yr and 4.3 person-rem, respectively. The increase is due to the Y-12 Plant operating at planned and required workload levels under Alternative 1B (No Action - Planning Basis Operations Alternative).

S.5.8 Visual Resources

Construction. No additional impact to visual resources is expected under the No Action - Planning Basis Operations Alternative or from the HEU Storage Mission and Special Materials Mission Alternatives because of the design of proposed new facilities and the existing visual setting of Y-12.

Operation. No additional impact to visual resources is expected under the No Action - Planning Basis Operations Alternative or from the HEU Storage Mission and Special Materials Mission Alternatives because of the design of proposed new facilities and the existing visual setting o f Y-12. Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Material Facility Plus Special Materials Complex) would have no additional impacts to visual resources.

S.5.9 Noise

Construction. Under the No Action - Planning Basis Operations Alternative, small noise impacts are expected from construction equipment and activities associated with the Environmental Management Waste Management Facility and the Field Research Center activities. Impacts would be limited to the general construction area. Feasible administrative or engineered controls would be used in addition to personal protective equipment (e.g., ear plugs) to protect workers against the effects of noise exposure.

Construction of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would have small noise impacts in the general construction area. Construction of the Special Materials Complex would have small noise impacts in the general construction area. Feasible administrative or engineered controls would be used in addition to personal protective equipment (e.g., ear plugs) to protect workers against the effects of noise exposure. No off-site noise impacts are expected because peak attenuated noise levels from construction of these facilities would be below background noise levels (53 to 62 dBA) at off-site locations within the city of Oak Ridge.

Construction related noise impacts under Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex) would result from relatively high and continuous levels of noise in the range of 89 to 108 dBA. Because of the distance between construction sites and locations relative to Y-12 Plant facilities, commutative noise impacts to Y-12 employee population would be mitigated to acceptable levels (approximately 70 dBA). Potential construction activity locations under the alternative are at sufficient distance from the ORR boundary and the city of Oak Ridge to result in no change to background noise levels at these areas.

Operation. Under the No Action - Planning Basis Operations Alternative, small noise impacts are expected from heavy equipment and activities associated with the Environmental Management Waste Management Facility and the Field Research Center. Impacts would be limited to the general operation areas.

Operation of the HEU Materials Facility and the Special Materials Complex would generate some noise, caused particularly by site traffic and mechanical systems associated with operation of the facility (e.g., cooling systems, transformers, engines, pumps, paging systems, and materials-handling equipment). In general, sound levels for all action alternatives are expected to be characteristic of a light industrial setting within the range of 50 to 70 dBA and would be within existing the No Action - Status Quo Alternative levels. Effects upon residential areas are attenuated by the distance from the facility, topography, and by a vegetated buffer zone.

S.5.10 Site Infrastructure

Construction. There would be no measurable change in Y-12 Site energy usage or other infrastructure resources under the No Action - Planning Basis Operations Alternative due to the construction of the Environmental Management Waste Management Facility or the Field Research Center activities. Existing site infrastructure would be used and energy usage would be minimal during the construction phase.

Construction of the HEU Materials Facility at Site A would result in less infrastructure impacts than Site B since no buildings would be demolished and utility relocation would be minimal. Site B would require demolition of eight buildings and realignment of Old Bear Creek Road. Construction materials and resources for the HEU Materials Facility would be the same for Site A and Site B. If the Upgrade Expansion of Building 9215 is constructed, some utility relocation would be necessary but no permanent buildings would require demolition. Construction materials and resources for the HEU Materials Facility would be the same for Site A and Site B. Construction materials and resources requirements for the Expansion of Building 9215 would be less than that for the HEU Materials Facility.

Construction materials and resource requirements for the Special Materials Complex would be the same for Site 1, Site 2, or Site 3. Construction of the Special Materials Complex at Site 1 would result in the least impact to infrastructure since no buildings would be demolished and only small utility relocation would be required. At Site 2, five buildings would be removed. At Site 3, eight buildings would be removed and a portion of Old Bear Creek Road would be realigned.

Operation. Under the No Action - Planning Basis Operations Alternative, there would be a slight increase from the No Action - Status Quo Alternative in energy and resource requirements. Electrical energy consumption would increase by approximately 189,000 MWh/yr to 566,000 MWh/yr and water use would increase by 4.5 MLD (1.2 MGD) to 20.2 MLD (5.38 MGD).

Operation of the HEU Materials Facility would require approximately 5,900 MWh/yr of electricity and 1,510 L/day (400 GPD) of water. Operation of the Upgrade Expansion of Building 9215 would require approximately 10,900 MWh/year and 1,975 L/day (520 GPD) of water. Sufficient electrical energy and water capacity exists at Y-12 to support the expected increases. The No Action - Planning Basis Operations Alternative Plus the new HEU Materials Facility would require a total of 572,000 MWh/yr of electricity and 20.2 MLD (5.38 MGD) of water.

Operation of the Special Materials Complex would require approximately 30,400 MWh/yr and 228,600 L/day (63,000 gal/day) of water. Sufficient electrical energy and water capacity exists at Y-12 to support the expected increases. Combined with the No Action - Planning Basis Operations Alternative, this alternative would require a total of 596,000 MWh/yr of electricity and 20.43 MLD (5.4 MGD) of water.

Operation of the new HEU Materials Facility and the Special Materials Complex, when combined with the No Action - Planning Basis Operations, would require an increase in electrical usage to 602,000 MWh/Y and an increase in water usage of 20.43 MLD (5.4 MGD). Sufficient electrical energy and water capacity exists at Y-12 to support the expected increases.

The vacating of existing HEU storage facilities and special materials operations facilities, if new projects are constructed, could potentially offset the projected increases and minimize potential impacts on site infrastructure and resources.

S.5.11 Cultural Resources

Construction. No impacts to cultural resources are expected under the No Action - Planning Basis Operations Alternative. NRHP-eligible properties in the proposed historic district encompassing the Y-12 Plant would continue to be actively used for DOE mission activities.

The impacts to cultural resources resulting from the Environmental Management Waste Management Facility and Field Research Center activities have been assessed in consultation with the SHPO (DOE 1999j, DOE 2000b). Although there are no known archaeological resources in the Y-12 Site area, there would be a remote possibility of encountering buried cultural resources during ground-disturbing activities. Procedures for addressing the unanticipated discovery of cultural resources are described in the Y-12 Cultural Resource Management Plan (CRMP).

No impacts to cultural resources are expected from construction of the HEU Materials Facility at Site A or Site B. The Upgrade Expansion of Building 9215 would be considered a major alteration of a historic property and require consultation with the SHPO in accordance with the Y-12 CRMP. Although there are no known archaeological resources in the Y-12 Site area, there would be a remote possibility of encountering buried cultural resources during ground-disturbing activities. Procedures for addressing the unanticipated discovery of cultural resources are described in the Y-12 CRMP.

No impacts to cultural resources are expected from construction of the Special Materials Complex at Site 1, Site 2, or Site 3. Because use of Site 1 would probably involve ground disturbance in an undisturbed area and may involve disturbance exceeding the depth and extent of previous ground disturbances the DOE-ORO would consult with SHPO and other parties to determine whether an archaeological survey is warranted. If a survey is conducted, any resources found would be evaluated for NRHP-eligibility and the effects determined in consultation with the SHPO and other parties. Although there are no known archaeological resources in the Y-12 Site area, there would be a remote possibility of encountering buried cultural resources during ground-disturbing activities. Procedures for addressing the unanticipated discovery of cultural resources are described in the Y-12 CRMP.

Operation. No impacts to cultural resources are expected under the No Action - Planning Basis Operations Alternative because NRHP-eligible properties would not be modified or demolished and ground-disturbing activities would be minimal. No impacts to cultural resources are expected from operation of HEU Materials Facility, the Upgrade Expansion of Building 9215, or the Special Materials Complex. Upon completion of the new HEU Materials Facility or Upgrade Expansion of Building 9215, NRHP-eligible buildings (9204-2, 9204-2E, 9204-4, 9215, 9720-5, and 9998) would no longer be used for the HEU storage mission. Upon completion of the Special Materials Complex, NRHP-eligible buildings (9201-5, 9202, 9731, and 9995) would no longer be used for the Special Materials Mission. Depending on the disposition of these historic properties, there could be impacts associated with moving the HEU Storage Mission and Special Materials Operations from these buildings. Potential impacts include changes in the character of the properties' use, the physical destruction of historic properties, and the neglect of properties leading to deterioration. If adverse effects on historic properties could result from the change of mission or subsequent disposition of these buildings, the SHPO must be consulted regarding the application of the criteria of adverse effect and in mitigation efforts to avoid or reduce any impacts in accordance with 36 CFR 800.

S.5.12 Waste Management

Construction. The Environmental Management Waste Management Facility and the Field Research Center activities would generate small amounts of nonhazardous construction waste under the No Action - Planning Basis Operations Alternative.

If the HEU Materials Facility is constructed at Site A, construction waste would be less than Site B. At Site A approximately 3,823 m^3 (5,000 yd^3) of nonhazardous construction debris and 14.8 million L (3.9 million gal) of nonhazardous sanitary waste would be generated during the 4-year construction period. At Site B an additional 22,707 m^3 (29,700 yd^3) of contaminated soil (mixed LLW) would be excavated before building construction could begin. Construction of the Upgrade Expansion of Building 9215 would generate the least amount of construction waste; approximately 3,058 m^3 (4,000 yd^3) of nonhazardous construction debris and 14.8 million L (3.9 million gal) of nonhazardous sanitary waste.

Construction of the Special Materials Complex at Site 2 would generate the most construction waste and Site 1 the least. At Site 2, approximately 46,867 m^3 (61,300 yd^3) of contaminated soil (mixed LLW) would be excavated and an additional 3,420 m^3 (4,470 yd^3) of nonhazardous construction debris and 1.4 million L (382,400 gal) of nonhazardous sanitary waste would be generated. At Site 3, approximately 22,707 m^3

(29,700 yd^3) of contaminated soil would be excavated. The amount of construction debris and sanitary waste would be the same as Site 2. No contaminated soil would be excavated at Site 1 and approximately 1,447,541 L (382,400 gal) of nonhazardous sanitary waste would be generated. Small amounts of hazardous waste would be generated by the use of construction equipment.

If both a new HEU Materials Facility and a new Special Materials Complex were constructed, the waste generated would be additional to the waste generated under the No Action - Planning Basis Operations Alternative (see Table S.5-1). The contaminated soils would be mixed LLW. Use of construction equipment would generate small amounts of hazardous waste. Nonhazardous waste would consist primarily of construction debris and wastewater.

Operation. Under the No Action - Planning Basis Operations Alternative, mixed LLW and hazardous waste are expected to increase slightly from the No Action - Status Quo Alternative. LLW generation rate is expected to remain approximately the same as the No Action - Status Quo Alternative. Sanitary/industrial wastes are expected to decrease by a small amount (see Table S.5–1). The operation of the Environmental Management Waste Management Facility would be a beneficial impact on Y-12 Waste Management operations because it would expand on-site CERCLA waste disposal capacity.

Operation of the HEU Materials Facility would be expected to generate small amounts of LLW, hazardous, and nonhazardous waste per year (see Table S.5–1). The Upgrade Expansion of Building 9215 would generate similar small amounts of the same types of waste (see Table S.5–1). Adequate waste management capacity exists to support the expected waste volumes. The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility operation waste generation is shown in Table S.5–1.

Operation of the Special Materials Complex would generate small amounts of hazardous and nonhazardous waste per year (see Table S.5–1). Less than 0.76m^3 (1 yd^3)of LLW would be generated per year from Analytical Chemistry testing in support of special materials operations. Special materials operations use no radiologicalmaterials. Adequate waste management capacity exists to support the expected waste volumes. The No Action - Planning Basis Operations Alternative Plus the Special Materials Complex operation waste generation is shown in Table S.5–1.

Operation of both an HEU Materials Facility and a new Special Materials Complex would add to waste generated under the No Action - Planning Basis Operations Alternative (Table S.5–1).

S.5.13 Environmental Justice

Construction. None of the proposed action alternatives would result in environmental justice impacts related to construction activities. There would be no significant health or environmental impacts on any populations. In addition, prevailing wind patterns are not in the direction of primarily minority or low-income populations. Therefore, any adverse impacts would not disproportionately affect these populations.

Operation. None of the proposed action alternatives would result in environmental justice impacts related to operation of Y-12 Plant facilities. There would be no significant health or environmental impacts on any populations. In addition, prevailing wind patterns are not in the direction of primarily minority or low-income populations. Therefore, any adverse impacts would not disproportionately affect these populations.

S.5.14 Worker and Public Health

Construction. Under the No Action - Planning Basis Operations Alternative, construction activities of the Environmental Management Waste Management Facility would be expected to result in approximately nine non-fatal occupational injuries/illnesses per year.

Construction of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would be expected to result in approximately three additional non-fatal occupational injuries/illnesses per year. Both facilities would require a 4-year construction period.

Construction of the Special Materials Complex would be expected to result in approximately three additional non-fatal occupational injuries/illnesses per year. The construction period for the Special Materials Complex is 3.5 years.

Operation. Under the No Action - Planning Basis Operations Alternative, the estimated number of non-fatal occupational injuries/illnesses per year for the total Y-12 workforce is 440. Because of the restart of all Y-12 mission operations, radiological impacts are expected. The annual average dose to workers would increase from the No Action - Status Quo Alternative (8.0 mrem [0.016 LCF per year]) by 3.6 mrem and result in an estimated 0.024 LCFs per year. The MEI dose would increase from the No Action - Status Quo Alternative (0.53 mrem [2.65×10^{-7} LCF per year]) to 4.5 mrem/yr and result in an estimated 2.25×10^{-6} LCFs per year. The dose to the population within 80km (50 mi) would increase from the No Action - Status Quo Alternative (4.3 person-rem/year [2.15×10^{-6} LCFs per year]) to 33.7 person-rem/yr and result in an estimated 1.69×10^{-5} LCFs per year.

Once constructed, the HEU Materials Facility or the Upgrade Expansion of Building 9215 would require the transfer of stored HEU in existing facilities to the new storage facility. This one-time transfer would expose workers involved in the transfer to an estimated dose of 150 mrem. An estimated 0.002 LCFs are expected from the transfer. For normal operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215, the worker dose is expected to be 21 mrem/yr and the same as for the No Action - Planning Basis Operations Alternative or the No Action - Status Quo Alternative. The MEI dose and the dose to the population within 80km (50 mi) would not change from the No Action - Planning Basis Operations or the No Action - Status Quo Alternatives.

Operation of the Special Materials Complex involves no radiological materials. The MEI dose and the dose to the population within 80km (50 mi) would not change from that described above for the No Action - Planning Basis Operations Alternative.

S.5.15 Facility Accidents

Operation. Under the No Action - Planning Basis Operations Alternative, the beyond-design-basis earthquake accident would result in an estimated 0.202 LCFs to the population living within 80km (50 mi), same as the No Action - Status Quo Alternative. The MEI of the public would receive a dose of 17 rem and result in an estimated 0.008 LCFs.

The postulated criticality accident under the No Action - Planning Basis Operations Alternative would result in an estimated 0.0043 LCFs to the population living within 80km (50 mi), same as the No Action - Status Quo Alternative. The MEI of the public would receive a dose of 3 rem and result in an estimated 1.5×10^{-3} LCFs.

The fire accident scenario involving radiological materials would result in an estimated 9×10^{-5} to 0.28 LCFs to the population living within 80km (50 mi), same as the No Action - Status Quo Alternative. The dose to the MEI of the public would be 0.01 to 16 rem and result in an estimated 5 x 10^{-6} to 0.008 LCFs.

The potential accident involving a chemical release due to loss of containment would potentially expose between 200 and 1,000 workers at Y-12 to ERPG-2 concentrations or greater, same as the No Action - Status Quo Alternative (See Appendix Section D.7.2.3 of this SWEIS for definition of ERPG-2).

Except for the potential release of chlorine from the water treatment plant, no off-site exposure is expected. The release of chlorine from the water treatment plant would potentially expose up to 6,500 members of the public to ERPG-2 concentrations or greater.

Due to the design and facility construction, the HEU Materials Facility or the Upgrade Expansion of Building 9215 is expected to reduce the likelihood of a beyond-design-basis earthquake accident by approximately a factor of 5, the criticality accident by a factor of 2 to 5, and the accident involving radiological material by a factor of 2 to 5 compared to the current situation under the No Action - Status Quo Alternative. There would be no change from the No Action - Planning Basis Operations Alternative for chemical accidents.

There would be no change from the No Action - Planning Basis Operations Alternative for radiological accidents if the Special Materials Complex is constructed. The likelihood of chemical accidents for the Special Materials Complex would be lower by approximately a factor of 2 to 5 compared to the current situation under the No Action - Status Quo Alternative due to design and facility construction.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 1 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Land Use						
<u>*Construction:*</u>						
Potential Land Disturbance	None	26 to 40 ha (64 to 99 acres) for EMWMF	5 ha (12.4 acres) at Site A	0.8 ha (2 acres)	8 ha (20 acres) at Site 1	10-13 ha (24.7-32.1 acres)
		5 to 7 ha (12.4 to 17 acres) Y-12 West End Borrow Area	5 ha (12.4 acres) at Site B		5 ha (12.4 acres) at Site 2 and Site 3	
		4 ha (10 acres) Field Research Center				
		Total: 35-51 ha	**Total with No Action - Planning Basis Operations Alternative: 40-56 ha**	**Total with No Action - Planning Basis Operations Alternative: 36-52 ha**	**Total with No Action - Planning Basis Operations Alternative: 56-59 ha**	**Total with No Action - Planning Basis Operations Alternative: 45-64 ha**
<u>*Operation:*</u>						
Potential Permanent Land Requirement	No change from existing 2,136 ha (5,279 acres) comprising Y-12 Site	9 to 18 ha (22 to 44 acres) for EMWMF	4 ha (10 acres) at Site A	0.5 ha (1.2 acres)	4 ha (10 acres) at Sites 1, 2 or 3	8 ha (20 acres)
		5 to 7 ha (12.4 to 17 acres) for Borrow Area	4 ha (10 acres) at Site B			
		< 4 ha (<10 acres) Field Research Center				
		Total: 18-29 ha	**Total with No Action - Planning Basis Operations Alternative: 22-33 ha**	**Total with No Action - Planning Basis Operations Alternative: 18.5-29.5 ha**	**Total with No Action - Planning Basis Operations Alternative: 22-33 ha**	**Total with No Action - Planning Basis Operations Alternative: 26-37 ha**

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 2 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Transportation						
<u>*Construction:*</u>						
Additional Vehicles/Day	None	75 for EMWMF	165 worker vehicles at Site A and Site B; 8 Material Trucks	165 worker vehicles; 3 Material Trucks	157 worker vehicles at Site 1, Site 2, Site 3; 5 Material Trucks	335
		< 10 for Field Research Center				
		Total: 85 vehicles	**Total with No Action - Planning Basis Operations Alternative: 258 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 253 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 247 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 420 vehicles**
<u>*Operation:*</u>						
Additional Vehicles/Day	No change from average daily traffic volume of 32,100	28 for EMWMF	No additional worker traffic	No additional worker traffic	No additional worker traffic	No additional worker traffic
		6 for Field Research Center	3,000 additional truck trips on site to relocate stored HEU to new facility	3,000 additional truck trips on site to relocate stored HEU to new facility		
		Total: 34 vehicles	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 3 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Transportation Risk	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	No additional risk from No Action - Status Quo Alternative associated with radiological material transportation under this alternative.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.
	The risk associated with radiological waste transportation would be less than 0.1 fatality per year.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year. The risk associated with the one-time on site transport of stored HEU to new facility would be less than 0.001 fatality.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year. The risk associated with the one-time on site transport of stored HEU to new facility would be less than 0.001 fatality.	No additional risk from No Action - Status Quo Alternative with radiological waste transportation under this alternative.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year.
Socioeconomics						
<u>*Construction:*</u>	No new construction	100 for EMWMF	220 for Site A and Site B	220	210 for Site 1, Site 2, Site 3	430
Peak Workforce		< 10 for Field Research Center				
		Total: 110 workers	**Total with No Action - Planning Basis Operations Alternative: 330 workers**	**Total with No Action - Planning Basis Operations Alternative: 330 workers**	**Total with No Action - Planning Basis Operations Alternative: 320 workers**	**Total with No Action - Planning Basis Operations Alternative: 540 workers**

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 4 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation:*</u> (Workers)	No change from existing workforce of 8,900	25 for EMWMF	100 for one year transition period	100 for one year transition period	36 for Site 1, Site 2, Site 3	66
		6 for Field Research Center	30 for normal operation	49 for normal operation		
		Total: 31	**Total with No Action - Planning Basis Operations Alternative: 61**	**Total with No Action - Planning Basis Operations Alternative: 70**	**Total with No Action - Planning Basis Operations Alternative: 97**	**Total with No Action - Planning Basis Operations Alternative: 97**
		Impact on Regional Economy < 1 percent	Impact on Regional Economy < 1 percent	Impact on Regional Economy < 1 percent	Impact on Regional Economy < 1 percent	Impact on Regional Economy < 1 percent
Geology and Soils						
<u>*Construction:*</u>	No new construction or potential increase in soil erosion	Potential increase in soil erosion due to storm water runoff from EMWMF and Y-12 borrow area. Detention basins and runoff control ditches would minimize soil erosion and impacts.	Potential increase in soil erosion due to storm water runoff at Site A construction lay down area and new parking lot. Detention basins and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected.	Small potential for increase in soil erosion. Standard soil erosion control measures would be used to minimize impacts. No impacts to geology are expected.	At Site 1, potential impact to soil profile and increase in soil erosion due to storm water runoff at construction lay down area and new parking lot. Detention basins and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected.	Potential increase in soil erosion due to storm water runoff. Detention basins, silt fences, and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 5 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
		Small potential increase in soil erosion from Field Research Center. Soil erosion controls would minimize impacts.			Small potential increase in soil erosion at Site 2 and Site 3. No impacts to geology are expected.	
Operation:	No increase in soil erosion or impact to geology.	Minimal impacts expected from EMWMF and Y-12 borrow area activities. Detention basins, runoff control ditches, and cell design components would minimize impacts to geology and soils.	No impacts to geology or soils are expected at Site A or Site B with engineered design measures.	No impacts to geology or soils are expected with engineered design measures.	No impacts to geology or soils are expected at Site 1, Site 2, or Site 3 with engineered design measures.	Minimal impact expected due to EMWMF and borrow site activities. Engineered controls would minimize impacts.
Water Resources						
Surface Water:						
Construction:	No change from 15.7 MLD treated water requirement or 17.9 MLD raw water requirement. Surface water discharges meet NPDES permit limits.	No substantial change to surface raw water requirements, discharge, or water quality conditions. Small increase (4.5 MLD) to 20.2 MLD in treated water requirement. Minimal impacts from sediment loading or contaminated runoff from EMWMF or Y-12 borrow area due to engineered barriers (e.g., detention basins, stormwater runoff control ditches).	No substantial change to surface raw water requirements, discharge, or water quality conditions. Small amount (5,140 L/day) of treated water requirement (7.5 million L during 4-yr. construction period) if HEU Materials Facility is constructed at Site A or Site B. Potential for increased storm water runoff at Site A.	No substantial change to surface raw water requirements, discharge, or water quality conditions. Small amount (3,980 L/day) of treated water requirements (5.7 million L during 4-yr. construction period) if Upgrade Expansion to Building 9215 is constructed.	No substantial change to surface raw water requirements, discharge, or water quality. Small amount (4,460 L/day) of treated water requirement (5.7 million L during 3.5-yr. construction period) if Special Materials Complex is constructed at Site 1, Site 2 or Site 3. Potential for increased stormwater runoff at Site 1.	No substantial change to surface raw water requirements, discharge, or water quality. Small increase (4,510,000 L/day) to 20.21 MLD in treated water requirement.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 6 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	No change from 15.7 MLD treated water requirement or 17.9 MLD raw water requirement. Surface water discharges meet NPDES permit limits.	No impacts from Field Research Center activities. No substantial change to surface raw water requirements, discharge, or water quality conditions. Small increase (4.5 MLD [1.2 MGD]) to 20.2 MLD (5.34 MGD) in treated water requirement. Minimal impacts from sediment loading or contaminated runoff from EMWMF or Y-12 borrow area due to engineered barriers (e.g., detention basins, stormwater runoff control ditches).	Negligible impact to surface water with soil erosion and surface water control measures. Small increase (1,510 L/day [400 gal/day]) in treated water requirements and discharge but negligible increase from No Action - Planning Basis Operations Alternative surface water requirements, discharges, or water quality conditions at Site A or Site B. All water quality parameters within established limits with pretreatment.	Negligible impact to surface water with soil erosion and surface water control measures. Small increase (1,975 L/day [520 gal/day]) in treated water requirements and discharge but negligible increase from No Action - Planning Basis Operations Alternative water requirements, discharge, or water quality conditions. All water quality parameters within established limits with pretreatment.	Negligible impact to surface water with soil erosion and surface water control measures. Small increase (228,600 L/day [63,000 gal/day]) in treated water requirements and discharge but negligible increase from No Action - Planning Basis Operations Alternative surface water requirements, discharges, or water quality conditions. All water quality parameters within established limits with pretreatment.	Negligible impact to surface water with soil erosion and surface water control measures. Small increase (20.43 MLD [5.4 MGD]) in treated water requirements over No Action - Status Quo Alternative but negligible increase to raw water requirements, discharges, or water quality conditions. All water quality parameters within established limits with pretreatment. Negligible impacts to surface water with soil erosion and surface No Action - Planning Basis Operations Alternative water control measures.
Groundwater						
Construction:	No new construction or change in groundwater use or quality.	Negligible impact from tracer material used in Field Research Center tests. No groundwater requirement or additional impacts to groundwater quality conditions from the EMWMF or Y-12 borrow area. No groundwater requirement or additional impacts to groundwater quality conditions from the Field Research Center.	Negligible impacts to surface water with soil erosion and surface water control measures. No groundwater requirement or additional impacts to groundwater quality conditions if new HEU Materials Facility is constructed at Site A or Site B.	Negligible impacts to surface water with soil erosion and surface water control measures. No groundwater requirement or additional impacts to groundwater quality conditions if new Building 9215 expansion is constructed.	Negligible impacts to surface water with soil erosion and surface water control measures. No groundwater requirement or additional impacts to groundwater quality conditions if new Special Materials Complex is constructed at Site 1, Site 2, or Site 3.	No groundwater requirement or additional impacts to groundwater quality conditions.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 7 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	No groundwater requirement or change in groundwater use or quality.	No groundwater requirement or additional impacts to groundwater quality conditions from the EMWMF. The EMWMF design measures (e.g., natural and man-made synthetic liners) would prevent releases that could impact groundwater quality.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.
		Field Research Center sampling activities would remove approximately 7,570 L (2,000 gal) of groundwater per year. Minor impacts to groundwater quality due to injected additives and tracers for research study. Groundwater quality may improve with some research study treatment tests.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 8 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Biological Resources						
Terrestrial						
<u>*Construction:*</u>	No new construction or impacts to terrestrial resources.	Impacts due to land clearing activities associated with EMWMF and Y-12 borrow area, loss of grassland, old field habitat, and mixed hardwood/conifer forest habitat. Small animal dislocation and reduction in abundance can be expected.	Impacts due to land clearing activities for construction and new parking lot if HEU Materials Facility is constructed at Site A. Loss of grassland, habitat (~2 ha [5 acres]) and small animal dislocation and disturbance can be expected.	Negligible impacts if new addition to Building 9215 is constructed.	Impacts due to land clearing activities at constructions site and construction lay down area if Special Materials Complex is constructed at Site 1. Loss of approximately 4 ha (10 acres) terrestrial habitat and dislocation/disturb-ance of wildlife.	Impacts due to land clearing activities and construction sites. Loss of grassland, old field habitat, and mixed hardwood/conifer forest habitat. Dislocation and disturbance to wildlife can be expected.
		Minimal impact to terrestrial species or habitat from Field Research Center activities.	Negligible impacts if HEU Materials Facility is constructed at Site B.		Negligible impacts if Special Materials Complex is constructed at Site 2 or Site 3.	
<u>*Operation:*</u>	No new impacts to terrestrial resources from Y-12 operations.	Minor impact to terrestrial resources from the EMWMF or Y-12 borrow area. Operations noise and human activity may disturb or displace some wildlife.	Negligible impacts at Site A or Site B from operations due to noise and human activity.	Negligible impacts from operations due to noise and human activity.	Negligible impacts at Site 1, Site 2, or Site 3 from operations due to noise and human activity.	Negligible impacts due to operation noise and human disturbance.
		Negligible impact to terrestrial resources from Field Research Center activities. Noise and human activity may disturb or displace some wildlife.				

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 9 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Wetlands						
<u>*Construction:*</u>	No change in the 18 wetlands (6.14 ha [15.2 acres]) within the Y-12 area of analysis.	Potential impact to 0.4 ha (1 acre) wetland from EMWMF. No impact from Y-12 borrow area activities.	Potential impact to 3 man-made wetlands (0.4 ha [1 acre]) if the HEU Materials Facility is constructed at Site A. Impacts due to construction of lay down area and new parking lot.	No impacts to wetlands if new expansion to Building 9215 is constructed.	Potential impact on 2 man-made wetlands (0.4 ha [1 acres]) if Special Materials Complex is constructed at Site 1. Impacts due to land clearing and potential sedimentation from construction activities.	Potential impact to 0.8 ha (2 acres) of wetlands within the Y-12 area of analysis.
		No impact from Field Research Center activities.	No impacts to wetlands if HEU Materials Facility is constructed at Site B.		No impact on wetlands if Special Materials Complex is constructed at Site 2 or Site 3.	
		Total: 0.4 ha (1 acre)	**Total with No Action - Planning Basis Operations Alternative: 0.8 ha (2 acres)**	**Total with No Action - Planning Basis Operations Alternative: 0.4 ha (1 acre)**	**Total with No Action - Planning Basis Operations Alternative: 0.8 ha (2 acres)**	**Total with No Action - Planning Basis Operations Alternative: 1.2 ha (3 acres)**
<u>*Operation:*</u>	No change in the 18 wetlands within the Y-12 area of analysis.	No impacts on wetlands from EMWMF or Y-12 borrow area operation activities. No impacts on wetlands from Field Research Center operation activities.	No impacts on wetlands at Site A or Site B from HEU Materials Facility operation.	No impacts to wetlands from operation.	No impacts on wetlands from Special Materials Complex operation.	No impacts on wetlands.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 10 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Aquatic						
<u>*Construction:*</u>	No new construction or change to aquatic resources.	No impacts to aquatic resources from EMWMF or Y-12 borrow area activities. No impact from Field Research Center activities.	No impacts to aquatic resources if HEU Materials Facility is constructed at Site A or Site B.	No impacts to aquatic resources if expansion to Building 9215 is constructed.	No impacts to aquatic resources if Special Materials Complex is constructed at Site 1, Site 2, or Site 3.	No impacts to aquatic resources.
<u>*Operation:*</u>	No change in aquatic resources from Y-12 operation activities. No impacts to aquatic resources.	No impacts to aquatic resources from EMWMF or Y-12 borrow area operation. No impact from Field Research Center operations activities.	No impacts to aquatic resources from HEU Materials Facility operation.	No impacts to aquatic resources from new storage expansion operation.	No impacts to aquatic resources from Special Materials Complex operation.	No impacts to aquatic resources.
Threatened/Endangered Species						
<u>*Construction:*</u>	No new construction or impacts to threatened/ endangered species within Y-12 area of analysis.	Potential impacts to Tennessee Endangered species pink lady slipper and Tennessee Threatened species tuberculed rein-orchid and carolina quillwort from EMWMF construction activities. Impacts due to forest clearing and construction activities in close proximity to sensitive habitat.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species if HEU Materials Facility is constructed at Site A or Site B.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species if storage expansion to Building 9215 is constructed.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species if Special Materials Complex is constructed at Site 1, Site 2 or Site 3.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species from HEU Materials Facility or Special Materials Complex.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 11 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	No impacts to threatened/ endangered species from operation activities.	No impact from Y-12 borrow area activities to threatened/endangered species. No impact from Field Research Center operation activities.	No impact to threatened/endangered species from HEU Materials Facility operation.	No impact to threatened/endangered species from storage expansion operation.	No impact to threatened/endangered species from Special Materials Complex operation.	No impact to threatened/endangered species from operations.
Air Quality						
Nonradiological Emissions						
Construction:	No new construction. All criteria pollutant levels within acceptable standards.	Potential fugitive dust emissions from EMWMF and Y-12 borrow area during construction. Standard dust control measures would be used. No off-site impact. Potential fugitive dust emissions from Field Research Center due to minor site clearing and drilling activities. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions if HEU Materials Facility is constructed at Site A or Site B. Site A construction activities would generate more fugitive dust emissions due to site preparation for new parking lot and lay down area. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions if expansion to Building 9215 is constructed. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions if Special Materials Complex is constructed at Site 1, Site 2, or Site 3. Site 1 construction activities would generate more fugitive dust emissions than Site 2 or Site 3 due to larger construction site, land clearing, and lay-down area site preparation. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions due to land disturbance and construction activities. Standard dust control measures would be used to minimize fugitive dust impacts. No off-site impacts.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 12 of 30]

	Alternative 1		**Alternative 2**		**Alternative 3**	**Alternative 4**
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation:*</u>	Concentrations of regulated nonradiological air pollutants are within standards except for 1-hour ozone. Concentrations of mercury vapor are well below the ACGIH TLV of 50 Fg/m^3.	No change to No Action - Status Quo Alternative air quality conditions from Y-12 mission normal operations. Nonradiological air pollutant concentrations would increase but would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Planning Basis Operations Alternative air quality conditions from HEU storage operations. Nonradiological air pollutant concentrations would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Planning Basis Operations Alternative air quality conditions from new storage expansion operations. Nonradiological air pollutant concentrations would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Planning Basis Operations Alternative air quality conditions from special materials operations. Nonradiological air pollutant concentrations would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Status Quo Alternative air quality conditions. Nonradiological air pollutant concentrations would increase but would be within established standards. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.
Radiological Emissions						
<u>*Construction:*</u>	No new construction or change in Y-12 radiological emissions.	No radiological emissions from EMWMF construction activities.	No radiological emissions from construction of HEU Materials Facility at Site A or Site B.	No radiological emission from construction of storage expansion to Building 9215.	No radiological emissions from construction of Special Materials Complex at Site 1, Site 2, or Site 3.	No radiological emissions.
		No radiological emissions from Field Research Center construction activities.				
<u>*Operation:*</u>	Radiation dose to the MEI is 0.53 mrem. The dose is well below the NESHAP standard of 10 mrem/yr.	Radiation dose to the MEI (1,080 m [3,543 ft] from Y-12) would increase from 0.53 mrem/yr under No Action - Status Quo Alternative to 4.5 mrem/yr. The dose is well below the NESHAP standard of 10 mrem/yr.	No change from No Action - Planning Basis Operations Alternative if HEU Materials Facility is constructed. Radiation dose to MEI would be 4.5 mrem/yr.	No change from No Action - Planning Basis Operations Alternative if storage expansion to Building 9215 is constructed. Radiation dose to MEI would be 4.5 mrem/yr.	No change from No Action - Planning Basis Operations Alternative. No radioactive materials would be used or stored at the complex. Radiation dose to MEI would be 4.5 mrem/ yr.	Radiation dose to the MEI would increase from 0.53 mrem/yr under No Action - Status Quo Alternative to 4.5 mrem/yr. The dose is well below the NESHAP standard of 10 mrem/yr.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 13 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
	Radiation dose to the population within 80 km (50 mi) is 4.3 person-rem/yr.	Radiation dose to the population (80 km [50 mi] radius) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.
Visual Resources						
Construction:	No change in Y-12 Site visual setting or visual resources.	The EMWMF, Y-12 borrow area, and Field Research Center Project areas are not visible to the public. The site construction activities would be compatible with current uses and consistent with existing visual character of the area. No additional impact to visual resources.	Site A and Site B for the HEU Materials Facility are not visible to the public. No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.	The Building 9215 expansion site is not visible to the public. No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.	Site 1, Site 2, and Site 3 for the new Special Materials Complex are not visible to the public. No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.	No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.
Operation:	No change in Y-12 Site visual setting or visual resources.	No additional impact to visual resources from No Action - Status Quo Alternative.	No additional impact to visual resources from No Action - Status Quo Alternative. The new HEU materials facility would be consistent with the existing visual character of the area.	No additional impact to visual resources from No Action - Status Quo Alternative. The Building 9215 expansion would be consistent with the existing visual character of the area.	No additional impact to visual resources from No Action - Status Quo Alternative. The new Special Materials Complex would be consistent with the existing visual character of the area.	No additional impact to visual resources from No Action - Status Quo Alternative. New facilities would be consistent with the existing visual character of the area.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 14 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Noise						
<u>*Construction:*</u>	No change in on-site noise levels of 50 to 70 dBA. Off-site noise levels would remain at 35 to 50 dBA in rural locations and 53 to 62 dBA in city of Oak Ridge.	Increase in noise levels due to construction equipment and activities associated with EMWMF and Y-12 borrow area. Impact would be limited to general construction area and not noticeable to the public. Small increase in noise levels from Field Research Center activities but localized in study area.	Increase in noise levels (89 to 108 dBA) if HEU Materials Facility is constructed at Site A or Site B. Impacts would be limited to general construction area. No off-site noise impacts except for construction vehicle traffic.	Localized increase in noise levels (89 to 108 dBA) if storage expansion to Building 9215 is constructed. No off-site noise impacts except for construction vehicle traffic.	Increase in noise levels (89 to 108 dBA) if Special Materials Complex is constructed at Site 1, Site 2, or Site 3. Impacts would be limited to general construction area. No off-site impacts except for construction vehicle traffic.	Increase in noise levels (89 to 108 dBA) due to construction equipment and activities. Impacts would be limited to the general construction area sites. Cumulative noise levels 70 dBA. No off-site impacts except for construction vehicle traffic.
<u>*Operation:*</u>	No change in on-site noise levels of 50 to 70 dBA. Off-site noise levels would remain at 35 to 50 dBA in rural locations and 53 to 62 dBA in city of Oak Ridge.	No off-site increase in noise levels from No Action - Status Quo Alternative due to operation of the EMWMF, the Field Research Center, or activities at Y-12 borrow area.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 15 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Site Infrastructure						
Construction:	No measurable change in Y-12 site energy usage or other infrastructure resources.	No measurable change in Y-12 site energy usage or other infrastructure resources from the construction of the EMWMF or Field Research Center.	If the HEU Materials Facility is constructed at Site A, existing utilities would require relocation but no buildings would be demolished. Construction resources include 25,100 m^3 (32,830 yd^3) of concrete and 7.5 million L (2 million gal) of water during the 4-year construction period. If the HEU Materials Facility is constructed at Site B existing infrastructure (Old Bear Creek Road) and utilities would require relocation. Eight buildings would be demolished. Construction resources include 25,100 m^3 (32,830 yd^3) of concrete and 7.5 million L (2 million gal) of water during the 4-year construction period.	If the Building 9215 expansion is constructed existing utilites would require relocation. No permanent building would be demolished. Construction resources include 7,650 m^3 (10,005 yd^3) of concrete and 5.7 million L (1.5 million gal) of water during the 4-year construction period.	If the Special Materials Complex is constructed at Sites 1, 2, or 3, existing utilities would require relocation. A number of buildings would be demolished at Site 2 and Site 3. Construction resources include 13,800 m^3 (18,050 yd^3) of concrete for Site 1 and 14,500m^3 (18,966 yd^3) for Site 2 and Site 3.	If the HEU Material Facility is constructed at Site A or B and the Special Materials Complex is constructed at Site 1, 2, or 3, existing utilities would require relocation and up to 16 buildings would be demolished. Construction resources would include 46,630 m^3 (61,000 yd^3) of concrete and 13.2 million L (3.5 million gal) of water during the construction period which could run from 4 to 7.5 years.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 16 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation:*</u>	Continue electrical usage of 377,000 MWh/yr and water usage of 15.7 MLD (4.2 MGD). Both amounts well within existing Y-12 site capacities.	Small increase in overall Y-12 energy and resource requirements. Electrical energy consumption would increase to 566,000 MWh/yr from 377,000 MWh/yr under No Action - Status Quo Alternative. Increases would be well within existing capacities at Y-12. Water usage would increase to 20.2 MLD (5.3 MGD) from 15.7 MLD (4.2 MGD) under No Action - Status Quo Alternative.	Increase of electrical usage by 5,900 MWh/yr and water usage of 1,510L/day (400 gal/day). Vacating existing HEU storage facilities could partially offset these increases. Sufficient capacity exists to support the increases.	Increase in electrical usage by 10,900 MWh/yr and water usage of 1,975L/day (520 gal/day). Vacating existing HEU storage facilities could partially offset these projected increases. Sufficient capacity exists to support the increases.	Increase in electrical usage by 30,400 MWh/yr and water usage of 228,600L/day (60,400 gal/day). Vacating existing Special Materials operations facilities could partially offset these projected increases. Sufficient capacity exists to support the increases.	Increase in electrical usage by 36,300 Mwh/yr Water usage would increase by 230,110 L/day (60,788 gal/day). Sufficient capacity exists to support the increases.
		Total: 566,000 MWh/y in electrical usage (an increase of 189,000). Combined water use increase of 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 572,000 MWh/yr in electrical usage (an increase of 194,900). Combined water use increase would still be approximately 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 577,000 Mwh/yr in electrical usage (an increase of 199,900). Combined water usage increase would still be approximately 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 596,000 Mwh/yr in electrical usage (an increase of 217,900). Combined water usage increase would still be approximately 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 602,000 Mwh/yr in electrical usage (an increase of 225,300). Combined water usage increase would be approximately 5.4 MGD.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 17 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Cultural Resources						
<u>*Construction:*</u>	No new construction or building modification; no impacts to cultural resources is expected	No impact to cultural resources is expected from the EMWMF, Y-12 Borrow area, or Field Research Center activities.	No impact to cultural resources is expected from construction of HEU Materials Facility at Site A or Site B. Utility relocation associated with construction could encounter buried cultural resources. Any potential adverse effects are anticipated to be minor and mitigatable.	The expansion of Building 9215 would be a major alteration of a historic property. Consultation with the Tennessee Historical Commission (SHPO)would be conducted in accordance with procedures in the Y-12 Cultural Resources Management Plan.	No impact to cultural resources is expected from construction of the Special Materials Complex at Site 1, Site 2, or Site 3. No historic properties would be affected. Utility relocation or site construction activities could encounter buried cultural resources. Any potential effects are anticipated to be minor and mitigatable.	No impact to cultural resources is expected. Utility relocation or site construction activities could encounter buried cultural resources. Any potential effects are anticipated to be minor and mitigatable.
<u>*Operation:*</u>	The continued use of buildings in their historic role would have a positive impact on the integrity of historic properties. Ongoing minor impacts due to aging of historic structures.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 18 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Waste Management						
<u>Construction:</u>	No new construction waste would be generated as a result of operations.	Small amounts of non-hazardous construction waste generated from the EMWMF, Y-12 borrow area, and Field Research Center construction activities.	At Site A, approximately 3,823m^3 (5,000 yd^3) of non-hazardous construction debris and 14.8 million L (3.9 million gal) of non-hazardous sanitary waste would be generated during the 4-year construction period.	Approximately 3,058 m^3 (4,000 yd^3) of non-hazardous construction debris and 14.8 million L (3.9 million gal) of non-hazardous sanitary waste would be generated during the 4-year construction period.	At Site 1, approximately 917m^3 (1,200 yd^3) of non-hazardous construction debris and 1,447,541 L (382,400 gal) of non-hazardous sanitary waste would be generated during the 3.5-year construction period.	Under this alternative approximatly 7,268m^3 (9,506 yd^3) of non-hazardous construction debris and 15,995,000L (4.2 million gal) of non-hazardous sanitary waste and would be generated.
			At Site B, approximately 3,823m^3 (5,000 yd^3) of non-hazardous construction debris and 14.8 million L (3.9 million gal) of non-hazardous sanitary waste would be generated during the 4-year construction period.		At Site 2, approximately 3,420 m^3 (4,470 yd^3) of non-hazardous construction debris and 1,447,541 L (382,400 gal) of non-hazardous sanitary waste would be generated during the 3.5-year construction period.	
			An additional 22,707m^3 (29,700 yd^3) of contaminated soil (mixed LLW) would be excavated.		An additional 46,867 m^3 (61,300 yd^3) of contaminated soil (mixed LLW) would be excavated.	An additional 69,574m^3 (90,999 yd^3) of contaminated soil would be excavated (mixed LLW).

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 19 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
					At Site 3, approximately 22,707m3 (29,700 yd^3) of contaminated soil (mixed LLW) would be excavated. An additional 3,445m^3 (4,500 yd^3) of non-hazardous construction debris and 1,447,541m3 (382,400 gal) of non hazardous sanitary waste would be generated during the 3.5 year construction period.	
			An estimated 3,000L (800 gal) and 38m^3 (50 yd^3) of hazardous waste would be generated from the use of construction equipment.	An estimated 1,100L (300 gal) and 15m^3 (20 yd^3) of hazardous waste would be generated from the use of construction equipment.	Up to 11,400L (3,000 gal) and 107m^3 (140 yd^3) of hazardous waste would be generated at any one site from the use of construction equipment.	An estimated 14,400L (3,804 gal) and 145m^3 (190 yd^3) of hazardous waste would be generated from use of construction equipment.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 20 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation:*</u>	Annual waste generation at Y-12 (1998) included:	Projected annual waste generation (1998) plus waste forecast:	Operation of the HEU Materials Facility would generate the following additional amounts of waste per year:	Operation of the Building 2915 storage expansion would generate the following additional amounts of waste per year:	Operation of the Special Materials Complex would generate the following additional amounts of waste per year:	Operation of the HEU Materials Facility and Special Materials Complex would generate the following total amounts of waste per year:
	LLW Liquid 1,000,000L (264,172 gal) Solid 1,224 m^3 (1,601 yd^3)	**LLW** Liquid 1,118,800L (295,556 gal) Solid 2,099 m^3 (2,745 yd^3)	**LLW** Liquid 757L (200 gal) Solid 119 m^3 (156 yd^3)	**LLW** Liquid 606L (160 gal) Solid 119m^3 (156 yd^3)	**LLW** Liquid - None Solid 0.8 m^3 (1 yd^3)	**LLW** Liquid 757 L (200 gal) Solid 120 m^3 (157 yd^3)
	Mixed LLW Liquid 22,500L (5,944 gal) Solid 33 m^3 (43 yd^3)	**Mixed LLW** Liquid 936,783 L (247,477 gal) Solid 162 m^3 (212 yd^3)	**Mixed LLW** Liquid - None Solid - None	**Mixed LLW** Liquid - None Solid - None	**Mixed LLW** Liquid - None Solid - None	**Mixed LLW** Liquid - None Solid - None
	Hazardous Liquid 3,300L (872 gal) Solid 8 m^3 (10 yd^3)	**Hazardous** Liquid 10,400L (2,748 gal) Solid 26 m^3 (34 yd^3)	**Hazardous** Liquid 2,498L (660 gal) Solid 1.5 m^3 (2 yd^3)	**Hazardous** Liquid 2,498L (660 gal) Solid 1.5 m^3 (2 yd^3)	**Hazardous** Liquid 12,500L (3,302 gal) Solid 9.2 m^3 (12 yd^3)	**Hazardous** Liquid 14,998 L (3,962 gal) Solid 10.7 m^3 (48 yd^3)
	Sanitary/Ind Liquid 1,406,000L (371,426 gal) Solid 5,389 m^3 (7,049 yd^3).	**Sanitary/Ind** Liquid 2,318,000L (612,298 gal) Solid 8,883 m^3 (11,619 yd^3). The EMWMF would have a beneficial impact on Y-12 waste management by providing on-site disposal capacity.	**Sanitary/Ind** Liquid 781,309L (206,400 gal) Solid 179 m^3 (234 yd^3).	**Sanitary/Ind** Liquid 1,273,601L (336,450 gal) Solid 179 m^3 (234 yd^3).	**Sanitary/Ind** Liquid 932,725L (246,400 gal) Solid 175 m^3 (229 yd^3).	**Sanitary/Ind** Liquid 1,714,034 L (452,800 gal) Solid 354 m^3 (463 yd^3)

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 21 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
			Total with No Action - Planning Basis Operations Alternative:	**Total with No Action - Planning Basis Operations Alternative:**	**Total with No Action - Planning Basis Operations Alternative:**	**Total with No Action - Planning Basis Operations Alternative:**
			LLW Liquid 1,119,557L (295,756 gal) Solid 2,218 m^3 (2,901 yd^3) **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162 m^3 (212 yd^3) **Hazardous** Liquid 12,898L (3,408 gal) Solid 27.7 m^3 (36.2 yd^3) **Sanitary/Ind** Liquid 3,099,309L (818,698 gal) Solid 9,062 m^3 (11,853 yd^3)	**LLW** Liquid 1,119,406L (295,716 gal) Solid 2,218 m^3 (2,901 yd^3); **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162 m^3 (212 yd^3) **Hazardous** Liquid 12,898L (3,408 gal) Solid 27.7 m^3 (36.2 yd^3) **Sanitary/Ind** Liquid 3,591,601L (948,748 gal) Solid 9,062 m^3 (11,853 yd^3)	**LLW** Liquid 1,118,800L (295,556 gal) Solid 2,100 m^3 (2,746 yd^3) **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162 m^3 (212 yd^3) **Hazardous** Liquid 22,900L (6,050 gal) Solid 35.3 m^3 (46.2 yd^3) **Sanitary/Ind** Liquid 3,250,725L (858,698 gal) Solid 9,058 m^3 (11,848 yd^3)	**LLW** Liquid 1,119,557L (295,756 gal) Solid 2,219 m^3 (2,902 yd^3) **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162m^3 (212 yd^3) **Hazardous** Liquid 25,398L (6,710 gal) Solid 37 m^3 (48 yd^3) **Sanitary/Ind** Liquid 4,032,034L (1,065,100 gal) Solid 9,237 m^3 (12,082 yd^3)
			These increases could be partially offset by reductions due to the phase-out of existing HEU storage operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.	These increases could be partially offset by reductions due to the phase-out of existing HEU storage operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.	These increases could be partially offset by reductions due to the phase-out of existing Special Materials operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.	These increases could be partially offset by reductions due to the phase-out of existing HEU storage and Special Materials operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 22 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Worker and Public Health						
Construction:	Nonfatal occupational injury/illness rate (per 100 workers) 4-year average is 8.58. Total number of injuries/illnesses calculated for a Y-12 worker population of 5,105 under No Action - Status Quo Alternative is 438 per year.	Construction of the EMWMF and activities associated with the Field Research Center would be expected to result in approximately 9 additional non-fatal occupational injuries/illnesses per year during construction.	Construction of the HEU Materials Facility would be expected to result in approximately 3 additional non-fatal occupational injuries/illnesses per year during the 4-year construction period.	Construction of the Building 9215 storage expansions would be expected to result in approximately 3 additional non-fatal occupational injuries/illnesses per year during the 4-year construction period.	Construction of the Special Materials Complex would be expected to result in approximately 3 additional non-fatal injuries/illnesses per year during the 3.5-year construction period.	Construction activities would result in approximately 16 additional nonfatal injuries/illnesses per year during construction under this alternative.
			Total with No Action - Planning Basis Operations Alternative: 12 additional nonfatal injuries/illnesses per year during construction.	**Total with No Action - Planning Basis Operations Alternative: 12 additional nonfatal injuries/illnesses per year during construction.**	**Total with No Action - Planning Basis Operations Alternative: 12 additional nonfatal injuries/illnesses per year during construction.**	**Total with No Action - Planning Basis Operations Alternative: 15 additional nonfatal injuries/illnesses per year during construction.**

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 23 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation:*</u>	Nonfatal occupational injury/illness rate (per 100 workers) 4-year average is 8.58. Total number of injuries/illnesses calculated for a Y-12 worker population of 5,105 under No Action - Status Quo Alternative is 438.	The estimated total number of non-fatal occupational injuries/illnesses per year for the Y-12 workforce (5,128) is 440.	The estimated total number of nonfatal occupational injuries/illnesses per year for the Y-12 workforce would be 440.	The estimated total number of nonfatal occupational injuries/illnesses per year for the Y-12 workforce would be 440.	The estimated total number of nonfatal occupational injuries/illnesses per year for the Y-12 workforce would be 440.	The estimated total number of nonfatal occupational injuries/illnesses per year would be 440.
	No change in the annual average dose to workers of 8.0 mrem. LCF's per year of exposure would be 0.016. HEU storage operations worker dose of 21 mrem (0.0003 LCF's).	The annual average dose to workers would increase by 3.6 mrem to 11.6 mrem. The estimated number of LCFs per year of exposure would increase to 0.024.	The annual average dose to Y-12 workers would be the same as No Action - Planning Basis Operations Alternative (11.6 mrem) an increase of 3.6 mrem from No Action - Status Quo Alternative. The estimated number of LCFs would be 0.024 per year.	The annual average dose to Y-12 workers would be the same as No Action - Planning Basis Operations Alternative (11.6 mrem) an increase of 3.6 mrem from No Action - Status Quo Alternative. The estimated number of LCFs would be 0.024 per year.	The annual average dose to Y-12 workers would be the same as No Action - Planning Basis Operations Alternative (11.6 mrem) an increase of 3.6 mrem from No Action - Status Quo Alternative. The estimated number of LCFs would be 0.024 per year.	The annual average worker dose to all Y-12 workers would increase from 8.0 mrem under No Action - Status Quo Alternative to 11.6 mrem under this alternative. The estimated number of LCFs per years of exposure would increase to 0.024 from 0.016 (No Action - Status Quo Alternative).
			For the HEU Materials Facility normal operations the worker dose would be 21 mrem. The estimated number of LCFs would decrease from 0.0003 for No Action - Status Quo Alternative HEU storage operations to 0.0001 under this alternative.	For Building 9215 storage expansion normal operations, the worker dose would be 21 mrem. The estimated number of LCFs would decrease from 0.0003 for No Action - Status Quo Alternative to 0.0001 under this alternative HEU storage operations.		

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 24 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
			The one-time transfer of stored HEU to the new HEU Materials Facility would result in a worker dose of 150 mrem to the 35 involved workers. The estimated number of LCFs is 0.002.	The one-time transfer of stored HEU to the new Building 9215 expansion would result in a worker dose of 150 mrem to the 35 involved workers. The estimated number of LCFs is 0.002.		This one-time transfer of stored HEU to the new HEU Materials Facility would result in a worker dose of 150 mrem to the 35 involved workers. The estimated number of LCFs is 0.002.
	The MEI dose is 0.53 mrem/yr. The estimated number of LCF's is $2.65x10^{-7}$.	The MEI dose would increase by 3.97 mrem/yr to 4.5 mrem/yr. The estimated number of LCFs per year of exposure would increase by $1.985x10^{-6}$ to $2.25x10^{-6}$.	The MEI dose would not change from the 4.5 mrem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 3.97 mrem/yr from the 0.53 mrem/yr under No Action - Status Quo Alternative).	The MEI dose would not change from the 4.5 mrem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 3.97 mrem/yr from the 0.53 mrem/yr under No Action - Status Quo Alternative).	The MEI dose would not change from the 4.5 mrem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 3.97 mrem/yr from the 0.53 mrem/yr under No Action - Status Quo Alternative).	The MEI dose would increase by 3.97 mrem/yr from 0.53 mrem/yr under No Action - Status Quo Alternative to 4.5 mrem/yr under this alternative. The estimated number of LCFs per year of exposure would increase by 0.0158 from 0.0002 (No Action- Status Quo Alternative) to 0.016.
	The 80 km (50 mi) population dose is 4.3 person-rem/yr. The estimated number of LCF's is $2.15x10^{-6}$.	The 80 km (50 mi) population dose would increase by 29.4 person-rem/yr to 33.7 person-rem/yr. The estimated number of LCFs per year of exposure would increase by $1.75x10^{-5}$ to $1.69x10^{-5}$.	The 80 km (50 mi) population dose would not change from the 33.7 person-rem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 29.4 person-rem/yr under No Action - Status Quo Alternative).	The 80 km (50 mi) population dose would not change from the 33.7 person-rem/yr under No Action - Planning Basis Operations Alternative (this would be an increase from of 29.4 person-rem/yr under No Action - Status Quo Alternative).	The 80 km (50 mi) population dose would not change from the 33.7 person-rem/yr under No Action - Planning Basis Operations Alternative (this would be an increase from of 29.4 person-rem/yr under No Action - Status Quo Alternative).	The 80 km (50 mi) population dose would increase by 29.4 person-rem/yr from 4.3 person-rem/yr under No Action - Status Quo Alternative to 33.7 person-rem/yr under this alternative. The estimated number of LCFs per year would increase by 0.0168 from 0.0002 (No Action - Status Quo) to 0.017.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 25 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Environmental Justice						
<u>*Operation:*</u>	Routine operations pose no significant health risks or adverse socioeconomic impacts to the public; no disproportionately high and or adverse effects on minority or low-income populations.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 26 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Facility Accidents						
Operation: (Radiological):	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**
Dose and increased likelihood of a cancer fatality per year:	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11 Public Maximally Exposed Individual: Dose-17 rem LCF-0.008 80km (50-mi) population: Dose-404 person-rem LCF-0.202	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11 Public Maximally Exposed Individual: Dose-17 rem LCF-0.008 80km (50-mi) population: Dose-404 person-rem LCF-0.202	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11 Public Maximally Exposed Individual: Dose-17 rem LCF-0.008 80km (50-mi) population: Dose-404 person-rem LCF-0.202 Likelihood of Beyond Design - Basis Earthquake Accident lower than Alternative 1A by approximately a factor of 5.	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11 Public Maximally Exposed Individual: Dose-17 rem LCF-0.008 80km (50-mi) population: Dose-404 person-rem LCF-0.202 Likelihood of Beyond Design - Basis Earthquake Accident for the HEU Storage Mission lower than Alternative 1A by approximately factor of 5.	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11 Public Maximally Exposed Individual: Dose-17 rem LCF-0.008 80km (50-mi) population: Dose-404 person-rem LCF-0.202	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11 Public Maximally Exposed Individual: Dose-17 rem LCF-0.008 80km (50-mi) population: Dose-404 person-rem LCF-0.202 Likelihood of Beyond Design - Basis Earthquake Accident for the HEU Storage Mission lower than Alternative 1A by approximately factor of 5.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 27 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
	Criticality Accident:	**Criticality Accident:**	**Criticality Accident:**	**Criticality Accident:**	**Criticality Accident:**	**Criticality Accident:**
	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-$4x10^{-3}$ Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-$4x10^{-3}$ Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-$4x10^{-3}$ Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-$4x10^{-3}$ Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-$4x10^{-3}$ Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-$4x10^{-3}$ Y-12 Plant Population: Dose-870 person-rem LCF-0.35
	Public Maximally Exposed Individual: Dose-3 rem LCF-$1.5x10^{-3}$ 80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	Public Maximally Exposed Individual: Dose-3 rem LCF-$1.5x10^{-3}$ 80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	Public Maximally Exposed Individual: Dose-3 rem LCF-$1.5x10^{-3}$ 80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	Public Maximally Exposed Individual: Dose-3 rem LCF-$1.5x10^{-3}$ 80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	Public Maximally Exposed Individual: Dose-3 rem LCF-$1.5x10^{-3}$ 80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	Public Maximally Exposed Individual: Dose-3 rem LCF-$1.5x10^{-3}$ 80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043
			Likelihood of criticality accident lower than Alternative 1A by approximately a factor of 2 to 5.	Likelihood of criticality accident lower than Alternative 1A by approximately a factor of 2 to 5.		Likelihood of criticality accident for the HEU Storage Mission lower than Alternative 1A by approximately a factor of 2 to 5.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 28 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
	Radiological Fire Accident: Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-5x10^{-6} to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3 Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-5x10^{-6} to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- 9x10^{-5} to 0.28	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-5x10^{-6} to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3 Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-5x10^{-6} to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- 9x10^{-5} to 0.28	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-5x10^{-6} to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3 Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-5x10^{-6} to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- 9x10^{-5} to 0.28 Likelihood of radiological fire accident lower than Alternative 1A by approximately a factor of 2 to 5.	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-5x10^{-6} to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3 Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-5x10^{-6} to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- 9x10^{-5} to 0.28 Likelihood of radiological fire accident lower than Alternative 1A by approximately a factor of 2 to 5.	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-5x10^{-6} to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3 Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-5x10^{-6} to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- 9x10^{-5} to 0.28	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-5x10^{-6} to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3 Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-5x10^{-6} to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF-9x10^{-5} to 0.28 Likelihood of radiological fire accident for the HEU Storage Mission lower than Alternative 1A by approximately a factor of 2 to 5.

TABLE S.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 29 of 30]

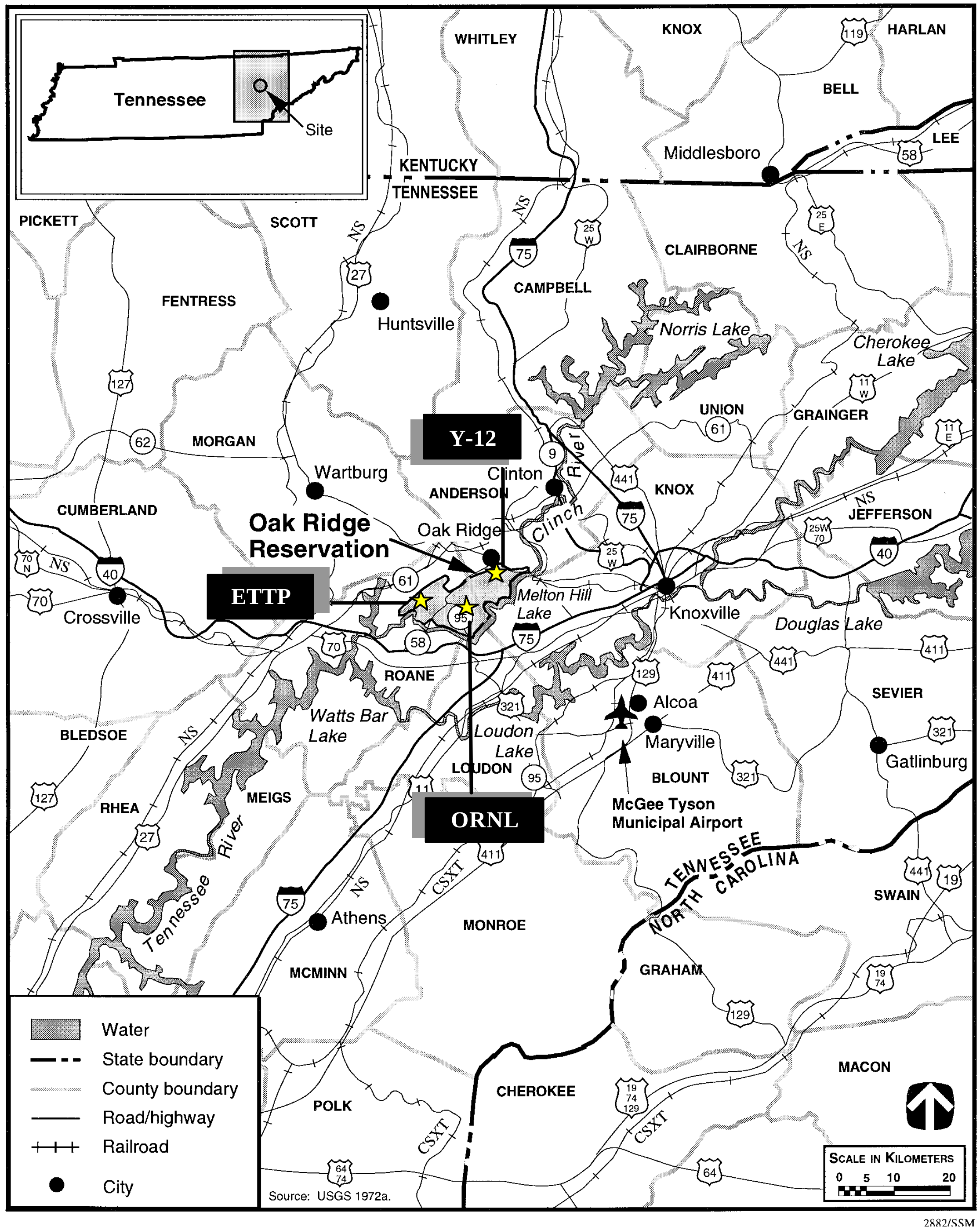
	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation*</u>: (Chemical)	**Fires involving chemicals:** Potentially expose between 10 and 220 workers to ERPG-2 concentrations of toxic materials. No exposures are expected off-site **Chemical release due to loss of containment:** Potentially expose between 200 and 1,000 workers to ERPG-2 concentrations or greater. Except for chlorine, no toxic gas release is expected to reach the public occupied areas. A release of chlorine could expose up to 6,500 members of the public to ERPG-2 concentrations or greater.	**Fires involving chemicals:** Potentially expose between 10 and 220 workers to ERPG-2 concentrations of toxic materials. No exposures are expected off-site **Chemical release due to loss of containment:** Potentially expose between 200 and 1,000 workers to ERPG-2 concentrations or greater. Except for chlorine, no toxic gas release is expected to reach the public occupied areas. A release of chlorine could expose up to 6,500 members of the public to ERPG-2 concentrations or greater.	No change from No Action - Status Quo Alternative or No Action - Planning Basis Operations Alternative.	No change from No Action - Status Quo Alternative or No Action - Planning Basis Operations Alternative.	Likelihood of chemical accidents for the new Special Materials Complex lower than Alternative 1A by approximately a factor of 2 to 5. Operation of the Special Materials Facility at Site 1 would potentially increase the likelihood of exceeding ERPG-2 (or TEEL-2) concentrations at the Y-12 boundary.	Likelihood of chemical accidents for the Special Materials Mission lower by approximately factor of 2 to 5. Potential increase in the likelihood of exceeding ERPG-2 (or TEEL-2) concentrations at the Y-12 boundary if Special Materials Complex is located at Site 1.

Note: EMWMF - Environmental Management Waste Management Facility; SHPO - State Historic Preservation Officer.

S.6 PREFERRED ALTERNATIVE

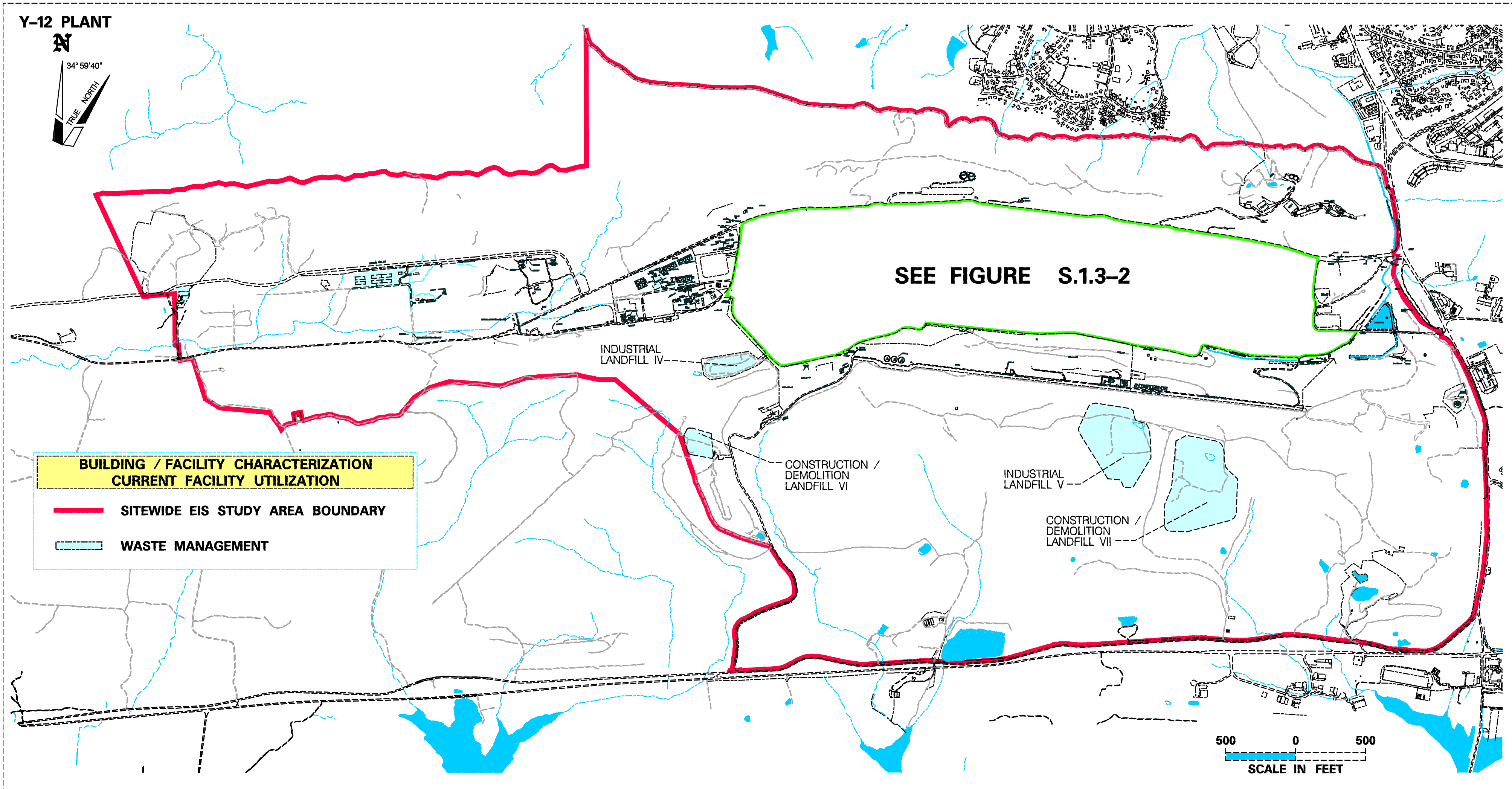
Council on Environmental Quality (CEQ) NEPA regulations require that an agency identify its preferred alternative, if one or more exists, in the Draft EIS (40 CFR 1502.14 [e]). As discussed in "Forty Most Asked Questions Concerning CEQ's NEPA Regulations. (46 FR 18026, March 23, 1981 as amended), the preferred alternative is the alternative which the agency believes would fulfill its statutory missions and responsibilities giving consideration to economic, environmental, technical, and other factors. Consequently, to identify a preferred alternative, DOE is developing information on potential impacts, costs, technical risks, and schedule risks for the alternatives under consideration. This Draft Y-12 SWEIS provides information on the potential environmental impacts. Cost, schedule, and technical analyses are also being prepared and will be considered in the identification of preferred alternatives.

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. The Final SWEIS will identify all preferred alternatives. The ROD will describe DOE's decisions for the Y-12 SWEIS proposed actions.



DOE 1996e

FIGURE S.1.1-1. — ***Location of Oak Ridge Reservation, Principal Facilities, and Surrounding Area***



Y-12 PLANT
34° 59'40"
TRUE NORTH
SEE FIGURE S.1.3-2
INDUSTRIAL LANDFILL IV
CONSTRUCTION / DEMOLITION LANDFILL VI
INDUSTRIAL LANDFILL V
CONSTRUCTION / DEMOLITION LANDFILL VII
BUILDING / FACILITY CHARACTERIZATION
CURRENT FACILITY UTILIZATION
SITEWIDE EIS STUDY AREA BOUNDARY
WASTE MANAGEMENT
500 0 500
SCALE IN FEET

FIGURE S.1.3-1

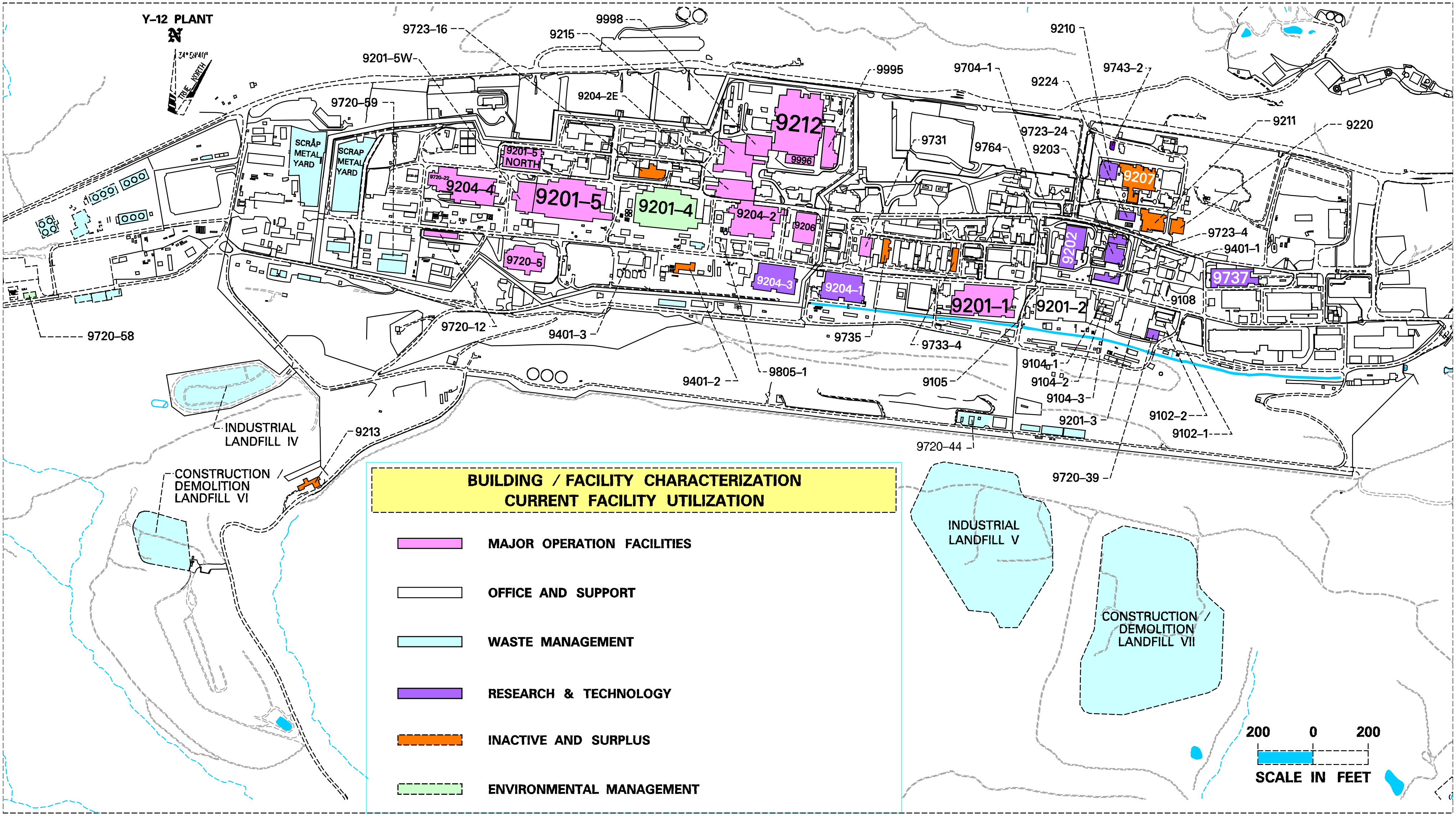
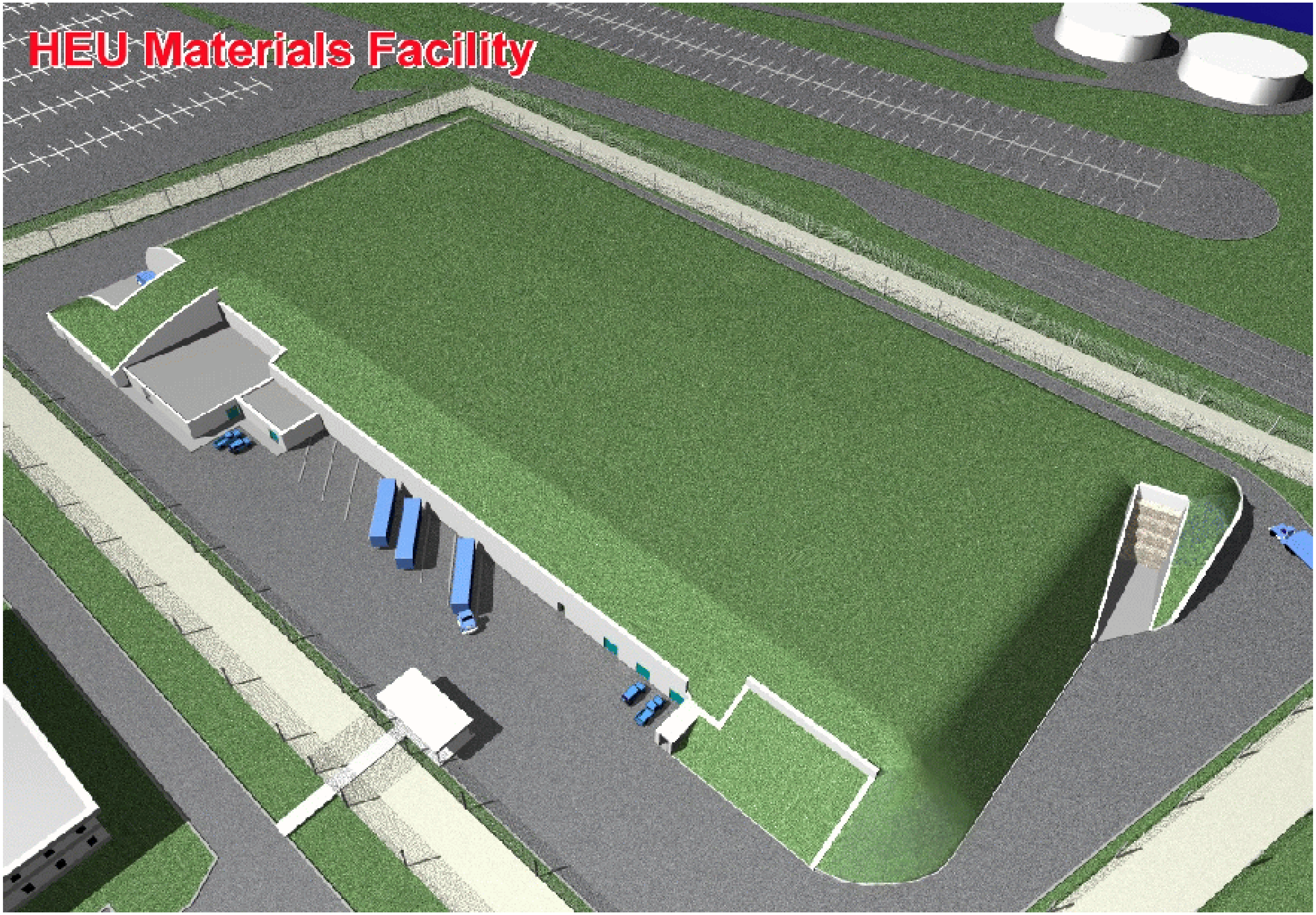
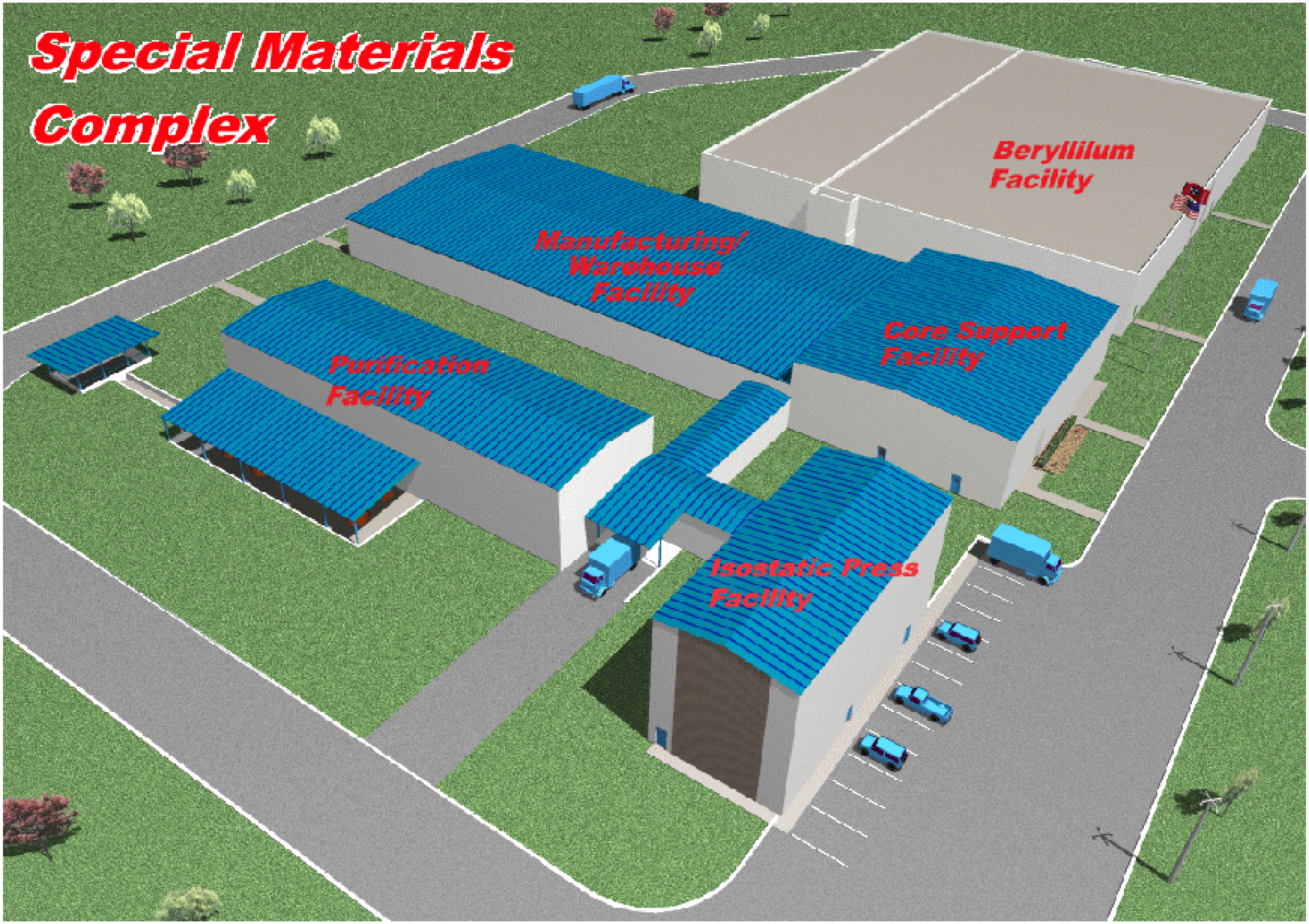

Y-12 PLANT
TRUE NORTH
BUILDING / FACILITY CHARACTERIZATION
CURRENT FACILITY UTILIZATION
MAJOR OPERATION FACILITIES
OFFICE AND SUPPORT
WASTE MANAGEMENT
RESEARCH & TECHNOLOGY
INACTIVE AND SURPLUS
ENVIRONMENTAL MANAGEMENT
200 0 200
SCALE IN FEET
SCRAP METAL YARD
SCRAP METAL YARD
INDUSTRIAL LANDFILL IV
CONSTRUCTION DEMOLITION LANDFILL VI
INDUSTRIAL LANDFILL V
CONSTRUCTION / DEMOLITION LANDFILL VII
9723-16
9998
9215
9201-5W
9720-59
9204-2E
9212
9996
9995
9704-1
9210
9743-2
9224
9731
9764
9723-24
9203
9211
9220
9201-5 NORTH
9720-22
9204-4
9201-5
9201-4
9204-2
9206
9207
9202
9723-4
9401-1
9737
9720-5
9204-3
9204-1
9201-1
9201-2
9108
9720-58
9720-12
9401-3
9735
9733-4
9104-1
9104-2
9104-3
9105
9401-2
9805-1
9201-3
9102-2
9102-1
9213
9720-44
9720-39

FIGURE S.1.3–2



Source: LMES 2000b

FIGURE S.3.2.3-1 - ***The Proposed New Highly Enriched Uranium Materials Facility***



Source: LMES 2000c

FIGURE S.3.2.4-1 - ***The Proposed Special Materials Complex***

Source: LMES 2000a

Figure S.4-1 - ***Aerial View Looking West of the Y-12 Plant at Oak Ridge Reservation, Tennessee***

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND/OVERVIEW

1.1.1 General

DOE is the Federal agency responsible for providing the Nation with nuclear warheads and ensuring that those weapons remain safe, secure, and reliable. The Oak Ridge Y-12 Plant (Y-12) is one of three primary installations on the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) in Oak Ridge, Tennessee. Figure 1.1.1–1 shows the location of the ORR. The other installations are the Oak Ridge National Laboratory (ORNL) and the East Tennessee Technology Park (ETTP) (formerly the Oak Ridge K-25 Site). Construction of Y-12 was started in 1943 as part of the World War II Manhattan Project. The early missions of the site included the separation of ^{235}U from natural uranium by the electromagnetic separation process and manufacturing weapons components from uranium and lithium.

Late Changes Affecting the Y-12 SWEIS

In the interim period between submitting the Draft Y-12 SWEIS for approval and the printing of the document for public release, a number of changes have occurred that affect some of the terminology used in the Y-12 SWEIS. Specifically, the changes involve:

- The National Nuclear Security Administration was established by Congress to manage the Nation's nuclear weapons complex. The National Nuclear Security Administration is a semi-autonomous agency within the Department of Energy. As one of the major production facilities within the nuclear weapons complex, Y-12 falls under the responsibility of the Y-12 Area Office as of October 1, 2000, under the new National Nuclear Security Administration. The National Nuclear Security Administration was created on March 1, 2000.
- Replacement of Lockheed Martin Energy Systems, Inc., by BWXT-Y12, L.L.C. as the M&O contractor for Y-12 on November 1, 2000.
- Change in the name of the Oak Ridge Y-12 Plant to Y-12 National Security Complex as of November 2, 2000.

Because these changes do not affect analyses present in the Y-12 SWEIS and in order to expedite public review, required revisions to the document will be made in the final version of the Y-12 SWEIS.

As one of the DOE major production facilities, Y-12 has been the primary site for enriched uranium processing and storage, and one of the primary manufacturing facilities for maintaining the U.S. nuclear weapons stockpile. Y-12 also conducts and/or supports nondefense-related activities including environmental monitoring, remediation, and decontamination and decommissioning (D&D) activities of the Environmental Management (EM) Program; management of waste materials from past and current operations; research activities operated by ORNL; support of other Federal agencies through the Work-for-Others Program and the National Prototyping Center; and the transfer of highly specialized technologies to support the capabilities of the U.S. industrial base (DOE 1999k).

During a September 1994 Defense Nuclear Facilities Safety Board (DNFSB) technical staff review, weaknesses were identified in the Y-12 Plant Conduct of Operations Program related to its criticality safety program. While these weaknesses did not represent a technical risk to facility workers, meaning that the required margins of safety were in place, they did indicate issues with training, document control, understanding of requirements, and procedures. After a full Y-12 Plant review, Plant management suspended all work not necessary to maintain regulatory compliance or that would pose a threat to the safety basis for the Plant (Stand-Down Status) until improvements could be implemented to the Conduct of Operations program. As of today, many, but not all Y-12 Plant facilities and processes have returned to Operating Status (i.e., executing the work for which the process, facility, or system was designed) (DNFSB 1994).

Source: DOE 1996e.

FIGURE 1.1.1–1.—*Location of Oak Ridge Reservation, Principal Facilities, and Surrounding Area.*

In response to the end of the Cold War and changes in the world's political regimes, the emphasis of the U.S. nuclear 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. Even with these significant changes, DOE’s responsibilities for the nuclear weapons stockpile continue, and the President and Congress have directed DOE to continue to maintain the safety, security, and reliability of the nuclear weapons stockpile.

In order to meet the challenges of the post-Cold War era, DOE prepared three programmatic environmental impact statements (PEISs) to analyze alternatives dealing with certain national security requirements. The *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS) (DOE 1996e), which was completed 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 Y-12, but to downsize the plant consistent with the reduced requirements. The *Storage and Disposition of Weapons-Usable Fissile Material Programmatic Environmental Impact Statement* (S&D PEIS) (DOE 1996h), which was completed in December 1996, evaluated alternatives for the long-term storage of fissile material and the disposition of surplus fissile material. In the S&D PEIS ROD, DOE decided that Y-12 would also store surplus enriched uranium pending long-term disposition. In addition, the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (S-HEU EIS) (DOE 1996b), which was completed in June 1996, evaluated alternatives for the disposition of weapons-usable highly enriched uranium (HEU) that has been declared surplus to national defense needs. In the S-HEU EIS ROD, DOE decided that Y-12 would be one of four sites for blending up to 85 percent of the Nation’s surplus HEU to low enriched uranium for commercial use as fuel feed for nuclear power plants and dispose of the remaining low enriched uranium as low-level waste (LLW). Section 1.1.4 discusses DOE’s decision resulting from these PEISs.

1.1.2 Stockpile Management Restructuring Initiative

The ongoing Stockpile Management Restructuring Initiative project supports the plan for downsizing the Y-12 Plant consistent with the future nuclear weapons secondary and case manufacturing mission defined by the SSM PEIS ROD. The purpose of the Stockpile Management Restructuring Initiative project is to assist in preparing the Y-12 Plant for the future production mission requirements for nuclear weapon secondaries, case components, and other miscellaneous components, while providing a smaller, more cost-effective production size. The ongoing downsizing task is to minimize the number of major buildings required while maintaining the capability to perform the Defense Programs (DP) production mission.

1.1.3 Y-12 Site Integrated Modernization Program

In 1999, DOE’s Office of Defense Programs asked DOE-Oak Ridge Operations (ORO) and Lockheed Martin Energy Systems, Inc. (LMES) to determine what activities would be required to develop and implement a program to modernize Y-12's facilities and ensure its capability to meet future stockpile needs. Consistent with that request, the Y-12 Site Integrated Modernization (Y-SIM) Program was established to develop and is currently implementing plans for modernizing Y-12.

The envisioned modernized Y-12 Plant includes the eventual replacement or upgrade of all major production facilities that support the DP Mission. Whereas current operations are housed in multiple facilities scattered throughout the west end of the Y-12 Plant, the envisioned Y-SIM Plant would consolidate operations into fewer, more efficient facilities. The ultimate goal is a modernized Y-12 Plant containing the following facilities:

- HEU Materials Facility for storage of assembled weapons secondaries and other forms of HEU
- Special Materials Complex for production of special materials (e.g., beryllium, plastic parts)
- Highly Enriched Uranium Manufacturing Facility
- Assembly/Disassembly/Quality Evaluation Facility for the assembly, disassembly, and surveillance of nuclear weapons secondaries
- Lithium Operations Complex for production of lithium hydride and lithium deuteride parts
- Depleted Uranium Operations Facility for production of depleted uranium parts and other nonnuclear components
- Other production support facilities
- Utility and infrastructure facilities

The extent of Y-12 modernization toward this desired goal is dependent upon many factors, including sustained funding. Construction of new facilities proposed by the Y-SIM Program would be accomplished through a series of Budget Line Item construction projects.

The Y-SIM Program would improve Y-12 capabilities by:

- Improving worker protection through the use of engineered controls
- Improving safety, environmental, and security compliance through the use of modern facilities and advanced technologies
- Supporting responsiveness to the Science-based Stockpile Stewardship Program through increased flexibility and use of advanced technologies
- Reducing costs through lowered maintenance costs and improved operating efficiencies

In support of the proposed HEU Materials Facility, the first component of the Y-SIM Program, the Conceptual Design Report (Y-12 1999a) has been prepared and issued, the Project Execution Plan has been prepared, and activities have been performed to support an Independent Project Assessment and project validation to include it as a Fiscal Year (FY) 2001 Line Item Project. The feasibility, design, costing, and pre-*National Environmental Policy Act* (NEPA) review of the HEU Materials Facility considered different siting locations, different designs (e.g., above-ground, below ground, or combination of both), and issues such as material storage and security requirements. Based partially on cost and security requirements, the above-ground design was selected and the potential sites for constructing the new structure was screened down to two locations. Further DOE internal scoping of the project for NEPA review also revealed a possible alternative to constructing the new HEU Materials Facility (e.g., upgrade the existing HEU facility). This upgraded/expanded facility alternative was considered reasonable for NEPA analyses based on earlier preliminary feasibility and costing studies and is included in the NEPA review for the HEU Storage Mission alternatives.

In addition, the planning and design of the Special Materials Complex have been expedited so that construction of the proposed new facility is expected to commence in FY 2003. Alternatives for the siting, construction, and operation of the HEU Materials Facility and Special Materials Complex are included in this *Site-Wide Environmental Impact Statement* (SWEIS) *for the Oak Ridge Y-12 Plant*. The other potential Y-SIM Program facilities (i.e., production, production support, and utility and infrastructure) are still under early feasibility studies and are not included as proposed projects in the Y-12 SWEIS. However, these potential future facilities are described in Section 3.3 (Potential Future Y-12 Site Integrated Modernization Projects) based on their current level of development. Further NEPA review would be required when these facilities are formally proposed and ripe for decision.

1.1.4 Proposed Action and Scope

The RODs from the SSM PEIS, the S&D PEIS, and the S-HEU EIS form a starting point for the scope of actions that are included in this Y-2 SWEIS. In the SSM PEIS ROD, DOE decided to maintain the national security missions at Y-12, 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 weapons; (2) evaluating components and subsystems returned from the stockpile; (3) storing enriched uranium that is designated for national security purposes (also referred to as nonsurplus enriched uranium); (4) storing depleted uranium and lithium materials and 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 future use); and (7) providing support to weapons laboratories. In the S&D PEIS ROD, DOE decided that Y-12 would also store surplus enriched uranium pending long-term disposition. In the S-HEU EIS ROD, DOE decided that Y-12 would be one of four sites for blending up to 85 percent of the Nation’s surplus HEU to low enriched uranium for commercial use as fuel feed for nuclear power plants and dispose of the remaining low enriched uranium as LLW.

In accordance with the SSM and S&D RODs, DOE proposes to provide the capability and capacity to maintain the Nation’s stockpile, in support of the U.S. Nuclear Weapons Program. Furthermore, DOE will continue the processing and storage of enriched and depleted uranium, lithium compounds, and other materials, as well as the manufacturing and assembly/disassembly mission assigned to Y-12 in the safest, most secure and most efficient manner practicable. In accordance with the S-HEU EIS ROD, Y-12 may blend surplus HEU to produce material for commercial use as fuel feed for nuclear power plants and dispose of the remaining material as LLW. Blend stock for this activity may include DOE surplus low enriched uranium and natural uranium or commercial natural uranium. These materials would be stored on-site on an interim basis to support blending of HEU. The Y-12 Plant currently blends small quantities of HEU with low enriched, depleted, or natural uranium to produce a metal or oxide product suitable for use in various reactor programs and for multiple supply orders to DOE customers. The Y-12 Plant does not have the capability to blend large quantities of HEU (tons/year). Facility upgrades or new building construction would be required to install this process at Y-12. Further NEPA review would be needed to initiate these facility upgrades or any new building construction.

The Y-12 SWEIS physical area of analysis for the Plant is shown in Figure 1.1.4–1. A detailed map of current facility utilization at Y-12 is provided in Figure 1.1.4–2.

Source: Tetra Tech, Inc./LMES 2000a.

FIGURE 1.1.4–1.—*The Y-12 Site-Wide Environmental Impact Statement Area of Analysis.*

Source: Tetra Tech, Inc./LMES 2000a.

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

1.2 ALTERNATIVES ANALYZED

The alternatives presented in the Y-12 SWEIS have changed significantly during this NEPA process from those identified in the Notice of Intent (NOI) on March 17, 1999. Internal DOE scoping, which formed the alternatives in the NOI, focused on the modernization of the Y-12 Plant. In this respect, alternatives (e.g., Upgrade Alternative, New Construction Alternative, and Upgrade/New Construction Alternative) centered on upgrades and new construction at the Plant for DOE to accomplish the mission assigned to Y-12 based on SSM PEIS and S&D PEIS ROD decisions. During preparation of the Y-12 SWEIS it became apparent that these alternatives were too broad, not well defined, and lacked the data needed to analyze the potential impacts. A reevaluation of the DOE proposed action for the Y-12 Plant resulted in the current alternatives analyzed in this SWEIS. The new alternatives focus on two of Y-12 Plant's mission components; the HEU Storage Mission and the Special Materials Mission.

The alternatives analyzed in the Y-12 SWEIS are based on the fact that the future mission of Y-12 (to maintain the capability and capacity to fabricate nuclear weapons secondaries, and limited life components and case parts in support of the U.S. Nuclear Weapons Program and to store non-surplus HEU long-term and surplus HEU pending disposition) has already been decided in the SSM and S&D PEISs and RODs. Therefore, "traditional" SWEIS alternatives such as Expanded Operations, Reduced Operations, or Site Closure are not appropriate and are not analyzed. Instead, the Y-12 SWEIS alternatives focus on factors that consider (1) Y-12's Mission; Y-12 already has the capability to perform its assigned stockpile mission, (2) Stockpile Management Restructuring Initiative; implementing downsizing actions consistent with the SSM ROD that enable Y-12 to more efficiently and cost effectively maintain that capability, and (3) Y-SIM Program modernization actions.

Because all operations at the Y-12 Plant have not regained operational readiness from the stand-down of the Y-12 Plant in 1994, the existing Y-12 activities and environmental conditions do not reflect a true No Action for the Y-12 Site for comparison of action alternative impacts. Therefore, two No Action Alternatives are presented in this SWEIS; No Action - Status Quo and No Action - Planning Basis Operations. The No Action - Status Quo Alternative, which is basically the status of Y-12 in 1998, is presented in this SWEIS to show the increase in production levels and potential impacts under the No Action - Planning Basis Operations Alternative and the action alternatives. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it would not meet Y-12 mission requirements. The No Action- Planning Basis Operations Alternative represents a Y-12 Plant operated at full planned and required work levels.

Table 1.2–1 shows the alternatives for the Y-12 HEU Storage Mission and Special Materials Mission components analyzed in this Y-12 SWEIS. The alternatives are described in detail in Chapter 3 and summarized in the following discussion.

Implementation of any of the action alternatives for the HEU Storage Mission or Special Materials Mission would result in the potential for surplus DP facilities and their possible transitioning to EM for cleanup and D&D. Appendix A.1 describes the Y-12 Plant facility transition process in detail. Estimated D&D wastes from vacated HEU storage facilities and special materials operation facilities are provided in Chapter 5 (Section 5.11) of this SWEIS.

Y-12 Site Alternatives

Alternative 1A (No Action - Status Quo Alternative). The No Action - Status Quo Alternative represents the current level of operations at Y-12 as reflected by the most recent monitoring data (1998) for the Y-12 Site and reported in the 1998 Annual Site Environmental Report (ASER) issued in 1999. Although approximately 40 percent of these types of operations associated with DP's assigned mission were operational ready in 1998 (following the Y-12 Plant stand-down of 1994), the Y-12 Plant was only operating at 10 percent capacity. This state/condition is used in the SWEIS as a basis for comparison of the impacts associated with the No Action - Planning Basis Operations Alternative and the actions that reflect full Y-12 DP mission operations at required levels plus recently approved projects by EM and ORNL at Y-12. The No Action - Status Quo Alternative is not considered a reasonable alternative for future Y-12 operations because it would not meet Y-12 mission needs and would not reflect DOE's decision in the SSM PEIS ROD (61 FR 68011) to maintain and downsize the DP mission at Y-12

TABLE 1.2–1.—*Y-12 SWEIS Alternatives*

Y-12 Mission -	**Alternative 1A** **No Action - Status Quo Alternative** (Partial Stand-Down Operation)
	Alternative 1B **No Action - Planning Basis Operations Alternative** (Continue historic mission operations)
HEU Storage Mission	**No Action (Same as Alternative 1B)** (Continue HEU storage in existing facilities) **Alternative 2A** **No Action - Planning Basis Operations Plus Construct and Operate New HEU Materials Facility** (Site A or Site B) **Alternative 2B** **No Action - Planning Basis Operations Plus Upgrade to existing Building 9215**
Special Materials Mission	**No Action (Same as Alternative 1B)** (Continue special materials operations in existing facilities with limited capabilities) **Alternative 3** **No Action - Planning Basis Operations Plus Construct and Operate New Special Materials Complex** (Site 1, Site 2, or Site 3)
Both HEU Storage Mission and Special Materials Mission	**No Action (Same as Alternative 1B)** (Continue historic HEU storage and special materials operations in existing facilities) **Alternative 4** **No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility and a New Special Materials Complex**

Alternative 1B (No Action - Planning Basis Operations Alternative). This alternative reflects the historic nuclear weapons program missions at Y-12, and includes the manufacture and assembly/disassembly of weapons components and the continued processing and storage of enriched uranium materials in existing facilities at required nuclear weapons stockpile support work levels. The No Action - Planning Basis Operations Alternative also includes other nondefense-related program activities at Y-12 that have been approved and would be implemented during the 10-year planning period. Nondefense-related program activities included under the No Action - Planning Basis Operations Alternative are the construction and operation of a new *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) waste disposal cell (referred to as the Environmental Management Waste Management Facility) to accommodate wastes resulting from environmental remediation, and the implementation of an Office of Science Field Research Center project at Y-12.

The Environmental Management Waste Management Facility would be constructed in Bear Creek Valley just west of the Y-12 Plant in an area currently designated for waste management activities. The Field Research Center component of the ORNL Natural and Accelerated Bioremediation Research (NABIR) Program would also be located in Bear Creek Valley near the Y-12 S-3 ponds.

Alternative 2 (No Action - Planning Basis Operations Alternative Plus HEU Storage Mission Alternatives). This alternative includes the No Action - Planning Basis Operations Alternative Plus an HEU storage facility. Options considered for HEU storage include a new HEU Materials Facility at one of two proposed sites (e.g., Sites A and B), and expansion of Building 9215. Candidate sites for the new HEU Materials Facility are located on the west end of the Y-12 Plant in the West Portal Parking Lot (Site A) and in the area of the Y-12 Scrap Metal Yard (Site B). The proposed HEU Materials Facility would be a single-story concrete structure covered by an earthen berm. The expansion of Building 9215 would be a new two-story concrete and steel structure attached to the north end of the building.

Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative). This alternative includes the No Action - Planning Basis Operations Alternative Plus a new Special Materials Complex at one of three proposed sites (e.g., Sites 1, 2, and 3). Candidate sites for the new Special Materials Complex are located in the west end of the Y-12 Plant. Two potential sites are in the area of the Y-12 Scrap Metal Yard (Sites 2 and 3) and one site is located northwest of Building 9114 and on the north side of Bear Creek Road (Site 1). The proposed Special Materials Complex would include a Beryllium Facility, a Manufacturing Warehouse Facility, a Purification Facility, an Isostatic Press Facility, and a Core Support Facility. All facilities in the Complex would be connected by covered corridors.

Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex). This alternative includes the No Action - Planning Basis Operations Alternative Plus Construction and Operation of a New HEU Materials Facility at one of two proposed sites and construction and operation of a New Special Materials Complex at one of three proposed sites.

1.3 LAWS AND REGULATIONS AND *NATIONAL ENVIRONMENTAL POLICY ACT* STRATEGY

This SWEIS has been prepared in accordance with Section 102(2)c of NEPA of 1969, as amended in the United States Code (42 U.S.C. 4321 et seq.), and regulations promulgated by the Council on Environmental Quality (CEQ) within the *Code of Federal Regulations* (CFR) (40 CFR 1500-1508) and DOE (10 CFR 1021), and follows DOE guidance (DOE 1998c). Under NEPA, Federal agencies, such as DOE, proposing major actions that could significantly affect the quality of the human environment are required to prepare an EIS to ensure that the environmental consequences of the proposed action and its alternatives are available to the public and considered before decisions to take an action are made.

For certain large multiple-facility sites, such as Y-12, a SWEIS is prepared (10 CFR 1021.330). The purpose of a SWEIS is to (1) provide DOE and its stakeholders with an analysis of the individual and cumulative environmental impacts resulting from both ongoing and reasonably foreseeable new operations and facilities (i.e., reasonable alternatives) at a DOE site, (2) provide a basis for site-wide decision making, and (3) improve and coordinate agency plans, functions, programs, and resource utilization. A SWEIS can be used to efficiently and effectively analyze multiple proposals and help establish an efficient, environmentally sound, and cost-effective plan for operating the site and its facilities. Additionally, a SWEIS provides an overall NEPA baseline for a site that is useful as a reference when project-specific NEPA documents are prepared. In accordance with 10 CFR 1021.330(d), DOE shall evaluate the SWEIS at least every 5 years after its completion to determine whether it remains adequate, should be supplemented, or should be replaced with a new SWEIS.

The DOE strategy for NEPA review of both the SSM and S&D programs consists of multiple phases. The first phase was to prepare PEISs (now completed) to support program-wide decisions. In the second phase, DOE would prepare necessary programmatic and/or project-specific NEPA documents required to implement any site-wide decisions. This Y-12 SWEIS is the next step for DOE's NEPA strategy for Y-12. Project-specific analyses for the proposed HEU Materials Facility and Special Materials Complex are included in this Y-12 SWEIS.

1.4 RELATIONSHIP OF THIS ENVIRONMENTAL IMPACT STATEMENT WITH OTHER *NATIONAL ENVIRONMENTAL POLICY ACT* REVIEWS

DOE has prepared or is currently preparing other programmatic, project-specific, and site-wide NEPA documents that influence the mix of potential long-term missions at Y-12. These documents, and their relationship to the Y-12 SWEIS, are discussed below.

1.4.1 Programmatic *National Environmental Policy Act* Reviews

DOE has prepared several PEISs to determine how best to carry out its national security requirements. As a result, DOE has already made a number of decisions related to the long-term storage and disposition of fissile material, the maintenance of national security, and reliability of the nuclear weapons stockpile. Y-12, based on DOE's programmatic decisions, has been selected to fulfill an integral role in the continuance of DOE's programs supporting the Nation's nuclear defense. The alternatives considered in this SWEIS are consistent with DOE's "higher-tier" programmatic requirements and are designed to support and implement the Y-12 related decisions made by DOE in the respective PEIS and EIS RODs. In these RODs, DOE decided that the mission of Y-12 would not change and that Y-12 would continue to maintain the capability and capacity to fabricate nuclear weapons secondaries and limited life components and case parts in support of the U. S. Nuclear Weapons Program, and store nonsurplus HEU long-term and surplus HEU pending disposition. This SWEIS “tiering” NEPA review (i.e., preparing site-specific analysis concentrating on the issues specific to the Y-12 SWEIS to implement the decisions made in the broader programmatic environmental impact statements) analyzes the potential environmental impacts associated with the various Y-12 proposed actions and alternatives for implementing these decisions. Each of the controlling PEISs is summarized below.

***Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS-0236, DOE 1996e).** A ROD was issued on December 19, 1996 (61 FR 68014). As identified in the ROD, DOE decided not to change the mission at Y-12 but maintain and downsize the DP missions including the weapons secondary and case component fabrication capability at Y-12. Figure 1.4.1-1 shows the facilities of the DOE complex and the missions of each respective site. The Y-12 SWEIS tiers off of the SSM PEIS and analyzes alternatives for implementing the decisions reached in the SSM PEIS ROD. The ROD decision forms the basis for the No Action - Planning Basis Operations Alternative (e.g., continue historic mission) and the alternative for the Special Materials Mission presented in this Y-12 SWEIS.

Source: DOE 1996e.

FIGURE 1.4.1–1.—*Current Department of Energy Stockpile Stewardship and Management Sites*.

***Storage and Disposition of Weapons-Usable Fissile Materials, Final Programmatic Environmental Impact Statement* (DOE/EIS-0229, DOE 1996h).** A ROD was issued on January 14, 1997 (62 FR 3014). In the ROD, DOE decided that Oak Ridge, in particular Y-12, would continue to store nonsurplus HEU (long-term) and surplus HEU (on an interim basis) in upgraded facilities pending disposition. The Y-12 SWEIS tiers off of the S&D PEIS and analyzes alternatives for implementing the decision reached in the S&D PEIS ROD. The ROD decision forms the basis for continuing the HEU Storage Mission at Y-12 and the proposal to construct and operate a new HEU Materials Facility at Y-12.

***Waste Management Programmatic Environmental Impact Statement* (DOE/EIS-0200-F, DOE 1997c).** The Final PEIS was issued in May 1997. Multiple RODs are being prepared for various categories of waste. A ROD for the Treatment of Non-Wastewater Hazardous Waste was issued on July 30, 1998 (63 FR 41810). In the ROD, DOE decided to continue to use off-site facilities for the treatment of major portions of the non-wastewater hazardous waste generated at DOE sites. In accordance with the ROD, the ORR, including Y-12, will treat some of its own non-wastewater hazardous waste on-site, where capacity is available in existing facilities and where this is economically favorable. The treatment of Y-12 non-wastewater hazardous waste is included in the Y-12 SWEIS Alternative 1A (No Action - Status Quo Alternative). A second ROD for transuranic (TRU) waste was issued on January 23, 1998 (63 FR 3629). TRU waste at the ORR will be packaged to meet waste acceptance criteria for the Waste Isolation Pilot Plant (WIPP) in New Mexico and then stored on-site for eventual disposal at the WIPP. Y-12 does not generate or manage TRU waste. DOE's preferred alternative for management of LLW and mixed LLW was issued December 5, 1999 (64 FR 69241). For the management of LLW and mixed LLW, DOE prefers regional disposal at the Hanford Site and Nevada Test Site. ORR would continue disposal of LLW generated on-site including Y-12's. The disposal of on-site generated LLW fromY-12 is included in the Y-12 SWEIS Alternative 1B (No Action - Planning Basis Operations Alternative). The ROD for LLW and unified LLW treatment and disposal was consistent with those preferred alternatives and was issued on February 25, 2000 (65 FR 10061).

***Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (DOE/EIS-0225, DOE 1996f).** The ROD was issued on January 27, 1997 (62 FR 3880). In the ROD, DOE decided that Pantex would continue nuclear weapons operations involving assembly and disassembly of nuclear weapons. The decisions announced in the ROD did not affect the continued shipment of HEU and depleted uranium components to Y-12 resulting from the disassembly of weapons. Uranium components received from Pantex are included in the Y-12 activities and all the alternatives analyzed in this Y-12 SWEIS.

1.4.2 Project-Specific *National Environmental Policy Act* Reviews

***Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE/EIS-0240, DOE 1996b).** A ROD was issued on August 5, 1996 (61 FR 40619). Y-12 is one of four domestic sites selected to potentially down-blend weapons-usable surplus HEU to nonweapons-usable low enriched uranium for use as commercial reactor fuel or as a LLW. Capabilities exist at the Y-12 Building 9212 to perform only small-scale (kg/year) HEU blending operations. The small-scale (kg/year) down-blending of HEU is included in the Y-12 No Action - Planning Basis Operations Alternative. The large-scale (tons/year) down-blending operations cannot be performed at Y-12 without major building and process upgrades or new construction. No projects have been proposed to increase the capacities at Y-12 at this time. Therefore, the potential impacts of this operation are included under cumulative impacts in Chapter 6 of this Y-12 SWEIS. Impacts of upgrades or construction will be analyzed when those projects are identified.

***Interim Storage of Enriched Uranium Environmental Assessment* (DOE/EA-0929)**. This Environmental Assessment (EA) and the finding of no significant impact (FONSI) were issued on September 14, 1995 (60

FR 54068). It allowed for the continued interim storage of enriched uranium at Y-12, with an increase in the amount of material stored above the historical maximum level. The S&D PEIS, discussed above, confirmed and extended this mission beyond the 10 years assessed in the EA. The long-term Y-12 HEU Storage Mission is addressed in Alternatives 1B, 2A, 2B and 4 of this Y-12 SWEIS.

***Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor* (DOE/EIS-0288, DOE 1999b).** A ROD was issued on May 6, 1999 (64 FR 26369). Y-12 is one of the sites identified to potentially down-blend HEU to low enriched uranium for use in commercial light water reactors to support tritium production. Building 9212 HEU blending operations could be used to support the tritium production mission. See the discussion at the beginning of this section under the *Disposition of Surplus Highly Enriched Uranium Final EIS* for the status of this potential project at Y-12 and its coverage in this Y-12 SWEIS.

***Replacement and Operation of the Anhydrous Hydrogen Fluoride* (AHF) *Supply and Fluidized-Bed Chemical Processing Systems Environmental Assessment* (DOE/EA-1049).** The EA and FONSI were issued on September 20, 1995 (DOE 1995b). This allowed for replacement of the AHF supply and fluidized-bed reactor systems at Y-12 to meet operational and safety requirements and extend the life of the process by approximately 20 years. This project is included in the No Action - Status Quo Alternative of this Y-12 SWEIS.

1.4.3 Oak Ridge Reservation *National Environmental Policy Act* Reviews

***Environmental Assessment for Selection and Operations of the Proposed Field Research Centers for the National and Accelerated Bioremediation Research* (NABIR) *Program* (DOE/ EA - 1196).** A FONSI was issued on April 18, 2000. The EA evaluated impacts of operating a field research component of the NABIR Program at two alterative sites; ORNL/Y-12 Site and the Pacific Northwest National Laboratory/DOE Hanford 100 - H area in Richland, Washington. The ORNL/Y-12 Site was selected as the site for the field research component. The Field Research Center is included in the Y-12 SWEIS under the No Action - Planning Basis Operations and is proceeding independent of the Y-12 SWEIS. The mission of the NABIR Program or the potential environmental impacts from the operation of the Field Research Center are not expected to change over the proposed 10-year life of the program.

***Spallation Neutron Source* (SNS) *Environmental Impact Statement* (DOE/EIS-0247, DOE 1999c).** The Final EIS was issued in April 1999 and the ROD on June 18, 1999 (64 FR 35140). This document evaluates four DOE alternative sites for construction and operation of a new SNS facility. The preferred alternative, a site near ORNL on the ORR, was selected. The potential cumulative impacts of this project are included in this Y-12 SWEIS.

***Lease of Land and Facilities Within the East Tennessee Technology Park Environmental Assessment* (DOE/EA-1175, DOE 1997d).** A FONSI was issued on December 1, 1997. The EA evaluated impacts of alternatives on future use and/or disposition of surplus facilities at the former K-25 Site on the ORR, and allowed for the lease of some facilities and land to commercial entities. The potential cumulative impacts of DOE land transfers are included in this Y-12 SWEIS.

***Long-Term Management and Use of Depleted Uranium Hexafluoride Programmatic Environmental Impact Statement* (DOE/EIS-0269, DOE 1999d).** The Final PEIS was issued in April 1999 and the ROD on August 2, 1999 (64 FR 43358). The ETTP (formerly the Oak Ridge K-25 Site) currently manages and stores this material pending transfer to another DOE site. Potential cumulative effects at ORR of this program are included in this Y-12 SWEIS.

***Environmental Assessment for the U.S. Department of Energy, Oak Ridge Operations, Receipt and Storage of Uranium Materials for the Fernald Environmental Management Project Site* (DOE/EA-1299, DOE 1999e).** The Final EA/FONSI was issued on April 13, 1999. Y-12 and the ETTP are available sites for storage of materials being removed in the cleanup effort at the Fernald Site in Ohio. Potential impacts on Y-12 from the EM program are included in this Y-12 SWEIS.

***Transuranic Waste Treatment Facility Environmental Impact Statement* (DOE/EIS-0305).** The Final EIS was issued June 2000 and the ROD on August 9, 2000 (65 FR 48683). DOE has selected the Low-Temperature Drying Alternative (the preferred alternative in the Final EIS) and will proceed with the construction, operation, and D&D of the TRU Waste Treatment Facility at ORNL. The waste to be treated is legacy waste (i.e., waste generated from past isotope production) and research/development that supported national defense and energy initiatives. Waste generated from ongoing ORNL operations of the Facility will also be treated. All treated TRU waste will be transported and disposed of at the WIPP while treated LLW transported and disposed of at NTS.

Facilities Revitalization Project at the Oak Ridge National Laboratory (DOE/EA-1362). This EA is being prepared to evaluate impacts of modernization of the ORNL. The proposed action includes the construction of a number of major new facilities and the renovation of several others over the next five years. The consolidation at the ORNL of Laboratory mission activities currently performed in Y-12 facilities and the associated ORNL personnel is part of the proposed action.

1.4.4 Other Documents

***Environmental, Safety, and Health Vulnerabilities Associated with the Storage of Highly Enriched Uranium* (DOE/EH-0525, DOE 1996g).** This report was issued in December 1996. The related Management Plan (DOE/DP-0139, DOE 1997b) was issued in April 1997. In this report, DOE evaluated 22 sites that handle and store HEU materials in a variety of forms, including disassembled weapons parts, reactor fuels, solids, solutions, and scrap and residues. Most of the HEU vulnerabilities identified at those sites, including Y-12, are associated with poor facility conditions and institutional weaknesses. This document is part of the basis for DOE's initiative to consider the upgrade and/or construction of new facilities and processes at Y-12 to ensure long-term capabilities to support the maintenance of the nuclear weapons stockpile. Proposed action and alternatives in the Y-12 SWEIS for the HEU Materials Facility address the HEU storage vulnerabilities identified at Y-12 facilities.

***Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1641&D2, DOE 1998b).** The Remedial Investigation was issued in August 1998. The Feasibility Study that accompanies the Remedial Investigation was issued in June 1999 (DOE/OR/01-1747&D2, DOE 1999g). A ROD on remediation of the Upper East Fork Poplar Creek (UEFPC) watershed is being prepared and is scheduled to be final in June 2001. The UEFPC characterization area is included in the Y-12 Plant physical study area of analysis for this SWEIS.

***Report on the Remedial Investigation of Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1455&D2, DOE 1997a).** The Remedial Investigation was issued in March 1997. The Feasibility Study that accompanies the Remedial Investigation was issued in November 1997 (DOE/OR/02-1525&D2, DOE 1997e). The ROD on remediation of the Bear Creek Valley watershed is being reviewed and should be final in calendar year 2000. A portion of Bear Creek Valley is included as part of the Y-12 Site physical area of analysis in this SWEIS.

Comprehensive Environmental Response, Compensation, and Liability Act Waste Disposal Facility. DOE has published a Remedial Investigation/Feasibility Study for the disposal of ORR CERCLA waste (DOE/OR/02-1637&D2, DOE 1998a). The Proposed Plan (DOE 1999a) and ROD (DOE 1999j) for the Environmental Management Waste Management Facility were issued in January 1999 and November 1999, respectively. The proposed action is on-site disposal at a new facility to be constructed in East Bear Creek Valley bordering the west end of the Y-12 Plant. This project is included in the Y-12 SWEIS No Action - Planning Basis Operations Alternative.

1.5 TIME PERIOD CONSIDERED IN ANALYSIS

The affected environment described in Chapter 4 is based on data for the calendar year 1998. These data, for the most part, were obtained from the *Oak Ridge Reservation Annual Site Environmental Report* (ASER) for 1998 (DOE 1999k). The Y-12 Site (No Action - Planning Basis Operations Alternative) analysis time period used in the SWEIS is 2001 to 2010. For proposed actions involving the Y-12 HEU Storage Mission and Special Materials Mission, the time period considered would be 50 years (i.e., the design life of the facilities). Impacts for construction and operation of new facilities and the operation of Y-12's missions under the No Action - Planning Basis Operations are presented in annual increments unless noted otherwise.

1.6 ISSUE IDENTIFICATION PROCESS

DOE published the NOI to prepare the Y-12 SWEIS in the *Federal Register* on March 17, 1999 (64 FR 13179). Additional public notice of the proposed EIS and the schedule for public scoping meetings were provided through the placement of advertisements in local newspapers. The public scoping period began on that day and continued through May 17, 1999. DOE invited the public to submit comments during the scoping period by postal mail, electronic mail, fax, telephone, and through written and verbal comments submitted at the public scoping meetings.

Both afternoon and evening public scoping meetings were held in Oak Ridge, TN, on April 13, 1999. More than 345 people attended the two scoping meetings held at the Oak Ridge Community Conference Center at the Oak Ridge Mall. At the beginning of each session, a neutral facilitator explained the scoping meeting format. This was followed by a welcome from a representative of the DOE Y-12 Site Office and a brief overview of the NEPA process by the DOE-ORO NEPA Compliance Officer. The DOE SWEIS Document Manager then presented an introduction and background of the Y-12 missions and history, followed by an overview of the Y-12 SWEIS Proposed Action and alternatives. A question and answer session was then held to encourage the public to ask questions to better understand the project before submitting comments.

At the end of the question and answer period, the formal public comment portion of the scoping meeting began and the facilitator invited members of the public to comment on the scope of the SWEIS. A court reporter typed verbatim transcripts of the entire scoping meetings and an audiotape was made of the proceedings. Blank comment forms were available for those members of the public who preferred to provide written comments. Exhibits and handouts about the Y-12 Site, the Y-12 SWEIS, the NEPA process, and the NOI were available at each meeting. Technical representatives were present to answer questions.

DOE public reading rooms in the Oak Ridge area were provided copies of the public notices, written public comments, and the transcripts of the scoping meetings. A database was created to track written and oral comments received during the scoping period. A total of 574 people submitted 701 individual comments that were recorded in the database. The comments were characterized and grouped within 20 major issue categories.

1.7 RESULTS OF PUBLIC SCOPING

DOE's disposition of the issues raised during public scoping for the Y-12 SWEIS was published in the *Scoping Summary Report for the Site-Wide Environmental Impact Statement, Oak Ridge Y-12 Plant* (DOE 1999h) and placed in the Oak Ridge area DOE Reading Rooms at the following locations:

DOE Public Reading Room
230 Warehouse Road
Building1916-T-2, Suite 300
Oak Ridge, Tennessee 37831

Oak Ridge Public Library
1401 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

The document can also be viewed on the DOE-ORO Home Page: http://www.oakridge.doe.gov.

1.7.1 Major Scoping Comments

DOE has considered all scoping comments in preparing the draft Y-12 SWEIS. The major issues identified by the public centered on the Proposed Action and Alternatives, the Y-12 Site Integrated Modernization (Y-SIM) Program, and the health and safety of workers and the public. The major issues are discussed further in this section and addressed throughout the SWEIS.

Of 701 total comments, 503 related to the SWEIS alternatives (a postcard campaign accounted for 461 of these comments), 67 addressed modernization, and 17 focused on occupational and public health. Of the remaining 114 comments, 62 addressed specific resource areas, while 52 were considered outside of the scope of this SWEIS.

Shutdown of Y-12 Plant. Some commentors opposed continuation of operations at the Y-12 Plant associated with weapons production. Several individuals stated that the production of nuclear weapons and materials should be halted immediately. Public health and safety related to Y-12 weapons production activities were also areas of concern.

The decision to continue the weapons production mission at Y-12 has already been made by DOE in the SSM PEIS ROD. Shutting down Y-12 is not a viable alternative at this time (see Section 3.4). The need for nuclear weapons has already been determined by the President and Congress, and is an issue that is beyond the scope of the Y-12 SWEIS. The impacts on worker and public health and safety from Y-12 operations are included and analyzed in Chapter 5 of this SWEIS.

Proposed Action and Alternatives. Commentors expressed a variety of opinions and preferences on the alternatives addressed in the SWEIS. Comments focused on which alternatives should be implemented in modernizing the Y-12 Plant and the preferred alternative that should be selected by DOE.

Commentors expressed confusion as to the exact definition of No Action and how the SWEIS would analyze this alternative. Some commentors stated that a total halt to weapons production at Y-12 and shutdown of the facility should be considered as the No Action Alternative. Other commentors stated that the No Action Alternative was not a viable alternative as indicated in the NOI because the Y-12 Plant was needed to support the Nation's Nuclear Weapon Stockpile. However, all the commentors were aware of and noted that NEPA regulations require analysis of a No Action Alternative.

Some commentors stated that the Y-12 mission could be accomplished solely with consolidation and upgrade of existing facilities as analyzed in the SSM PEIS. Others stated that DOE should pursue the total modernization of the Y-12 Plant by all new construction should be pursued by DOE. A large number of comments were received through a postcard campaign that supported the modernization of the Y-12 Plant by using a combination of upgrades to existing facilities and construction of new facilities as appropriate. Commentors wanted specific buildings identified that would be upgraded or vacated due to construction, even if they were tentative designations.

DOE has considered all comments on alternatives for the Y-12 SWEIS and has addressed the major comments described above in the following manner.

Shutting down the Y-12 Plant is not a viable alternative as explained in the NOI on March 17, 1999 (64 FR 13179). DOE has already decided in the SSM PEIS and S&D PEIS RODs that the mission at Y-12 would not continue (see Section 3.4). Therefore, the No Action - Planning Basis Operations Alternative analyzed in this SWEIS addresses the continuation of Y-12 historic missions. The No Action - Planning Basis Operations Alternative reflects the Y-12 Plant operations at planned weapons production support levels (see Section 3.2.2). A No Action - Status Quo Alternative, which is basically the status of the Y-12 in 1998, is also presented in the SWEIS to show the potential increase in production levels and potential impacts under the No Action - Planning Basis Operations Alternative and action alternatives. The No Action - Status Quo Alternative does not meet Y-12 mission requirements and is not considered reasonable because most Y-12 Plant operations were not operating in 1998 as a result of the 1994 stand-down of Y-12.

The Y-12 Plant consolidation efforts analyzed in the SSM PEIS are included in the Stockpile Management Restructuring Initiative (see Section 1.1.2) which implements the plan for downsizing the Y-12 Plant. The potential impacts of consolidation and limited upgrade are included under the No Action - Planning Basis Operations Alternative (see Section 3.2.2.1), consistent with the SSM PEIS ROD. Because of the age of Y-12 facilities, new requirements for natural phenomena and worker health standards, and limited budgets, upgrade alone is not considered a reasonable approach to continue the Y-12 Plant mission and meet long-term workload requirements.

Construction of an all new Y-12 Plant is not considered an alternative in the SWEIS. The Y-SIM Program, which is the foundation for an all new Y-12 Plant proposal, is a long-term process and most projects are not developed to the extent that they can be proposed and analyzed under NEPA at this time. However, new construction alternatives to support the Y-12 Plant HEU Storage Mission and the Special Materials Mission are included in the SWEIS (see Section 3.2.3 and 3.2.4). DOE's preferred alternative for the HEU Storage Mission is to construct and operate a new HEU Materials Facility. The preferred alternative for the Special Materials Mission at Y-12 is to construct and operate the new Special Materials Complex. A preferred site for these facilities will be identified in the Final Y-12 SWEIS.

Y-12 Site Integrated Modernization Program. Many commentors expressed concern about the advanced age of the Y-12 facilities, because many of the buildings are more than 40 years old. These commentors stated that the facilities should be modernized to reduce operating costs and to enhance health, safety, and environmental requirements. Some commentors expressed concern about the potential budget impacts of modernization on EM activities and pointed out that it is more difficult to assign a cost to such things as environmental issues and health and safety.

It also was the opinion of many commentors that modernization of Y-12 should not be delayed and should be conducted in an integrated way. Alternatively, one commentor opposed any modernization of nuclear processes and facilities and suggested several sub-alternatives for modernization and consolidation for those activities associated only with dismantling weapons and processing and storage of HEU.

As explained in Section 1.1.2, the Y-SIM Program is a long-term process designed to modernize the Y-12 Plant in an integrated way so as not to disrupt the assigned weapons mission support activities or jeopardize the Y-12 weapons production capabilities. The parts of modernization that can be analyzed at this time are included in the SWEIS (i.e., the HEU Storage Mission Alternatives and the Special Materials Mission Alternatives)(see Section 3.2.3 and 3.2.4). The potential future modernization projects, such as the Enriched Uranium Manufacturing Facility are described in Section 3.3 of the SWEIS, but are not analyzed as proposed projects in the SWEIS. All modernization projects, as well as EM activities, are subject to congressional budget appropriations and changes.

Alternatives that eliminate components of the mission at Y-12 (i.e., weapons production and support activities) are not viable alternatives since they would not continue the current Y-12 mission, nor would such alternatives be consistent with the SSM PEIS ROD (see Section 3.4).

Worker and Public Health and Safety. Comments related to worker and public health and safety stated that the SWEIS should address enriched uranium, beryllium, and other radiological and hazardous materials. This included the request that the SWEIS discuss analysis of off-site exposure to uranium-contaminated dust, potential hazard to workers due to external gamma and possible criticality reactions from storage of enriched uranium, and a chronic beryllium disease management plan.

The SWEIS analyzes potential worker and public health impacts associated with criteria pollutants, hazardous air pollutants and radiological air pollutants in Section 5.12 of this SWEIS. Criticality accidents are addressed in Section 5.14 and Appendix D of this SWEIS. Appendix D.6 presents summaries on past or ongoing beryllium studies associated with Y-12 workers and the public.

1.8 ORGANIZATION OF THIS SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT

This Y-12 SWEIS consists of three volumes; the Summary, Volume I, which contains the main text, and Volume II, which contains technical appendixes that support the analyses in Volume I and additional project information.

Volume I, contains 12 chapters, which include the following information:

Chapter 1 - Introduction. A background of DP activities at Y-12 in support of national security programs, and the NEPA process.

Chapter 2 - Purpose of and Need for DOE Action. Reasons why DOE needs to take action and the objectives DOE proposes to achieve.

Chapter 3 - Description of Alternatives. How DOE proposes to meet the specified need and achieve the objective. The chapter also includes a summary comparison of the potential environmental impacts of the SWEIS alternatives.

Chapter 4 - Affected Environment. Aspects of the environment (i.e., natural, built, and social) that might be affected by the SWEIS alternatives.

Chapter 5 - Environmental Consequences. Analyses of the potential impacts on the human environment. Impacts from activities that are expected to support Y-12 Site missions (the No Action - Planning Basis Operations Alternative) as well as potential impacts from proposed new facilities and alternatives compared to the No Action - Status Quo Alternative. The chapter also includes resource commitments, unavoidable adverse impacts, short-term uses versus long-term productivity, and irreversible or irretrievable resource commitments.

Chapter 6 - Cumulative Impacts. Contains the discussion of cumulative impacts resulting from the proposed action and alternatives when added to past, present, and reasonably foreseeable actions in the SWEIS study area.

Chapter 7 - Statutes, Regulations, Consultations, and Other Requirements. Environmental, safety, and health regulations that would apply to the SWEIS alternatives and agencies consulted for their expertise.

Chapters 8 through 12 - A List of Preparers and Contributors, an Index, a list of references used in preparing the SWEIS, a Glossary, and a list of persons and agencies to whom copies of this SWEIS were sent.

Volume II contains three appendixes of technical information and supporting data for the environmental analyses presented in Volume I. The remaining appendixes in Volume II consist of a copy of the NOI for the SWEIS, consultation letters, and contractor disclosure statements.

CHAPTER 3: DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

3.1 MAJOR PLANNING ASSUMPTIONS AND BASIS OF ANALYSIS

The *Stockpile Stewardship and Management Final Programmatic Environmental Impact Statement* (SSM PEIS) (DOE 1996e) identified Y-12 as a key component for maintaining the safety and reliability of the nuclear weapons stockpile without underground nuclear testing or production of new design weapons. Accordingly, DOE decided in the SSM PEIS ROD to maintain the national security missions at Y-12, but to downsize the Plant consistent with reduced stockpile requirements. In the *Storage and Disposition of Weapons-Usable Fissile Materials, Final Programmatic Environment Impact Statement* (DOE 1996h) ROD, DOE decided that Y-12 would store both nonsurplus and surplus enriched uranium pending disposition.

Pursuing these directives, this SWEIS evaluates the potential direct, indirect, and cumulative impacts associated with proposed actions and alternatives to continue current and assigned historical Y-12 missions into the 21st century. The planning assumptions and considerations that form the basis of the analyses and impact assessments presented in the SWEIS are listed below.

- ***Assumption 1*:** The mission at Y-12 will not change and is consistent with the decisions reached in the SSM PEIS ROD and the S&D PEIS ROD. All alternatives are based on this assumption. Two No Action Alternatives are presented in the Y-12 SWEIS: the No Action - Status Quo Alternative and the No Action - Planning Basis Operations Alternative. the No Action - Status Quo Alternative represents the current level of operations, i.e. the operations of Y-12 at the current (1998) level reported in the Annual Site Environmental Report (ASER) issued in 1999. Approximately 40 percent of the operations associated with DP's assigned mission were operational ready in 1998 (following the Y-12 Plant stand-down in 1994). About 10 percent of actual operating capacity was achieved. As discussed in the "Forty Most Asked Questions Concerning CEQ's NEPA Regulations," (46 FR 18026, March 23, 1981, as amended), "No Action" may also mean "No Change" from current management directions. Accordingly, the SWEIS also evaluates a No Action - Planning Basis Operations Alternative for the Y-12 Site that presents the continuation of historical mission operations at the Y-12 Plant consistent with the RODs from the SSM and S&D PEIS. The No Action - Planning Basis Operations Alternative includes the resumption of all remaining weapons program operations at Y-12 which have been in stand-down since 1994. No major upgrades or new construction of DP facilities to maintain weapon program capabilities or capacity are included under the No Action - Planning Basis Operations Alternative. The No Action - Planning Basis Operations Alternative does incorporate ongoing upgrades to existing facilities that address action items or findings from past reviews (e.g., HEU vulnerability or health and safety studies) to resolve the findings.

- ***Assumption 2*:** To modernize Y-12's current mission capabilities and address long-term ES&H requirements, DOE is proposing new facilities for the HEU Storage Mission and Special Materials Mission at Y-12. Various alternatives for these two new facilities, the HEU Materials Facility and the Special Materials Complex, are analyzed in this SWEIS. These proposed projects are independent actions to each other, i.e., decision making for one project does not influence, and is not influenced by, decision making for the other project.

  Other potential modernization projects being considered have been developed to the extent practical and are described in Section 3.3. The potential impacts of these projects are addressed qualitatively and are included in the cumulative impacts in Chapter 6. These potential future projects would be addressed under separate NEPA review when conceptual design information is available and the time is appropriate to make a decision on the need for a specific facility.

- ***Assumption 3*****:** The non-DP missions at Y-12 conducted by the Nuclear Energy, Nuclear Nonproliferation and National Security (NN), Work-for-Others, and Technology Transfer programs are not expected to change significantly over the next 10 years and would be the same as described in Chapter 2 and reflected in the current affected environment shown in Chapter 4. These missions are consistent with the missions already analyzed in the SSM PEIS, S&D PEIS, and the S-HEU EIS and are not expected to change. Budgeting and long-range planning for these programs indicate no major upgrades or new construction are proposed for these missions. To the extent that these missions do change or additional buildings or facilities are needed, they will undergo the appropriate NEPA analysis once sufficient data are available with which to assess the potential environmental impacts associated with such proposals.

- ***Assumption 4*****:** NN missions at Y-12 involve the management of surplus HEU, including blending small quantities (i.e., kg/year) of HEU with low enriched uranium or natural uranium to produce a metal or oxide product suitable for use in various reactor programs, and for multiple supply orders to DOE customers. The HEU blending operations using existing Y-12 facilities and processes are included in the No Action - Planning Basis Operations Alternative.

- ***Assumption 5*****:** Large volume (tons/year) down-blending of HEU at Y-12 has been considered by NN and analyzed under NEPA in the S-HEU EIS, DOE/EIS-0240 (1996), but no projects to implement the activities (upgrade existing functions or new construction) have been proposed. Therefore, potential impacts of this down-blending are not included under No Action. However, the potential impacts from down-blending large quantities of HEU at Y-12 as described in the S-HEU EIS have been included in Chapter 6 (Cumulative Impacts) of this Y-12 SWEIS. Impacts of projects to upgrade or construct facilities will be analyzed when those projects are identified.

- ***Assumption 6*****:** DP is currently storing ^{233}U in Building 3019 (Radiological Development Facility) at the ORNL. This facility is the ^{233}U National Repository and has been an ongoing operation at ORNL since 1982. The storage and disposition of this ^{233}U is not included in the scope of analysis for the Y-12 SWEIS because the material is not associated with Y-12's Missions or located at the Y-12 Plant. The storage and disposition of this ^{233}U is currently planned for a separate NEPA review in the future. The planned NEPA review is expected to consider the status of the existing storage facility, the characterization of the material in storage (e.g., useful material or waste), the potential for beneficial uses of the material, the treatment of ^{233}U material prior to disposal, and the possible alternatives for relocation and storage. The potential use of Y-12 facilities or processes for treatment and/or storage of ^{233}U would be analyzed, if determined to be a viable candidate site for these actions, in the subsequent NEPA review.

- ***Assumption 7*****:** Project construction material lay-down areas have been identified for the proposed HEU Materials Facility, the upgrade expansion of Building 9215, and the Special Materials Complex. Potential impacts associated with these lay-down areas are discussed in the SWEIS under each alternative. The identified sites of the construction lay-down areas are considered to be the best locations for each project based on project engineering cost and efficiencies; and their reasonable proximity to the actual construction sites. An optional construction material lay-down area may be available. The potential site is the current permanent MK Ferguson (on-site General Contractor) construction lay-down area located on Old Bear Creek Road west of the S-3 Parking Lot, as shown in Figure 3.2.2-1. Other than erection of a fence to separate the area into two areas (one for MK Ferguson materials and one for SWEIS project materials) there would be no additional major site preparations. Since the site is an operating construction material lay-down area, there would be no additional environmental impacts with the use of the site. However, availability of the MK Ferguson site for proposed HEU Storage Mission or Special Materials Mission project construction support is uncertain, therefore, the impacts of this potential option are not presented in the SWEIS. If the MK Ferguson construction lay-down area were available and used for the HEU Storage Mission or Special Materials Mission Alternatives construction projects, the potential impacts discussed in the SWEIS associated with the identified construction lay-down areas would not occur.

3.1.1 No Action - Status Quo Alternative (Defense Programs Operations and Emissions)

The DNFSB mandated stand-down of the Y-12 Plant in 1994 essentially curtailed most Y-12 weapons program support activities. Because operations still have not resumed to full levels, the 1998 environmental conditions and operations described in Chapter 4 of the SWEIS do not reflect a fully functional Y-12 Plant performing its assigned mission at required and planned work levels.

In 1998, approximately 40 percent of the types of Y-12 Plant operations needed to support Y-12 mission requirements had achieved operational readiness from the 1994 stand-down, and about 10 percent of Y-12 Plant operational capacity was being used. Most of the 10 percent operating capacity during 1998 resulted from the continued operation of a few critical operations at Y-12 that were required to maintain the nuclear weapons stockpile. Therefore, the environmental monitoring and environmental surveillance information described in Chapter 4 reflect only a small part of the typical operating conditions, i.e., as occurred prior to the 1994 stand-down and as will resume in the near future. To aid the reader in identifying the differences between operations and environmental conditions as they are now compared to what they will be under a fully operational Y-12, a No Action - Status Quo Alternative is provided in the SWEIS. The No Action - Planning Basis Operations Alternative discussed below provides a second benchmark for comparison the Action Alternative. The No Action - Status Quo Alternative, which is basically a continuation of the status of Y-12 in 1998, is presented in the SWEIS to show the potential increase in production levels and potential impacts under the No Action - Planning Basis Operations Alternative and other alternatives described in Section 3.1.2. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it does not meet Y-12 mission requirements.

3.1.2 No Action - Planning Basis Operations Alternative (Defense Programs Operations and Emissions)

The Y-12 Plant has not operated at required and planned operation levels since the stand-down in September 1994. Additionally, enriched uranium metal operations performed in Building 9212 were shut down prior to the stand-down for modification in 1989. The modifications were completed but not before the stand-down prevented their restart. Since all required Y-12 DP mission functions have not been operating, existing Y-12 conditions for the most part do not represent a fully operational Y-12 Plant performing assigned mission operations at required levels to support the nuclear weapons stockpile. Therefore, an estimate of planned Weapons Program and Y-12 Plant workload schedules was compared to historical Y-12 Plant operations prior to the 1994 stand-down to estimate the DP planning basis operations requirements and potential emissions for use as a second No Action Alternative in the Y-12 SWEIS for the 10-year planning period (Garber 2000).

The major production-related operations at the Y-12 Plant during the late 1980s involved enriched and depleted (or natural) uranium. These operations would resume and would continue under the No Action - Planning Basis Operations Alternative. Other activities conducted in that time period involving weapons materials included weapons disassembly, joint test assembly production, quality evaluation, and special production. These other activities have not been suspended and would continue through 2010. The contribution of these other program activities to uranium emissions and other effluents is very small relative to enriched and depleted uranium operations. While weapons dismantlement is expected to increase during the next 10 years, Y-12 Plant DP effluents and resource requirements should not vary appreciably from current baseline levels.

During the 1987 timeframe, enriched uranium recovery operations in Building 9212 were performed on a 3 shift-a-day, 7 day-a-week operation (21 shifts). Recovery operations in Building 9206 were also functioning at full capacity. An estimated 50 percent of the 1987 uranium operations emissions were from production operations and the remaining 50 percent were from enriched uranium recovery operations.

Weapons Program activity levels have been projected for the period 2001-2010 from the Stockpile Life Extension Program and other Y-12 Plant workload schedules. The weapons activity levels for this period were then associated with the respective enriched uranium production and recovery activities. The activity level for weapons production, quality evaluation, and special productions is estimated to be approximately 30 percent of the activity level at Y-12 experienced in 1987. Enriched uranium recovery operations during the period 2001-2010 is expected to be at levels equal to 1987 using 21-shift (3 shift-a-day, 7 day-a-week) operations. Therefore, uranium emission levels expected during the period 2001-2010 for enriched uranium recovery is estimated to be equal to 50 percent of the total uranium emissions for 1987. Enriched uranium emissions due to other weapons production activities are estimated to be 30 percent of the remaining 50 percent of the total uranium emissions for 1987. Thus the annual enriched uranium emissions and other process effluents from the Y-12 Plant for the period 2001-2010 are estimated to be 65 percent of the Y-12 Plant levels experienced in 1987. This estimate is considered a bounding case because of various process and facility improvements that have been incorporated at Y-12 since 1987, and because actual production levels will fluctuate over the 2001-2010 time period.

Depleted uranium and non-enriched uranium operations and emissions involving weapons materials are also expected to be at 30 percent of the levels experienced at Y-12 in 1987 except for Lithium Recovery Operations. During the period 2001-2010, Lithium Recovery Operations are expected to return to 100 percent of the levels experienced at Y-12 in 1987.

3.2 ALTERNATIVES

A No Action - Status Quo Alternative is presented in the SWEIS but is not considered a reasonable alternative for future Y-12 operations because it would not meet Y-12 mission needs. The No Action - Status Quo Alternative is used in this SWEIS as a benchmark for comparison of the impacts associated with the No Action - Planning Basis Operations Alternative and action alternatives that reflects full Y-12 DP mission operations at required levels and approved projects by EM and Office of Science at Y-12 over the 10-year planning period.

Alternatives analyzed in the Y-12 SWEIS include the No Action - Planning Basis Operations Alternative for the mission at Y-12 and site-specific alternatives for two of Y-12's mission components (i.e., HEU Storage Mission and Specials Materials Mission). There are two options for the Y-12 HEU Storage Mission: (1) construct a new HEU Materials Facility and (2) construct an upgrade expansion to existing Building 9215. The preferred option is to construct and operate the new HEU Materials Facility. Under the new HEU Materials Facility construction alternative, two siting alternatives are analyzed (i.e., Sites A and B).

For the Special Materials Mission at Y-12, the proposed action is to construct and operate a new Special Materials Complex. Three candidate sites are analyzed for construction of the Special Materials Complex (i.e., Sites 1, 2, and 3).

3.2.1 Alternative 1A (No Action - Status Quo Alternative)

The No Action - Status Quo Alternative represents the current level of operations at Y-12 as reflected by the most recent monitoring data (1998) for the Y-12 Site and reported in the ASER issued in 1999. Although approximately 40 percent of the types of operations associated with DP's assigned mission were operational ready in 1998 (following the Y-12 Plant stand-down in 1994), the Y-12 Plant was only operating at 10 percent capacity, and this state/conditions used in the SWEIS as a basis for comparison of the impacts associated with the No Action - Planning Basis Operations Alternative and the action alternatives that reflect full Y-12 DP mission operations at required levels and recently approved projects by EM and ORNL at Y-12. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it would not meet Y-12 mission needs and would not reflect DOE's decision in the SSM PEIS ROD (61 FR 68014) to maintain and downsize the mission at Y-12.

3.2.2 Alternative 1B (No Action - Planning Basis Operations Alternative)

Under the No Action - Planning Basis Operations Alternative, Y-12 would continue facility operations in support of assigned missions. The No Action - Planning Basis Operations Alternative reflects the implementation of the DOE decision in the SSM PEIS ROD (61 FR 68014) to maintain the DP national security mission at Y-12, but to downsize the Plant consistent with reduced requirements. Downsizing of the Y-12 Plant is being implemented under the direction of the Stockpile Management Restructuring Initiative Project described in Section 3.2.1.1. Y-12 assigned missions include DP capabilities to produce and assemble uranium and lithium components, to recover uranium and lithium materials from the component fabrication process and disassembled weapons to produce secondaries, cases, and related nonnuclear weapons components, to process and store enriched uranium (see Appendix A.3 and A.4 for a description of Y-12 major facilities and processes, respectively), and to supply enriched uranium, lithium, and other material products; EM activities at Y-12 related to environmental monitoring, remediation, deactivation and decontamination, and management of waste materials from past and current operations; Office of Science activities operated by ORNL; and DP support of other Federal agencies through the Work-for-Others Program, the National Prototype Center, and the transfer of highly specialized technologies to support the capabilities of the U.S. industrial base. The No Action - Planning Basis Operations Alternative also includes activities to store surplus enriched uranium pending disposition in accordance with the S&D PEIS ROD (62 FR 3014). Figure 3.2.2–1 shows the Y-12 Plant and EM waste management facilities outside the Y-12 Plant fenced area within the Y-12 SWEIS physical study area of analysis, while Figure 3.2.2–2 presents a detailed map of facility location and utilization at the Y-12 Plant under the No Action - Planning Basis Operations Alternative.

3.2.2.1 *Defense Programs*

Enriched Uranium Operations. Under the No Action - Planning Basis Operations Alternative, Enriched Uranium Operations performed in the Building 9212 Complex and the Building 9215 Complex would resume and continue. Appendix A.4 gives a description of the Buildings 9212 and 9215 Complexes that house uranium operations, and Appendix A.3.1 describes Y-12 uranium processing. Figures 3.2.2–3 and 3.2.2–4 show an overview of the enriched uranium processing stream and the enriched uranium chemical recovery operations stream, respectively. A major upgrade of the Building 9212 anhydrous hydrogen fluoride (AHF) supply and fluidized-bed reactor systems has been completed (DOE 1995b). The new systems design provide for 99.9 percent control of fugitive emissions of AHF during normal operations and, in the event of an accident, capture of the entire inventory of AHF in a secondary containment enclosure.

Source: Tetra Tech, Inc./LMES 2000a.

FIGURE 3.2.2–1.—*Alternative 1B (No Action - Planning Basis Operations Alternative) Facilities within Y-12 SWEIS Area of Analysis.*

Source: Tetra Tech, Inc/LMES 2000a.

FIGURE 3.2.2–2.—*Alternative 1B* (*No Action - Planning Basis Operations Alternative) Facility Location and Utilization at the Y-12 Plant.*

Highly Enriched Uranium Storage. Buildings 9720-5, 9204-2E, 9204-2, 9998, 9215, and 9204-4 would continue to be used for storage of Categories I and II HEU (See Glossary for description of Categories). (See Appendix A.4 for a description of these facilities.) Adequate storage space exists within these facilities to accommodate expected mission storage requirements for HEU at Y-12 through 2010. No major upgrades or new facility construction would occur under the No Action - Planning Basis Operations Alternative.

Special Materials Operations. The existing facilities used to perform the Special Materials functions, including beryllium operations, would continue to be used under the No Action - Planning Basis Operations Alternative. Special Materials Operations would include activities associated with beryllium machining and spraying, and production, purification, and processing of certain special materials (nonradiological). Facilities supporting Special Materials Operations include Building 9731, 9202, 9204-4, 9201-5, 9201-5N, 9995, 9204-2E, 9404-11, 9805-1, and 9720-46. Special Materials Operations production levels would vary according to mission requirements but would be at or below Y-12 historic operating levels for these activities.

Assembly/Disassembly/Quality Evaluation Operations. The evaluating, rebuilding, or dismantling weapons and storage of returned weapons components would continue to be performed in Buildings 9204-2E, 9204-2, and 9204-4. Supporting operations including container refurbishment, nondestructive examination, metallurgical laboratory activities, and dimensional inspection would also continue. Quality Evaluation facilities are currently being consolidated and relocated from Building 9204-4 to Building 9204-2E as part of the Stockpile Management Restructuring Initiative and the Quality Evaluation Relocation Project. Projected Assembly/Disassembly/Quality Evaluation production levels for the No Action - Planning Basis Operations Alternative are expected to continue at the current levels, which are approximately 30 percent of historic levels the Y-12 Plant experienced in 1987 when Y-12 was in full Cold War weapons production mode.

Depleted Uranium Operations. Buildings 9215, 9204-4, 9998, 9201-5, and 9201-5N would continue to be used for Depleted Uranium Operations activities under the No Action - Planning Basis Operations Alternative. These operations would include metal casting, rolling, forming, machining, plating, and waste and scrap metal management and processing. Figure 3.2.2–5 shows an overview of the Y-12 Plant depleted uranium operations. Most depleted uranium operations are performed in the Building 9201-5 and the Building 9215 Complexes. (See Appendix A.4 for a description of these facilities.) Depleted Uranium Operations are currently being consolidated primarily in Building 9998 and the Buildings 9215 and 9201-5 Complexes as part of the Stockpile Management Restructuring Initiative. Depleted Uranium Operations production levels through 2010 under the No Action - Planning Basis Operations Alternative are expected to continue at levels approximately 30 percent of the historic levels experienced at the Y-12 Plant in 1987 when Y-12 was in full Cold War weapons production.

Lithium Operations. Current lithium and support operations performed in Buildings 9204-2, 9404-9, 9805-1, 9720-19, and 9720-19A would continue under the No Action - Planning Basis Operations Alternative. A description of the Y-12 lithium process and activities is found in Appendix A.3.1. The buildings housing lithium production and support functions are described in Appendix A.4. Projected lithium production operations through 2010 under the No Action - Planning Basis Operations Alternative are expected to continue at historic levels experienced at the Y-12 Plant in 1987 when Y-12 was in full Cold War weapons production.

FIGURE 3.2.2–3.—*Overview of the Y-12 Plant Enriched Uranium Parts Production Operations.*

FIGURE 3.2.2–4.—*Overview of the Y-12 Plant Enriched Uranium Chemical Recovery Operations.*

FIGURE 3.2.2–5.—*Overview of the Y-12 Plant Depleted Uranium Operations.*

Product Certification Organization. Under the No Action - Planning Basis Operations Alternative, the Product Certification Organization would continue to provide independent tests, inspections, and quality assurance for weapons programs and other approved Y-12 customers. The testing and inspection services provided would include a full range of physical testing and dimensional inspection services for a wide variety of materials and components. All materials utilized in Y-12 weapons activities would be tested by these operations, including fissile, non-nuclear, and hazardous materials, as well as materials requiring special handling. There are 15 major Product Certification Organization facilities operational within the Y-12 Plant. These facilities are generally located in proximity to production capabilities developed at Y-12. Many facilities were consolidated in the 1990s and that consolidation would continue under the No Action - Planning Basis Operations Alternative. Product Certification Organization activities through 2010 under the No Action - Planning Basis Operations Alternative are projected to continue at current operation levels.

Analytical Chemistry Organization. Under the No Action - Planning Basis Operations Alternative, the Analytical Chemistry Organization would continue to provide analytical services including project management, sampling, analyses, and data evaluation in support of DP and other customers. The services would include a full range of chemical and physical tests applied to a wide variety of materials and components including fissile, nuclear, non-nuclear, and hazardous. The Bioassay Program, which assesses any potential uranium exposure of personnel, would continue to be performed at the Analytical Chemistry Organization's Union Valley Facility located outside the Y-12 Plant. Building 9995, which houses the primary operations area of the Analytical Chemistry Organization at the Y-12 Plant, would continue to be used for analytical chemistry mission support of DP and other customers. Analytical chemistry activities at Y-12 under the No Action - Planning Basis Operations Alternative are projected to continue at current operations levels through 2010.

Y-12 Utility and Support Infrastructure. The Y-12 Plant is supported by a broad range of utilities including: (1) steam and condensate, (2) raw and treated water, (3) sanitary sewer, (4) demineralized water, (5) natural gas, (6) plant and instrument air, (7) industrial gases, (8) electrical power, and (9) telecommunications systems.

1. Steam is used at the Y-12 Plant for a variety of purposes, but primarily for building heating, ventilation, and humidity control. Additional uses include heating of process materials, hot water heating, and vacuum production using steam ejectors. The Y-12 Steam Plant (Building 9401-3) would continue to produce and distribute steam to Y-12 facilities and operations. The projected peak steam load over the next 10 years is expected to remain at historic levels of approximately 226,800 kg/hr (500,000 lb/hr). Average steam usage under the No Action - Status Quo Alternative is 83,900 kg/hr (185,000 lb/hr).

2. The source of raw water for the Y-12 Plant and the city of Oak Ridge Water Treatment Plant is the Melton Hill Reservoir. The projected long-range requirements for raw and treated water for the Y-12 Plant is expected to be within the currently available capacities of 26,497,800 L/day (7 MGD) for treated water and 20,819,700 L/day (5.5 MGD) for raw water. Under the No Action - Status Quo Alternative treated water usage at the Y-12 Plant averaged 18,927,000 - 22,712,000 L/day (5-6 MGD) or 600 - 750 million L/month (160-200 million gal/month).

3. Sanitary sewage from the Y-12 Plant flows by gravity to the city of Oak Ridge West End Treatment Plant. The current system capacity is approximately 5,678,100 L/day (1.5 MGD). A project initiated in the early 1990s to upgrade Y-12 Plant sewer system operations and correct inflow infiltration problems is now complete and the system is functioning efficiently. The No Action - Status Quo Alternative usage is approximately 2,880,000 L/day (0.76 MGD). The current capacity is adequate for projected long-term use through 2010.

4. Demineralized water is used to support various processes at the Y-12 Plant that require high-purity water. A central system located in and adjacent to Building 9404-18 would continue to serve the entire plant through a distribution piping system. The system includes four mixed-bed-type demineralizer units, each capable of delivering 545,090 L/day (144,000 gal/day) of water. The system also includes three storage tanks: one with a 113,560-L (30,000-gal) capacity and two with 75,700-L (20,000-gal) capacity each. The No Action - Status Quo Alternative usage is approximately 7,400 L/day (1,955 gal/day). The projected long-range requirements for demineralized water through 2010 are expected to be within available capacity of the current system.

5. The Y-12 Plant would continue to use natural gas and coal to fuel process furnaces and steam generation and natural gas for laboratory needs. Natural gas requirements for the next 10 years are projected to be within currently available capacity. Approximately 4,000,000 m^3 (141 million scf) of natural gas and 81,000 t (89,300 T) of coal would be used annually through 2010. The No Action - Status Quo Alternative usage of natural gas was 3,800,000 m^3 (134 million scf) while coal usage was 78,500 t (86,500 T).

6. Plant and instrument air would continue to be supplied by compressors and air-drying equipment located throughout the Y-12 Plant. The total installed compressor capacity is approximately 386,968,100 m^3/yr (13,700 million scf/yr), while the average usage is approximately 200,925,740 m^3/yr (7,100 million scf/yr). Plant and instrument air requirements for the next 10 years under the No Action - Planning Basis Operations Alternative are projected to be within currently available capacity. The No Action - Status Quo Alternative usage is approximately 156,000,000 m^3/yr (5,500 million scf/yr).

7. Industrial gases (argon, helium, hydrogen, nitrogen, and oxygen) would continue to be delivered by truck to storage and distribution facilities at Y-12. The storage and use of industrial gases to support Plant operations is expected to continue at current levels through 2010. The storage capacity for argon is 116,350 L (30,737 gal), equivalent to approximately 396,270 m^3 (3.4 million scf) of gas. Total capacity of distribution is 13,395,040 m^3/yr (473 million scf/yr) or approximately 26 million scf/month.

   Helium storage capacity is 4,530 m^3 (160,000 scf) with an additional 1,020 m^3 (36,000 scf) of emergency standby storage. The No Action - Status Quo Alternative helium usage is approximately 63,150 m^3/yr (2,230,000 scf/yr). Hydrogen storage capacity is 2,550 m^3 (90,000 scf). The No Action - Status Quo Alternative hydrogen usage is approximately 10,100 m^3/yr (357,000 scf/yr).

   The Y-12 nitrogen supply system consists of five liquid-nitrogen storage tanks, a bank of atmosphere vaporizers, a steam-to-nitrogen vaporizer, and hot-water vaporizers. Nitrogen use at the Y-12 Plant under the No Action - Status Quo Alternative is 5,465,000 m^3 (193 million scf).

   The Y-12 oxygen supply system consists of one 25, 890 m^3 (914,460 scf) vacuum insulated storage tank for liquid oxygen. Distribution capacity is 1,438,720 m^3/yr (49.2 million scf/yr). The No Action -Status Quo Alternative usage is approximately 94,000 m^3 (3.3 million scf). Average annual oxygen consumption ranges from 84,950 m^3 to 113,260 m^3 (3 to 4 million scf).

8. Electrical power would continue to be distributed throughout the Y-12 Plant using existing 161-kV feeder lines and distribution substations. The total installed transformer capacity at Y-12 is approximately 400 MVA. The Y-12 Plant load during the 1990s averaged approximately 44 MVA. Projected electrical power requirements for Y-12 under the No Action - Planning Basis Operations Alternative are 565,710 MWhr/yr over the next 10 years, an increase of 188,570MWhr/yr from the No Action - Status Quo Alternative levels.

9. Telecommunications systems within the Y-12 Plant include the Oak Ridge Integrated Communications Network, the Cable Television Network, the unclassified Y-12 Intrasite Network, and the classified Y-12 Defense Programs Network. Under the No Action, Y-12 would continue to use the existing telecommunications systems. The existing networks are sufficient for near-term needs. Updating the networks systems would be reviewed as necessary based on technology advances and Y-12 requirements.

Stockpile Management Restructuring Initiative. The Stockpile Management Restructuring Initiative project supports the plan for downsizing the Y-12 Plant consistent with the future secondary and case manufacturing mission defined by the SSM PEIS and ROD. No new facilities were analyzed at Y-12 to support the DP national security missions in the SSM PEIS. The construction, operation, emissions, employment, and waste management data of the downsizing and building upgrades of the DP weapons mission at Y-12 are detailed in the SSM PEIS Section 3.4.4.2 and Appendix A.3.2.

The purpose of the Stockpile Management Restructuring Initiative project is to assist in preparing the Y-12 Plant for the future production mission requirements for nuclear weapon secondaries, case components and other miscellaneous components, as well as providing a smaller, more cost-effective production size.

The ongoing downsizing task, which is included under the No Action - Status Quo Alternative is to minimize the number of major buildings required while maintaining the capability to perform the DP production mission. Figure 3.2.2–6 shows the buildings affected by the Stockpile Management Restructuring Initiative. The project utilizes previous production consolidation activities started in the early 1990s and continues these efforts by consolidating and downsizing additional production operations into a minimum number of major buildings. The consolidation and downsizing of these facilities are as follows:

- Consolidating enriched uranium machining in Building 9215
- Placing Building 9201-5 machine shop in active status to maintain production machining capability
- Installing a depleted uranium sawing facility in Building 9212 to handle surge production as well as centralizing depleted uranium operations and providing a furnace for dismantled weapon material consolidation
- Refurbishing two vacuum induction furnaces in Building 9998
- Relocating the ceramic machining function out of Building 9201-5 to a smaller capacity operation in Building 9204-2 to enable the transition of Building 9201-5 for surplus
- The material phenomena upgrades originally defined for the Stockpile Management Restructuring Initiative were postponed and a plan was being developed for all Y-12 DP facilities. Implementation of this plan when completed may require major upgrades.

The Stockpile Management Restructuring Initiative project has been covered under NEPA by existing, approved Categorical Exclusion.

FIGURE 3.2.2–6.—*Buildings Affected by the Y-12 Plant Restructuring Initiative.*

3.2.2.2 *Waste Management*

Radioactive and hazardous waste has been generated at Y-12 by the processing and storage of enriched and depleted uranium, lithium compounds, and other materials; the weapons manufacturing and assembly/disassembly mission; and the nondefense-related activities associated with the environmental restoration, nondefense R&D, and Work-for-Others Programs. As DOE missions have changed, an increasing volume of waste has been generated through the environmental restoration activities at Y-12. This increase is expected to continue into the future.

In addition to the Environmental Management Waste Management Facility described in this section that is included under the No Action - Planning Basis Operations Alternative, the following ongoing waste management activities would continue at Y-12:

- Providing LLW and mixed waste treatment and storage capabilities to the Y-12 generators
- Storing and/or treating hazardous waste
- Storing hazardous waste pending off-site shipment for treatment, storage, and/or disposal
- Storing mixed waste awaiting treatment or disposal, treatment at Y-12, or shipping to another ORR facility for treatment or disposal
- Continuing closure of inactive waste sites, as planned
- Storing PCB waste, pending off-site shipment for treatment, storage, and/or disposal
- Providing disposal capability for on-site generated, solid nonhazardous waste
- Continuing the Waste Minimization/Pollution Prevention Program

Environmental Management Waste Management Facility

DOE's Office of Environmental Management will construct and operate an on-site waste disposal facility for CERCLA waste expected to be generated by cleanup of the ORR and associated sites. The new disposal facility would be located in West Bear Creek Valley within the Y-12 SWEIS area of analysis and will require the clearing of 26 - 39 ha (64 - 98 acres). The permanent commitment of land for this facility will be 9 - 23.5 ha (22-58 acres).

Detailed information on the Environmental Management Waste Management Facility and potential construction and operation impacts can be reviewed in the remedial investigation/feasibility study (DOE 1998a), its addendum (DOE 1998d), and proposed plan (DOE 1999a). The ROD (DOE 1999i) selecting the proposed remedy (construction and operation of the Environmental Management Waste Management Facility at Y-12) was published in November 1999.

Design elements of the Environmental Management Waste Management Facility include site development, the above-ground engineered disposal cell, and support facilities. The total disposal cell capacity is 273,000 m^3 (357,000 yd^3) for the low-end conceptual design and 1.3 million m^3 (1.7 million yd^3) for the high-end design.

Site Development. The following development actions would prepare the site for construction of the disposal facility. The existing east-west trending 13.8-kV overhead electric transmission lines would require relocation to the south before significant mobilization for construction. Water, electricity, telephone lines, and sanitary waste facilities (septic system or collection tanks) would be established on-site.

Trees would be removed from the construction, spoils, and borrow areas as required. Topsoil would be removed and stored, and the facility site and borrow area would be prepared for construction activities. Fences and gates would be installed to restrict the controlled area site. Site development actions would be performed to minimize environmental impacts. Existing gravel roads would be upgraded, new gravel roads would be constructed between the borrow area and the disposal facility (as required), and temporary roads and the staging area would be developed. Detention basins and runoff control ditches would be constructed to prevent run-on and protect streams from construction activities (Figure 3.2.2–7).

Disposal Facility. The disposal facility conceptual design includes a clean-fill perimeter dike; a 3-m (10-ft) geologic buffer below a 2-m (6-ft)-thick multilayer base liner system consisting of primary and secondary geosynthetic membranes and clay liners, primary and secondary leachate collection/detection systems, and a protective soil layer; a 5-m (16-ft)-thick multilayer cap consisting of a low-permeability liner, a flexible geomembrane, a drainage layer, a biointrusion layer, and a soil/rock matrix cover (Figure 3.2.2–8). A detailed description of each of these disposal cell components can be reviewed in the *Remedial Investigation/Feasibility Study for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste* (DOE 1998a).

Support Facilities. A support area and an exclusion area would be established within the fenced control area of the disposal facility. The conceptual design for the support area includes truck scales, an office area, employee and visitor parking area, and a guard station at the main gate. An employee facility would connect the exclusion area to the support area and would include personnel showers, bathrooms, monitoring and decontamination equipment, and a break area. Water from showers and toilet facilities would go to a septic tank and drain field or to a collection tank for disposal at a wastewater treatment plant.

Waste operations would be conducted in the exclusion area, which would be assumed to be contaminated during operations. Any personnel, equipment, vehicles, or containers leaving the exclusion area would be monitored and, if necessary, decontaminated. Clothing worn in the exclusion area would be washed or packaged for disposal. Water from the washers would go to a decontamination tank. An enclosed decontamination facility with a collection sump and pump and high-pressure water spray equipment would be available to inspect and decontaminate vehicles, equipment, and containers. Decontamination water collected in the sump would be pumped to the decontamination tank. The tank would be emptied, as needed, and decontamination water would be transported by tanker truck to the ETTP Central Neutralization Facility or used for dust control in the exclusion area.

An equipment storage, maintenance, and fueling area would be constructed in the exclusion area for use during operations. A waste staging area inside the exclusion area would serve as a temporary storage area for incoming waste. This area would be used if the rate of incoming waste deliveries exceeds the rate of waste placement in the disposal facility, as could occur during inclement weather. A covered storage area would be included in the staging area.

Existing groundwater monitoring wells would be used, where possible, and additional groundwater monitoring wells would be installed as needed. Air monitoring equipment would be installed for use during construction and operations.

Source: Tetra Tech, Inc./ DOE 1998a.

FIGURE 3.2.2–7.—*The Environmental Management Waste Management Facility Site Plan.*

Source: Tetra Tech, Inc./ DOE 1998a.

FIGURE 3.2.2–8.—*Cross Section of the Environmental Management Waste Management Facility Disposal Cell.*

Project Borrow Area. A large volume of clay-rich soil would be needed from a borrow area in the vicinity of the disposal facility for construction of the geologic buffer, base liner, temporary covers during operations, and cap. Based on the results of the *Environmental Restoration Soil Borrow Area Site Selection Study for the Remediation of Lower East Fork Poplar Creek Floodplain Soils* (DOE 1994b), the Y-12 West End Borrow Area contains a suitable volume and quality of material to meet the construction needs for the disposal unit. This facility is located on Chestnut Ridge, immediately south of Bear Creek Road and approximately 0.62 km (1 mi) east of SR 95. The Y-12 West End Borrow Area would be expanded from its current area of 7.1 ha (17.5 acres) to between 12 and 15 ha (29 and 36 acres), depending on the waste volume scenario. This would represent an increase of between 4.8 and 7.3 ha (11.8 and 18 acres). Figure 3.2.2–9 shows the Y-12 West End Borrow Area, including the areas projected to be impacted by excavation of fill for construction of the low- and high-end design facilities.

Construction

Construction activities for the disposal facility would include site development, disposal cell construction, construction of support facilities, capping, and closure. The disposal cell would be constructed in phases consistent with waste generation schedules. The conceptual schedule assumes that the disposal facility would be constructed and operated in two phases for the high-end scenario with the first phase of construction for the high-end scenario approximating the total low-end volume capacity. Disposal would begin once construction of the Phase I area was complete. An interim cap would be placed over the Phase I area as soon as that portion of the cell was filled. Phase II construction would be completed and this area would be ready to accept waste concurrent with interim capping of the Phase I area.

For the conceptual high-end scenario construction schedule, Phase I would include construction of all support facilities and that portion of the clean-fill dike, liner, and leachate systems to allow receipt of approximately 30-35 percent of the planned waste capacity. Phase I would include complete site clearing and preparation, and the construction of security fences, access roads, the leachate collection tanks, sediment detention basins B and C, and other necessary support facilities. A small dike would be constructed to delineate the boundary between the two phases and separate contact runoff (i.e., the rainfall that potentially contacts waste) from noncontact runoff. The clean-fill dike would be left open facing Phase II construction.

Phase II would involve construction of the remainder of the clean-fill dike, liner, leachate system, and sediment detention basin A. Construction of this phase would likely take 2-3 years. Phase II construction would follow Phase I construction during placement of waste in the completed Phase I area. During this period, vehicles hauling waste and fill material would use the same site access road. Once on-site, fill traffic and waste traffic would use separate routes. Installation of the final cover for the entire cell would occur during closure of Phase II.

Operations and Waste Placement

Operational scenarios would be different for the low- and high-end waste volumes. Under the low-end scenario, most of the candidate waste volumes would be generated by FY 2009. Because it would not be cost-effective to operate the disposal facility for the small volumes generated after that date, operations would discontinue after FY 2009 and the facility would be closed by FY 2011. Candidate wastes generated after operations cease would be shipped to off-site facilities. Long-term surveillance and maintenance (S&M) would continue indefinitely. For the high-end volume scenario, on-site disposal operations are assumed to continue through FY 2030. Closure would be completed in FY 2033 and active institutional controls would continue indefinitely.

Source: Tetra Tech, Inc./ DOE 1998a.

FIGURE 3.2.2–9.—*Y-12 Plant West End Borrow Area.*

The operations phase would consist of waste acceptance and inspections, placement of wastes into the disposal cell, decontamination of waste containers and transport vehicles, and maintenance of the disposal facility. Facility maintenance would include providing daily cover over the emplaced waste, leachate collection and management, equipment maintenance, support facility maintenance (e.g., roads, buildings), and record keeping.

The facility would have temporary storage capacity to accommodate disposal requirements or accept deliveries during inclement weather when waste placement operations are curtailed. The temporary storage capacity would include a 1,858 m^2 (20,000 ft^2) covered storage building capable of housing approximately 612 m^3 (800 yd^3) of packaged waste.

To ensure that waste received at the disposal facility could be properly handled, the physical form of waste would be restricted. Bulk waste containing debris no larger than 20 cm (8 in) in any dimension would be handled and compacted in the disposal cell with standard earth-moving equipment. Large debris (i.e., debris with any dimension larger than 20 cm [8 in]), containers, and solidified waste could be accepted if special handling arrangements were made. Limitations on large debris would be developed to minimize void spaces in the disposal cell and prevent damage to the liner system. Appropriately sized, solidified waste in the form of slabs would be accepted. No free liquids would be permitted.

Wastes would be transported in closed trucks or by truck in large containers (e.g., intermodals) or discrete packaging such as B-25 boxes, drums, and bags. Bulk waste in the form of soil, debris, miscellaneous solids, and stabilized sediment/sludge shipped in closed dump trucks and self-dumping large containers is expected to compose the largest portion of waste received at the disposal facility, although equipment for unloading a number of different types of transport vehicles and containers would be available.

Trucks carrying waste would enter the facility via the waste traffic access road and proceed to the truck scale/acceptance facility. The trucks would be weighed, waste manifests would be verified, and waste packages would be inspected. The trucks would then proceed into the disposal facility.

Within the disposal facility, active 30 by 30 m (100 by 100 ft) working faces would be prepared to receive waste. The 0.3-m (1-ft)-thick protective soil layer placed over the geotextile during construction would be removed as needed and replaced with sand or gravel before the placement of waste in the first lift. Removal of a portion of the soil layer would allow drainage of precipitation into the leachate collection system. It is assumed that only one or two faces would be active and other faces would have temporary covers to provide containment and shielding and reduce infiltration. If more accurate waste generation data indicate that exposures would be acceptable, additional faces could be opened during periods of high disposal rates or when segregation of incoming waste streams is appropriate. Segregation of incompatible wastes is assumed to be unnecessary because wastes would be treated to land disposal restrictions (LDRs). Segregation for other purposes may be desirable but is not expected to affect productivity.

Flatbed trucks carrying discrete, smaller containers such as B-25 boxes and drums would be off-loaded onto a mobile dock in the cell. Large containers would be emptied directly into the working cell. After depositing the wastes, the containers and trucks would be decontaminated before leaving the disposal cell. Before leaving the waste staging area and entering the uncontrolled area, trucks and containers would be checked at the vehicle and waste container monitoring/decontamination facility and decontaminated again, as required.

Bulk waste would be placed in 0.3-m (1-ft) lifts and compacted. Debris and containers would be placed to minimize possible damage to the geotextile layer and to minimize void spaces after backfilling. Void spaces in the disposed waste would be filled with waste soil, clean soil, or flowable fill (e.g., low-strength grout). A cover made of soil or foam would be placed over the cell following each day's operations and would be removed from the active cell before placement of the next layer of waste. This cover would prevent precipitation from contacting the waste and reduce fugitive emissions.

A berm would separate the working face of the cell from completed cells and those areas of the cell that have yet to receive waste. This berm would segregate collected precipitation that has not contacted disposed waste from collected precipitation that is potentially contaminated because of contact with waste. Precipitation accumulating in the working cells would infiltrate into the leachate collection system. Precipitation accumulating in the unused portion of the cell would be collected in a temporary sump or basin and pumped to one of the sediment detention basins south of the facility. Leachate would be pumped from collection sumps located outside the cell to collection tanks south of the cell for storage. During peak leachate generation, up to six 18,927-L (5,000-gal) tanker truck loads per day would be required to transport leachate from the collection sumps to the ETTP Central Neutralization Facility or other wastewater treatment facility on ORR.

After storm events, the detention basins would be inspected. The basins would be excavated to original design grade when 60 percent of the capacity is filled with sediment. The sediment would be hauled to a sanitary or construction landfill on ORR.

Closure

For the high-end scenario, Phase I disposal operations and Phase II construction of the geologic buffer, clean-fill dike, and liner should be near completion at the same time. When Phase II disposal operations start, installation of the final cover on Phase I could begin.

Closure activities would include removal of leachate storage tanks (after collection volumes diminish) and other support facilities and placement of contaminated media into the disposal cell, installation of the final cover, and site restoration. Restoration could include removal of the sediment ponds, replacement of wetlands if necessary, and grading and seeding the disturbed areas outside the disposal cell to restore the area.

Deed restrictions would prohibit residential use of the property, construction of any facilities that could damage the cover, or installation of groundwater extraction wells (for purposes other than monitoring). These deed restrictions would also identify other administrative controls necessary to protect the public and the integrity of the disposal cell and would be attached to the deed description and filed with the appropriate local governmental authority.

Post-Closure Care

During development of the support facilities, monitoring of the disposal facility and its environs would begin as soon as monitoring facilities were installed. Historic information and results from pre-disposal monitoring would be used to develop a baseline for comparison with post-operation monitoring results. S&M and monitoring would be performed for an indefinite period after facility closure. These activities and the associated reporting requirements would be conducted in accordance with approved facility-specific S&M and monitoring plans.

Surveillance. An integral part of post-closure care is surveillance and site inspection. The site would be inspected to verify adequate performance of the containment features installed and to alert DOE and regulatory agencies of any potential problems. The inspections would provide an early warning that specific elements may need more careful evaluation and monitoring.

During the first year of operation, one or two inspections could be performed immediately after high rainfall events to verify the effectiveness of water retention and transport systems and the accuracy of the performance predictions. Additional data should be collected after significant events such as storm events of a 5-year intensity or greater. In the first 5 years after closure, inspections could be performed more frequently than in later years to evaluate seasonal effects on operation of the systems. Certain elements, such as disposal-cell stability, may require more frequent inspections. The timing of the inspections could be determined after evaluation of the first year's seasonal results to provide the most useful information. After the fifth year and upon completion of the first CERCLA 5-year review, inspection frequency could be adjusted as appropriate.

Maintenance. Post-closure maintenance activities would include the clearing of uncontrolled plant growth from the disposal-cell crest and side slopes; clearing, repair, and realignment of surface water transport structures; inspection, emptying, and maintenance of the leachate collection/detection system; replacement of signs; reestablishment of survey monuments; and collection of piezometer data. Undesired plant growth would be cleared annually for the period of active institutional controls. Regrading, ditch realignment, fence and sign repair survey monument reestablishment, and other minor maintenance items would be conducted based on surveillance findings.

Long-Term Maintenance. Long-term media monitoring (groundwater, surface water, air, and biota) would be performed to detect releases from the disposal cell. A groundwater monitoring system with wells located upgradient and downgradient of the disposal cell would be sampled annually to monitor containment concentrations and determine whether there have been contaminant releases from the disposal cell. Continued monitoring would support 5-year reviews under CERCLA [40 CFR 300.430 f(4)V]. The surface water downstream from the disposal cell would be monitored during operation of the facility and through post-closure care in support of 5-year CERCLA reviews.

3.2.2.3 *Environmental Restoration*

Environmental Restoration activities would continue in the form of characterization and remediation of contaminated areas or facilities. Environmental Restoration is not considered a land use, but an activity necessary for reuse or disposition of land and facilities. The Environmental Restoration projects at Y-12 that would continue under the No Action Alternative include:

- Decontamination and Decommissioning Facilities
- Upper East Fork Poplar Creek Actions
- Upper East Fork Poplar Creek East End Volatile Organic Compound (VOC) Plumes
- Upper East Fork Poplar Creek West End Mercury Area Remediation
- Groundwater/Surface Water Actions
- Soils/Sediments Contamination Reduction Actions
- Soils/Sediments Remediation Actions

3.2.2.4 *Nuclear Nonproliferation and National Security*

The No Action - Planning Basis Operations Alternative would also include continued down-blending of small quantities (kg/year) of HEU to various degrees of enriched uranium by blending HEU with depleted or natural uranium in Building 9212. The product would be metal or oxide used in various reactor programs, weapons programs, and for multiple uranium supply orders to DOE customers.

Y-12 would continue to support ongoing NN programs, operations and activities under the No Action - Planning Basis Operations Alternative. Ongoing and planned National Security Program Offices activities include:

- Verification activities
- Bilateral treaty support
- IAEA interface activities related to uranium
- Support activities pertaining to all National Security Nuclear Nonproliferation Programs

3.2.2.5 *Nuclear Energy*

Under the No Action - Planning Basis Operations Alternative, DOE would continue to host existing projects and program activities of Nuclear Energy, Science and Technology at levels not exceeding those of the recent past.

3.2.2.6 *Nondefense Research and Development Program*

Y-12 would continue supporting ongoing program operations. Ongoing and planned nondefense R&D operations and activities at Y-12 that would continue under the No Action - Planning Basis Operations Alternative include:

- National Environmental Research Park Program Activities
- ORNL General Research and Support Activities
- ORNL Engineering Technology Division Activities
- ORNL Fusion Energy Division Activities
- ORNL Biology and Environmental Research Program Activities

One new Nondefense Research and Development Program initiative included under the No Action - Planning Basis Operations Alternative is the Field Research Center associated with the ORNL NABIR Program.

The Office of Biological and Environmental Research, within the Office of Science, is adding a Field Research Center component to the existing NABIR Program at Y-12, which was analyzed at ORNL (ORNL 1999). DOE has prepared a EA for the project (DOE/EA-1196, DOE 2000b) and issued a FONSI on April 18, 2000, which provides a description of the proposed action, alternatives, and potential impacts. A summary of the project is presented here.

The Y-12 Field Research Center site would include a 98-ha (243-acre) previously disturbed contaminated area and a 163-ha (440-acre) background area. The contaminated area would be used for conducting experiments on contaminated groundwater and subsurface sediments. The background area would provide for comparison studies in an uncontaminated area and is outside the Y-12 SWEIS analysis area shown in Figure 3.2.1-1. The contaminated area and background area would be located in Bear Creek Valley. Bear Creek Valley is approximately 16 km (10 mi) long and extends from the eastern end of the Y-12 Site to the Clinch River on the west. Bear Creek is a tributary to East Fork Poplar Creek (EFPC), which drains into the Clinch River at the ETTP. Except for the extreme eastern end of the contaminated area of the Field Research Center, the area is outside any security fences, adjacent to public use roads, but protected from unwarranted passersby. Initially, test plots of less than 0.4 ha (1 acre) would be constructed in proximity to the S-3 Ponds Site parking lot (Figure 3.2.2–10).

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.*

A CERCLA Remedial Investigation Report was completed on the Bear Creek Valley in 1997 (DOE 1997a); the report provided a significant amount of characterization data on the S-3 Ponds Site as well as other areas of the Bear Creek Valley. The contaminated and background areas would serve as the primary field site for small-scale basis bioremediation research activities. The types of activities that could occur at the Field Research Center can be categorized into passive and active site characterization, obtaining research-quality samples, and in situ research. Because the activities at the Field Research Center would be undertaken in an area limited to less than an acre and a depth of 23 m (75 ft), the scale of research activities would be considered small.

Passive subsurface characterization activities are described as nonintrusive (e.g., ground -penetrating radar, electromagnetics, and resistivity) and intrusive (e.g., seismic tomography, direct push penetrometer, creation and use of injection/extraction wells). Active characterization can be defined as the addition of some substance (e.g., air, nontoxic chemical tracers such as bromide, or a gas tracer such as helium or neon) to the subsurface under controlled conditions. These active characterization studies would allow the NABIR investigators to better understand the hydraulic properties of the subsurface, provide a detailed understanding of groundwater flow paths and the speed at which groundwater and other substances might move through the aquifer, and could assist in determining additional chemical and physical properties of an aquifer.

The Field Research Center would be a primary source for groundwater and sediment samples for NABIR investigations. Groundwater would be sampled by pumping water from existing wells or by installing new wells. Approximately 200 groundwater samples per year would be expected. These would be small quantity samples, approximately 1 L (0.264 gal) each and totaling less than 76,000 L (20,000 gal) per year, and would not change the groundwater flow rates or availability of groundwater. Approximately 600 core samples of sediments would be taken over the 10-year life of the proposed Field Research Center through the use of a drill rig or split-spoon sampler. Again, the sediment samples would be small in volume (approximately less than 1 m^3) (35.31 ft^3) and the drilling holes would be backfilled when no longer needed.

Collection and transportation of samples within the boundaries of the Y-12 Site would follow existing DOE procedures and meet all ES&H requirements. Samples could be shipped off-site to researchers at universities and commercial laboratories. Any shipment of hazardous materials to or from the Field Research Center would follow U.S. Department of Transportation (DOT) Hazardous Materials Regulations.

Approximately 40 in-situ research activities would be conduced over the 10-year life of the proposed Field Research Center. Two types of in-situ activities are proposed to take place: biostimulation and bioaugmentation.

Biostimulation would involve introducing substances into the subsurface to stimulate naturally occurring microorganisms in situ to bioaccumulate or transform a heavy metal or radionuclide. Biostimulation activities might include (1) injection of electron donors or electron acceptors to change part of the chemical environment of the subsurface so that it is more favorable for microbial activity or growth, (2) injection of gases or nutrients to stimulate the growth of selected microorganisms, (3) injection of chelators to test the extent of contaminate mobilization, or (4) injection of surfactant to reduce the toxicity of a specific contaminant to microorganisms.

Bioaugmentation would involve the injection of additional microorganisms (either native or non-native) into the subsurface to either bioaccumulate heavy metals or radionuclides, or transform them such that they become less toxic or less mobile in the subsurface.

With the exception of the proposed placement of temporary work/sample preparation trailers at the test plots, no new construction would be involved with the operation of the Field Research Center. Existing utilities would be used. Heavy equipment (e.g., drill rigs, brush hogs, augers) would be used when necessary for site clearing prior to conducting research at the background or contaminated sites. The equipment would be used for short periods of time. Best management practices and all applicable rules and regulations would be followed during the use of equipment.

3.2.2.7 *Work-for-Others Program*

The Work-for-Others Program and the National Prototyping Center are hosted by DOE and include the shared use of certain facilities and resources at Y-12. Under the No Action - Planning Basis Operations Alternative, DOE would continue to host the projects and activities of other Federal agencies, foreign governments, and other countries at activity levels not exceeding those of the historic past. The Work-for-Others Program was not affected by the 1994 stand-down of Y-12 DP mission activities.

3.2.2.8 *Technology Transfer Program*

The Technology Transfer Program is hosted by DOE and has as its goal to apply unique expertise, initially developed for highly specialized military purposes, to a wide range of manufacturing situations to support expansion of the capabilities of the U.S. industrial base. Under the No Action - Planning Basis Operations Alternative, DOE would continue to host the projects and activities of the Technology Transfer Program at levels not exceeding those of the historic past. The Technology Transfer Program was not affected by the 1994 stand-down of Y-12 DP mission activities.

Technology Transfer activities that would be expected to continue include the following:

- Predictive Maintenance
- Computer-aided Design/Manufacturing/Engineering/Specific Technologies
- Manufacturing and Inspection Technologies

3.2.3 Alternative 2 (No Action - Planning Basis Operations Alternative Plus HEU Storage Mission Alternatives)

This alternative includes the No Action - Planning Basis Operations Alternative Plus a new HEU Storage Mission Facility. There are two proposed options for the HEU Storage Mission at Y-12: (1) construct a new HEU Materials Facility at one of two potential candidate sites, and (2) construct an upgrade expansion to existing Building 9215. The preferred option is to construct and operate the new HEU Materials Facility, which would enable Y-12 to continue to safely and securely store Categories I and II HEU, including canned subassemblies that contain HEU; HEU in metal and oxide form in cans that is part of the strategic reserve or excess inventories. Scrap material that contains HEU awaiting recovery (Central Scrap Management Office scrap metal, oxides and other miscellaneous compounds that are being returned from other DOE facilities and university programs) will be stored in existing facilities until reprocessed to an acceptable form. A discussion of each of the options and the candidate sites for the proposed new HEU Materials Facility is provided in the following sections.

3.2.3.1 *Alternative 1B (No Action - Planning Basis Operations Alternative)*

Under the No Action - Planning Basis Operations Alternative, the HEU Materials Facility would not be constructed. The Y-12 Plant would continue to use the existing storage facilities (Buildings 9204-2, 9204-2E, 9204-4, 9215, 9720-5, 9206, and 9998) to perform the HEU Storage Mission and meet DOE requirements. Appendix A.4 gives a detailed description of these buildings. Most of these facilities have been constructed for HEU storage by building vault space within existing buildings or as appendages to buildings. The existing storage facilities rely upon an appropriate mix of both physical, engineered, and administrative controls to safely and securely store HEU. Some of the buildings in which storage facilities are located have been identified as not meeting current DOE standards for natural phenomena events (e.g., tornado and seismic occurrences). Although the facilities now used for HEU storage provide sufficient space for current and near-term future national security needs, they do so at increasingly greater difficulty and costs associated with meeting DOE, design, ES&H, and security requirements.

3.2.3.2 *Alternative 2A (No Action - Planning Basis Operations Alternative Plus Construct and Operate a New HEU Materials Facility)*

This section includes a description of the proposed new HEU Materials Facility, its construction and operation, the candidate sites for the facility, and infrastructure requirements. The new HEU Materials Facility would replace the use of the existing storage vaults and facilities located within existing Y-12 buildings as described in Section 3.2.1.1 and 3.2.2.1. The HEU materials in storage facilities located in Building 9720-5, 9204-2E, 9204-2, 9998, 9215, 9206, and 9204-4 would be consolidated in the new HEU Materials Facility. All operations associated with HEU storage, including transport and receiving, would be transferred to the new HEU Materials Facility. Existing storage facilities would be declared surplus and used for other activities or turned over to EM for D&D, based on a formal transition process review described in Appendix A.1.2. D&D estimated wastes volumes are provided in Section 5.11.2 of this document

HEU Materials Facility Description

The proposed HEU Materials Facility would be a single structure with a total footprint of approximately 12,077 m^2 (130,000 ft^2). The HEU Materials Facility would be used for long-term storage of Categories I and II HEU that is not "in process." In process HEU is material that is actually being used in manufacturing and is tied up in equipment or being handled within manufacturing facilities or part of processing activities. The new facility would provide the capacity to store approximately 14,000 cans and 14,000 drums (208-L [55-gal] equivalents) of HEU, a surge capacity area for an additional 4,000 drums, and a storage area for material currently under international safeguards. The facility would be covered by an earthen berm. Figure 3.2.3–1 shows an artist's rendering of the proposed HEU Materials Facility.

The design of the HEU Materials Facility would meet Y-12 Conduct of Operations and Integrated Safety Management requirements; minimize the number of personnel required for operations and security; and meet DOE requirements for SNM accountability and control. The design service life of the proposed new facility would be 50 years. The HEU Materials Facility would be equipped with appropriately sized filtered heating, ventilation, and air conditioning (HVAC) systems. These systems would constitute a vital component in the protection of workers, the public, and the environment. While the facility would not have airborne uranium emissions under routine operations, sensors would trigger a series of barriers to prevent the escape of radioactive materials from within the HEU Materials Facility during an off-normal occurrence.

The material processing areas within the HEU Materials Facility would incorporate the appropriate use of gloveboxes, inert atmosphere, negative air pressure, and other engineered controls, supported by administrative controls, to protect the facility workers from exposure to radiological and hazardous materials. Exhaust emissions for the facility would comply with the applicable Federal and state requirements. In conjunction with other engineered containment measures at the container and storage vault levels and with supporting administrative controls, the ventilation system barriers would provide a layered system of protection.

Other systems that would be included in the new HEU Materials Facility for facility operation and ES&H protection include:

- Criticality Accident Alarm System
- Emergency Notification System
- Central Alarm System
- Fire Suppression Alarm Systems
- Telephone and public address system

- Classified and unclassified computer network
- Personnel Monitoring System
- Berm and other security-related sensors
- Automated inventory system with continuous real-time monitoring

The HEU Materials Facility would provide secure docking for safeguard transports (SGTs) and safe-secure trailers (SSTs) to ensure the secure, safe transfer of secondaries and other materials containing HEU. The shipping and receiving docks at the HEU Materials Facility would accommodate the simultaneous loading and unloading of three SGTs or SSTs. A parking area for an additional seven SGTs and/or SSTs would be included within the facility site footprint. The docks and long-term parking areas would accommodate the trailers and associated tractors. The dock parking area would have the electrical hookups required for the SGTs and SSTs.

Separate confirmatory areas would contain the equipment necessary to perform material receipt verification and nondestructive assay (NDA) of the materials received. Access to the storage and work areas in the facility would be controlled and monitored using both active and passive technological methods and administrative controls. To further reduce operational costs, the new HEU Materials Facility would include provisions for an enclosed and secure transit corridor. The corridor would connect the HEU Materials Facility with potential future Y-SIM projects such as the Enriched Uranium Manufacturing Facility. HEU storage practices would involve application of simple, rugged, easily maintained, state-of-the-art technologies and techniques. The use of a horizontal drum-storage system that would place individual drums on a seismically qualified, storage rack is being evaluated. The racks would be designed, fabricated, and installed to meet the applicable requirements specified in DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*. All racks, which would have six vertical storage locations, would include features to ensure that during a seismic event, drums/containers would not become dislodged from their storage locations. The system would require the use of a turret-mast forklift to permit straight-in and straight-out aisle entrance and exit. In addition, this forklift would also be able to handle drums from either the left or right because of the ability to reverse the fork mechanism. A guidance system would be installed to guide the forklift when operating in the storage aisle. Such a system would maximize storage space by eliminating the need for forklift turning space within the storage bays.

The can storage system being evaluated for use in the facility consists of a palletized rack storage system which will have cavities to receive the cans. Each pallet would include a removable, lockable metal cover. Final decisions on storage systems would depend on the completion of a detailed nuclear criticality safety analysis. The impact of the various storage systems and materials on workers and public health and safety would be evaluated and would be incorporated in the facility Preliminary and Final Safety Analysis Reports.

Design, site preparation, construction, and operational activities would be conducted in accordance with applicable regulations, DOE Orders, national codes, and other requirements identified in Chapter 7, and the requirements established during preparation of the Preliminary Safety Analysis Report. Some elements of the new HEU Materials Facility would be designed to meet natural phenomena PC-3 requirements (See Glossary for definition of PC levels).

The preliminary schedule for the project indicates that site preparation would begin in the second quarter of FY 2001. Construction of the foundation and facility would begin in the second quarter of FY 2002 and would be completed in the second quarter of FY 2005. Following test and checkout and the Operational Readiness Review, the HEU Materials Facility would be ready for operation in the first quarter of FY 2006.

HEU Materials Facility Construction

The current HEU Materials Facility design calls for a single-story storage structure with reinforced concrete floors, roofs, and walls. The entire facility would be surrounded and covered by an earthen berm of compacted clay and rock riprap (see Figure 3.2.3–1). The last clay fill would be installed to create a finish slope that would enable water to drain off to the west, north, and east sides of the berm. Once the final clay cap has been installed, the entire berm would receive a layer of topsoil and sod.

The structure's foundation would be concrete piers that are drilled down into the bedrock of the site, or a thick concrete slab. To reduce the overall footprint of the structure, a precast-concrete crib retaining wall would be constructed on the north and west sides of the proposed HEU Materials Facility. The precast-concrete retaining wall would be 8 to 10 m (25 to 30 ft) high. A suitable foundation would be provided for the crib wall. Double cells would be required because of the proposed height of the crib walls. Crib walls would be backfilled with rock riprap.

Conventional construction techniques would be used to build the HEU Materials Facility. Construction activities would be performed in a manner that assures protection of the environment during the construction phase. Techniques would be used to minimize the generation of construction debris that would require disposal. Disposal of construction debris would be made in accordance with waste management requirements in properly permitted disposal facilities. The extent and exact nature of such activities as site clearing, infrastructure improvements, and support facility construction required would depend on the candidate site considered for the HEU Materials Facility. Throughout the construction process storm-water management techniques, such as silt fences and runoff diversion ditches, would be used to prevent erosion and potential water pollutants from being washed from the construction site during rainfall events.

As conceptually designed, about 4 ha (10 acres) of land would be required for the HEU Materials Facility. Additional land area may be required to accommodate parking, access roads, and support structures (e.g., security infrastructure requirements). The actual amount of land required depends on the selected site. During construction, about 0.8 ha (2 acres) of land would be required for a construction laydown area. The laydown area would be located within or near the location designated for the facility. Following construction, the laydown area would be restored to its pre-construction condition or incorporated into the landscape or infrastructure support design of the site.

HEU Materials Facility Operation

The following discussion outlines the anticipated workflow for storage operations in the proposed new HEU Materials Facility. Storage operations in the new facility would replace existing HEU storage operations as described in Section 3.2.2.1. Appropriate procedures to implement this workflow would be developed after the final design is approved.

FIGURE 3.2.3–1.—*Artist's Rendering of Proposed Highly Enriched Uranium Materials Facility.*

Drum Storage. The following list identifies the main operational steps that would be involved in handling drums containing HEU materials.

- SST arrives at the loading dock.
- Shipping containers are offloaded and moved to the NDA and re-containerization area.
- A transfer check is performed.
- Drums undergo nondestructive assay (NDA).
- HEU materials are placed in new containers if required.
- Each drum is entered into the computerized tracking system and is assigned a rack location.
- Each drum is moved by forklift to its assigned location in the storage area.
- Each drum is connected to the automated inventory system.

Canned Storage. The Continuous Automated Vault Inventory System (CAVIS), a computerized inventory and monitoring system, would be used on those cans stored in the HEU Materials Facility. The following list identifies the main operational steps that would be used in handling cans containing HEU materials.

- SST or in-plant transfer vehicle arrives at the loading dock.
- Shipping containers with cans are offloaded and moved to the NDA and re-containterization area.
- A transfer check is performed.
- Cans undergo NDA.
- Cans are placed in the can pallets.
- Each can and pallet is entered into the computerized tracking system and is assigned a rack location.
- Each loaded pallet is moved by forklift to its assigned location in the storage area.
- Each loaded pallet is connected to CAVIS and then activated.

An operational consideration that must be accommodated is the need to operate both the existing HEU storage facilities and the new HEU Materials Facility in parallel for approximately 1 year after the new facility is certified operational. This dual operation period would also cover the transfer of materials from the current storage facilities to the new facility. Such dual operation would result in a short-term increase in personnel and operational costs because of the need to staff the new facility while the current facilities also remain in operation. When a currently used storage facility is emptied of material (the material having been transferred to the new facility), that facility would be eligible for reuse or shutdown.

HEU Materials Facility Candidate Sites

Site A

Site A for the proposed HEU Materials Facility is in the Y-12 West Portal Parking Lot, just north of Portal 16. This site is outside of but adjacent to the existing Perimeter Intrusion, Detection, and Assessment System (PIDAS). Figure 3.2.3–2 shows the location of Site A relative to other buildings at Y-12. This West Portal Parking Lot is close to the existing HEU processing complex and represents a large level site with minimal site preparation requirements.

Site A preparation involves site design, relocation of existing utilities (e.g., lights, towers, and underground pipelines), construction of an addition to the Polaris Parking Lot, extension of utilities to the new facility site, modifications to an existing portal, removal of nearby office trailers, and modification of a cooling tower. The PIDAS would need to be extended to encompass this area after the HEU Materials Facility was completed.

Source: Tetra Tech, Inc./LMES 2000b.

FIGURE 3.2.3–2.—*Site A for the Proposed Highly Enriched Uranium Materials Facility.*

Construction and Operation

Construction

Relocation of Utilities and Other Features. Site A would be cleared of electrical utilities that would interfere with construction of the HEU Materials Facility. Pole-mounted lighting fixtures, public address system speakers, and associated aerial cables would be removed. An overhead 13.8-kV yard feeder that enters the parking lot from the south would be rerouted around the east side of the parking lot. Overhead electrical services to a guard tower at the northeast corner of the parking lot would be removed and then the tower would be demolished. A high-mast lighting tower located on the northern boundary of the parking lot would be relocated to the north side of Bear Creek Road. Other electrical lines would be relocated as appropriate to cross under the PIDAS. Services to office trailers scheduled for removal would be disconnected.

A water line that passes under the proposed location of the vehicle gate for the new HEU Materials Facility would be relocated to pass under the existing PIDAS at another point. Water service would be extended to the new facility from the relocated water line. Another water line would also be rerouted under the PIDAS from an existing water line just north of Building 9111. An abandoned water line on the north side of the proposed facility site would be removed where it runs within the limits of the proposed project site, and concrete caps would be placed on the end points. A polyvinyl chloride (PVC) sanitary sewer main would be extended to the new facility from the current sanitary sewer system just west of Building 9703-11.

The HEU Materials Facility storm sewer system would include a comprehensive collection system that would tie into the existing system near the northeast corner of the project site. Storm sewer pipe would be reinforced concrete and would be designed to collect a 100-year storm event. The storm sewer system along Bear Creek Road would be designed to accommodate the simultaneous failure of the two 5.7 million L (1.5 million gal) water tanks on the south side of Pine Ridge. Pipe sizes, number of catch basins, locations, etc., would be a consideration of the design of the storm sewer system along Bear Creek Road.

Traffic Planning, Polaris Parking Lot, and Construction Lay-Down Area. The HEU Materials Facility footprint and the alignment of the new PIDAS may require relocation of a short stretch of Bear Creek Road (Figure 3.2.3–3). Early engineering studies show that the new PIDAS would infringe upon the southernmost lane of Bear Creek Road near the northwest corner of the site. If so, an additional vehicle lane would be built on the north side of the existing road. The new lane would be approximately 122 m (400 ft) long. Support poles to the traffic light would be relocated northward. Up to 200 car spaces may be built to replace the parking spaces lost when the proposed HEU Materials Facility is constructed on the existing West Portal Parking Lot. These additional parking spaces would be an extension of the existing Polaris Parking Lot, which is located on the north side of Bear Creek Road, just northwest of the HEU Materials Facility site (see Figure 3.2.3–3). A storm collection system featuring reinforced concrete pipe and curb and gutter catch basins and precast concrete head walls would be designed for the new parking lot expansion. The new storm sewer system would tie into the existing storm sewer system.

The construction staging area for the HEU Materials Facility would occupy approximately 0.8 ha (2 acres) of land and would be north of Bear Creek Road or at a site on the west end of Y-12. The site would be sufficiently graded and developed to accommodate a number of temporary construction trailers, storage buildings, and materials storage yards. The staging area would have electric power and potable water. Sanitary service would be provided by PVC double-wall collection tanks, which would be pumped out as needed. A smaller area 0.4 ha (1 acre) would be available for daily lay-down construction needs in the adjacent parking lot west of Site A. Figure 3.2.3–3 shows the location of the two construction lay-down areas.

Utility Extension. The cooling and potable water lines, electrical services, security systems, standby power, and telephone systems would be extended under the existing PIDAS. All the utility services would be extended from existing Y-12 services from within the Protected Area of Y-12. When completed, the new HEU Materials Facility would have no overhead utilities.

Cooling Tower Modifications. A chilled water loop would be installed to support the new HEU Materials Facility HVAC requirements. This also would require that the new cooling tower (Building 9409-24E) be completed and brought on-line. Piping would be laid in accordance with all necessary safety and security precautions. A chilled water booster pump and piping would be required in conjunction with the new chiller cell. Return chilled water would be used as condenser water.

Removal of Office Trailers. Three office trailers are located east of the West Portal Parking Lot. Personnel would be relocated, and these trailers would be removed and salvaged. The utilities to these trailers would be removed. The area where these trailers are located would be used for the approach road and new PIDAS vehicle entrance to the HEU Materials Facility.

Remediate Construction Lay-Down Area. Once the construction of the HEU Materials Facility is complete, the construction office trailers would be removed and material lay-down areas would be re-graded and seeded after removal of any soil that may have become contaminated with construction-related materials such as diesel fuel.

Site Preparation and Facility Construction. Table 3.2.3–1 lists the construction resource requirements, number of construction workers, and estimated waste generation of constructing the proposed facility on Site A. Site preparation would follow the advanced work described above and would include any excavation, filling, and grading needed to meet design requirements for an on-grade, reinforced concrete structure. Preliminary testing of Site A has shown that the parking lot was partially built on top of a filled area. The subsurface conditions encountered during testing vary widely across the site and include existing fill, residual silts, and weathered shale. Bedrock dips across the site at an angle of approximately 45 degrees as indicated by the auger refusal depths that ranged from 6 to 18 m (20 to 60 ft) below grade. Additional detailed testing would be conducted to fully characterize site geology, hydrology, and soil compaction, as well as to sample for radioactive contamination, mercury, and other materials of concern before construction.

On Site A, the HEU Materials Facility would be a one-story, reinforced concrete building covered by a soil overburden roof. The floor of the facility would be reinforced concrete slab supported on well-compacted sub-grade. Because of the extremely large loading imposed by the soil overburden and the thick roof slab, the columns, exterior walls, and storage area perimeter walls would be supported by reinforced concrete drilled piers or thick concrete mat. Piers would be socketed into sound bedrock to a depth of 1.8 m (6 ft). Drilled pier diameters and depths would vary across the building length with an average depth approximately 12 m (40 ft). The HEU Materials Facility structure would be designed to meet the requirements of the applicable DOE Orders and Standards and the appropriate model building codes for specialized construction. The design for the natural phenomena hazards (earthquake, tornadic winds, floods, and lightning) would be in accordance with DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*.

Operation

The HEU Materials Facility operations would be the same as described earlier. Table 3.2.3–2 lists the operations requirement, number of operations workers, and the expected waste generations for the proposed HEU Materials Facility.

Source: Tetra Tech, Inc./LMES 2000b.

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.*

TABLE 3.2.3–1.—*Highly Enriched Uranium Materials Facility Construction Requirements and Estimated Waste Volumes for Site A or Site B*

Requirements	Consumption	
Materials/Resource		
Electrical energy (MWh)	5,000	
Concrete m³ (yd³)	25,100 (32, 830)	
Steel (t)	2,100	
Liquid fuel and lube oil L (gal)	568,000 (150, 050)	
Water L (gal)	7,571,000 (2,000,046)	
Aggregate (yd³)	1,550 (2,027)	
Land ha (acre)	5 (12.3)	
Employment		
Total employment (worker years)	145	
Peak employment (workers)	220	
Construction period (years)	4	
Waste Category	**Volume**	
	Site A	**Site B**
Low-level		
Liquid m³ (gal)	none	none
Solid m³ (yd³)	none	none
Mixed Low-level		
Liquid m³ (gal)	none	none
Solid m³ (yd³)	none	22,707[a] (29,700)
Hazardous		
Liquid m³ (gal)	3 (800)	3 (800)
Solid m³ (yd³)	38.2 (50)	38.2 (50)
Nonhazardous (Sanitary)		
Liquid m³ (gal)	14,347 (3,970,000)	14,349 (3,970,000)
Solid m³ (yd³)	none	none
Nonhazardous (Other)		
Liquid m³ (gal)	none	none
Solid m³ (yd³)	3,823 (5,000)	3,823 (5,000)

[a]Excavated contaminated soil to a depth of 3 ft at Site B.
[b]Construction debris.
Source: LMES 2000b.

TABLE 3.2.3–2.—*Highly Enriched Uranium Materials Facility Annual Operation Requirements and Estimated Waste Volumes*

Requirements	Consumption
Electrical energy (MWh)	5,900
Peak electrical demand (MWe)	1.1
Liquid fuel L (gal)	none
Natural gas m^3 (yd^3)	none
Water L (gal)	550,000 (145,295)
Plant footprint ha (acres)	4 (9.9)
Employment (workers)	30(100[a])

Waste Category	Average Annual Volume
Low-level	
Liquid m^3 (gal)	0.8 (200)
Solid m^3 (yd^3)	119 (156)
Mixed Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Hazardous	
Liquid m^3 (gal)	2.5 (660)
Solid m^3 (yd^3)	1.5 (2)
Nonhazardous (Sanitary)	
Liquid m^3 (gal)	777.1 (205,300)
Solid m^3 (yd^3)	none
Nonhazardous (other)	
Liquid m^3 (gal)	4.2 (1,100)
Solid m^3 (yd^3)	178.9 (234)

[a]Approximately 100 workers would be required during the 1-year transition period while the existing HEU materials in storage are transferred to the new HEU Materials Facility.
Source: LMES 2000b.

Site B

Site B for the proposed HEU Materials Facility is located at the Y-12 Scrap Metal Yard. The site is south of Building 9114, west of the westernmost portion of the Y-12 PIDAS fence, and north of Portal 33 and Section Street. Figure 3.2.3–4 shows the location of Site B relative to other buildings at Y-12. Old Bear Creek Road is the western boundary of the proposed Site B.

Site B preparation would involve site design, relocation of existing utilities (e.g., lights, underground water lines, storm sewers, steal lines, etc.), a portion of Old Bear Creek Road, numerous structures, office trailers, and a portion of the Y-12 Scrap Metal Yard. The PIDAS would need to be extended to encompass this area after the HEU Materials Facility was completed. A sector of the existing PIDAS fence would need to be modified to install a vehicular entry gate for the new facility.

Construction and Operation

Construction

Table 3.2.3–1 lists the construction requirements and estimated waste volumes for the proposed HEU Materials Facility.

Relocation of Utilities and Other Features. A steam line and steam condensate line that serves the Y-12 West End Tank Farm and Building 9114 would be relocated. Numerous overhead electrical lines within the proposed site would have to be removed and a 143.8-kV electrical line along Old Bear Creek Road would be relocated westward from its current location. Numerous communications and computer lines would have to be rerouted. Portions of a sanitary sewer main that serve the west end of Y-12 would be rerouted. A water line that follows the Old Bear Creek Road alignment would also be relocated for the new facility.

Sanitary sewer services would be provided for the new facility by extending a sanitary sewer main from the relocated sewer main along Old Bear Creek Road. Potable water and firewater services for the new facility would be extended from the relocated water line along Old Bear Creek Road.

Electrical services, chilled water lines, security service lines, and computer services that would serve the proposed new facility would be extended from the Y-12 Plant site. These existing Y-12 services would be rerouted under the existing Y-12 PIDAS just north of Post 33.

The proposed HEU Materials Facility storm sewer system for Site B would include a comprehensive collection system that would tie into the existing Y-12 storm sewer system. Off-site water, which would be coming from the north of the proposed site, would be rerouted around the new HEU Materials Facility on the west side along the relocated Old Bear Creek Road. Storm sewer pipe would be reinforced concrete pipe and would be designed for a 100-year storm event.

Source: Tetra Tech, Inc./LMES 2000b.

FIGURE 3.2.3–4.—*Site B for the Proposed Highly Enriched Uranium Materials Facility.*

Traffic Planning, Construction Lay-Down Areas, and Parking. Additional parking areas would not be needed to meet the needs of the operations personnel associated with the new HEU Materials Facility at Site B. Sufficient parking is available at the S-3 Ponds Parking Lot. However, temporary parking spaces for construction workers and plant personnel would need to be developed in the west tank area and just south of old Post 17 during construction of the new facility on Site B. Approximately 0.8 ha (2 acres) would be needed for the temporary parking spaces. The temporary parking would be needed because the S-3 Ponds Parking Lot would be used as a construction lay-down area for the new facility. Figure 3.2.3–5 shows the Site B construction lay-down area and temporary parking locations. The construction staging area would have electrical power and potable water. Sanitary sewer services would be provided by PVC double-wall collection tanks, which would be pumped out as needed.

Remediate Construction Lay-Down Area. Once the construction of the HEU Materials Facility is complete, the construction office trailers and material lay-down areas would undergo remediation. The potable water lines and the electrical services would be removed. Any office trailers would be removed. The parking lot would then be paved with a 4-cm (1.5-in)-thick asphalt concrete surface. The parking lot spaces would then be relined for employee parking.

Demolition of Existing Structures. Trailers 9983-18, 9983-24, 9983-29, 9983-45, 9983-46, 9983-74, and 9983-99 would have to be removed and relocated or salvaged. Structures 9831, 9720-15, 9814, 9819, 9420, 9420-1, 9627, and 9626 would have to be demolished. The functions that occur within the buildings to be demolished would be relocated to other areas at the Y-12 Plant.

Site B Environmental Remediation. A portion of the existing Y-12 Scrap Metal Yard would have to be cleared of materials and environmentally stabilized before construction of the new HEU Materials Facility could be started. Approximately 15,290 m^3 (20,000 yd^3) of scrap and an estimated 13,000 m^3 (17,000 yd^3) of contaminated soil (VOCs, metals, and radionucluides) would be removed from the site. Current planning is to dispose of this material in the new Environmental Management Waste Management Facility being constructed in the West Bear Creek Valley area of Y-12.

Operation

The HEU Materials Facility operations would be the same as described earlier. Table 3.2.3–2 lists the operations requirements, number of operation workers, and expected waste generations for the proposed HEU Materials Facility.

3.2.3.3 *Alternative 2B (No Action - Planning Basis Operations Alternative Plus Upgrade Expansion of Building 9215)*

Under this alternative, the storage of HEU would be accommodated through the expansion of the existing Building 9215. The building expansion would be approximately 48 by 90 m (160 by 300 ft) with two floors and would be sized to handle all of the long-term storage requirements anticipated for Y-12 similar to that described for the proposed new HEU Materials Facility. The upgrade expansion of Building 9215 would replace the use of existing storage vaults and facilities located within existing Y-12 buildings as described in Section 3.2.2.1 under the No Action - Planning Basis Operations Alternative for the DP HEU Storage Mission. The HEU materials in storage facilities located in Buildings 9720-5, 9204-2E, 9204-2, 9998, 9206, and 9204-4 would be consolidated in the new Building 9215 storage expansion. A modest amount of in-process storage associated with processing activities in Buildings 9212 and 9215 would continue. All operations associated with HEU storage, including transport and receiving, would be transferred to the new Building 9215 storage expansion.

Source: Tetra Tech, Inc./LMES 2000b.

FIGURE 3.2.3–5.—*Highly Enriched Uranium Materials Facility Site B Construction Lay-Down Area and Temporary Parking Lot.*

The proposed site for construction of the Building 9215 expansion is a parcel of land located west of Buildings 9212 and 9998 and north of Building 9215 as shown in Figure 3.2.3–6. This parcel has no major permanent structures and is currently occupied by trailers and temporary facilities. The proposed site is on high ground, not susceptible to flooding or storm water runoff.

The expansion of Building 9215 would allow the automated transfer of material between the storage building expansion and Building 9215, from which the material can be moved internally to Buildings 9212 and 9204-2E. An enclosed transfer system between these major production facilities is envisioned.

The design of the storage building expansion would allow much more efficient utilization of storage space than can be achieved in existing storage buildings. This would be accomplished by layout of the building expansion in repetitive bays specifically sized for optimum storage using modular storage vaults for can storage and 1.2 by 1.2 m (4 by 4 ft) pallets for drum storage. Should future needs for storage increase beyond current projections, the new expansion storage facility could be expanded by adding additional bays. The expansion of Building 9215 for consolidated HEU storage would allow the potential use of existing storage facilities for other Y-12 mission activities or to be declared surplus.

Building 9215 Expansion Site Preparation

The expansion of Building 9215 for HEU storage would require approximately 0.8 ha (2 acres) to accommodate the construction activities and the building expansion footprint. The proposed site for the expansion is shown in Figure 3.2.3–6. Personnel in the existing trailers would be relocated and the trailers would be removed and salvaged. Other temporary facilities would be relocated and utilities and other infrastructure would be modified to support the construction activities and operation of the new expansion.

Construction waste from the storage building expansion would consist of excavated soils and general construction debris. Construction activities would be planned and performed to minimize the quantities of excavated soils needing disposal. Table 3.2.3–3 shows the construction resource requirements, number of construction workers, and estimated waste generation of constructing the Building 9215 expansion storage facility. The expansion of Building 9215 for consolidated storage of HEU would take approximately 4 years to implement.

Building 9215 Expansion Storage Operations

Operations within the proposed storage building expansion would be the same as described earlier under Site A for the proposed new HEU Materials Facility. Storage operations in the Building 9215 storage expansion would replace existing HEU storage operations as described in Section 3.2.2.1. Table 3.2.3–4 shows the annual operations requirements for the Building 9215 expansion storage facility.

Source: Tetra Tech, Inc/LMES 2000b.

FIGURE 3.2.3–6.—*Proposed Building 9215 Expansion Area.*

TABLE 3.2.3–3.—*Building 9215 Expansion Construction Requirements and Estimated Waste Volumes*

Requirements	Consumption
Materials/Resource	
Electrical energy (MWh)	5,000
Concrete m^3 (yd^3)	7,650 (10,005)
Steel (t)	1,100
Liquid fuel and lube oil L (gal)	265,000 (70,006)
Water L (gal)	5,678,000 (1,499,968)
Land	1 (2.5)
Employment	
Total employment (worker years)	145
Peak employment (workers)	220
Construction period (years)	4
Waste Category	**Volume**
Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Mixed Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Hazardous	
Liquid m^3 (gal)	1.1 (300)
Solid m^3 (yd^3)	15.3 (20)
Nonhazardous (Sanitary)	
Liquid m^3 (gal)	14,347 (3,970,000)
Solid m^3 (yd^3)	none
Nonhazardous (Other)	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)[a]	3,058 (4,000)

[a]Construction debris.
Source: LMES 2000b.

TABLE 3.2.3–4.—*Building 9215 Expansion Storage Facility Annual Operation Requirements and Estimated Waste Volumes*

Requirements	Consumption
Electrical energy (MWh)	10,900
Peak electrical demand (MWe)	1.4
Liquid fuel L (gal)	none
Natural gas m^3 (yd^3)	none
Water L (gal)	720,000 (190,204)
Plant footprint ha (acre)	0.5 (1.2)
Employment (Workers)	49[a] (100)
Waste Category	**Average Annual Volume**
Low-level	
Liquid m^3 (gal)	0.6 (160)
Solid m^3 (yd^3)	119 (156)
Mixed Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Hazardous	
Liquid m^3 (gal)	2.5 (660)
Solid m^3 (yd^3)	1.5 (2)
Nonhazardous (Sanitary)	
Liquid m^3 (gal)	1269.4 (335,350)
Solid m^3 (yd^3)	none
Nonhazardous (Other)	
Liquid m^3 (gal)	4.2 (1,100)
Solid m^3 (yd^3)	178.9 (234)

[a]Approximately 100 workers would be required during the 1-year transition period while the existing HEU materials in storage are transferred to the new HEU Materials Facility.
Source: LMES 2000b.

3.2.4 Alternative 3 (No Action - Planning Basis Operations Alternative Plus Special Materials Mission Alternative)

This alternative includes the No Action - Planning Basis Operations Alternative Plus a New Special Materials Complex at one of three candidate sites. The proposed action is to construct and operate a new Special Materials Complex which would enable Y-12 to ensure efficient production of adequate quantities of special materials for all anticipated scenarios considered for the enduring nuclear weapons stockpile while providing for improved worker health and safety. A key component of the proposed Special Materials Complex is the construction of a new Beryllium Facility to house all beryllium production operations at

Y-12. Facility design would incorporate strategies that replace the current administrative safety and health controls and personal protective equipment with engineered controls. A discussion of the alternatives and the candidate sites for the proposed new Special Materials Complex is provided in the following sections.

3.2.4.1 *Alternative 1B (No Action - Planning Basis Operations Alternative)*

Under the No Action - Planning Basis Operations Alternative, the new Special Materials Complex would not be constructed. The Y-12 Plant would continue to use the existing special materials operations facilities (Buildings 9204-2, 9202, 9201-5, 9201-5N, 9731, 9404-11, 9204-4, 9204-2E, 9805-1, 9720-46, and 9995) to perform the Special Materials Mission and meet DOE requirements. Appendix A.4 gives a detailed description of these buildings. The existing special materials operations facilities range in age from 27 to more than 50 years old, and the operations contained within them were not designed to meet today's health, safety, natural phenomena, environmental, and security requirements. These facilities therefore rely heavily on administrative controls to provide for the protection of workers, the public, and the environment from the hazards associated with beryllium and other special materials. In addition, some processes have not been operated in several years and would require extensive equipment upgrades and facility refurbishment. Even so, worker health and safety protection would still rely on administrative rather than engineered controls.

3.2.4.2 *Construct New Special Materials Complex*

This section includes a description of the proposed Special Materials Complex, its construction and operation, the candidate sites for the facility, and infrastructure requirements. The Special Materials Complex would replace special materials operations currently performed in Building 9731, 9202, 9204-4, 9201-5, 9201-5N, 9995, 9204-2E, 9404-11, 9805-1, and 9720-46 as described in Section 3.2.1.1 under the No Action - Planning Basis Operations Alternative for the DP Special Materials Operations Mission.

Special Materials Complex Description

The proposed Special Materials Complex shown in Figure 3.2.4–1 would house a number of separate processing operations and the support facilities to serve each. These operations would be housed in distinct areas to ensure that the safety basis of operation of each is independent of the other operation. Included in the Special Materials Complex would be:

- All beryllium production operations at Y-12
- A facility for purification of special material
- A manufacturing/warehouse facility to produce special materials and provide for storage of raw materials and parts
- An isostatic press for forming blanks for machining
- A core support structure to house common support functions for the Complex

The facilities would be attached to one another with weather-protected walkways to facilitate the flow of materials.

The preliminary schedule for the Special Materials Complex project indicates that site preparation could begin as early as FY 2002. Construction of the facilities would begin in FY 2003 and would be completed in FY 2005. Following test and checkout and Operational Readiness Review, the Special Materials Complex would be ready for operation in FY 2007.

Beryllium Facility Description

The Beryllium Facility would be a two-story building constructed from reinforced concrete. Portions of the roof and exterior walls would be designed to resist the wind and missiles generated from a tornado. The first floor slab, beams, and columns would also be reinforced concrete. The ground floor would be a concrete slab, and foundations for the concrete columns would be spread footings supported on a well-compacted subgrade. The area of the Beryllium Facility would be approximately 13,378 m^2 (144,000 ft^2). Ventilation zones would be used to contain contamination. The primary (regulated) zone would house the actual process operations, the buffer zone would be for all areas directly surrounding the primary zone, and nonregulated zones would surround the buffer zone. Each zone would have increasing negative air pressure, passing from the nonregulated zone inward to the primary zone.

A containment system would be established for the collection and HEPA filtration of ventilation exhaust air from primary enclosures and equipment containing hazardous materials before discharge to the main ventilation exhaust system. Centralized air emission control systems would ensure environmentally acceptable discharges of all ventilation and would include a central discharge stack and a system to permit collection of appropriate air samples.

The major function of the second floor would be to provide space for materials storage, non-toxic support facilities, and for the HVAC and electrical support needed by the equipment on the first floor. This would allow the support equipment to be placed in close proximity to the operations without actually placing it within the buffer area.

The Beryllium Facility would house all production operations that must be performed in a beryllium control area. The facility would use state-of-the-art engineered controls to eliminate the required use of respirators during normal operations and comply with the new ACGIH limit for suspended beryllium in air of 0.2 $\mu g/m^3$ (125×10^{-11} lb/ft^3). In addition to housing all the beryllium production operations at Y-12, the Beryllium Facility would house major support functions involving beryllium. The Beryllium Facility would house the following activities:

- Beryllium blank forming operations
- Beryllium machining
- Beryllium inspection and certification
- Materials and parts storage
- Beryllium analytical laboratory work
- Beryllium air monitoring laboratory analysis
- Laboratory analysis of smears to detect beryllium
- Spray operation for beryllium sprayed parts
- Inspection and certification of parts
- Tooling preparation
- Maintenance
- Prototype development
- Packaging of accepted parts

Because of the toxic nature of beryllium, appropriate measures would be incorporated in the building design to ensure isolation of workers from hazardous materials (e.g., the use of multiple occupancy zones to achieve containment; and the isolation of all people, equipment, and processes not required to be in direct contact with the toxic materials).

The Beryllium Facility would have two main production areas: (1) the blank forming and machining operations, and (2) the plasma spray operations. Equipment and supporting services would be provided to form beryllium powder into blanks. All blank forming operations would be enclosed in gloveboxes to protect workers from exposure to beryllium. Blank forming operations would include removing containers of powder from storage units, weighing and blending the powder, loading it into molds to be pressed, pressing, disassembling the molds, removing the formed blanks, cleaning and certifying blanks, and transferring them to machining.

The machining process would rough and finish grind the formed blanks to the required dimensions using speciality grinding machines. The machining operations would be enclosed in gloveboxes. The machined parts would be cleaned, inspected, and nondestructively tested. Parts that pass inspection and nondestructive testing would be certified. Beryllium part certification would include physical testing, dimensional metrology, and radiography. The certified parts would be packaged and transported to the beryllium shipping area.

All plasma spraying would be performed in inert atmosphere gloveboxes. Plasma spray operations would require a tooling preparation area, dimensional inspection area, and a radiographic inspection area to certify components. The tooling preparation area would include a demineralized water tank, a nickel plating tank, and an acid-cleaning tank. After acceptance, the completed parts would be cleaned and packaged for shipment.

The gloveboxes and any enclosed area within the secondary zone would be equipped with wash-down capability. Any water used for washing down these areas would be collected for filtration and sampling prior to their discharge to the Y-12 sanitary sewer system. The Beryllium Facility would also include a shower and change area for operations workers, and storage area for in-process and completed parts, equipment, and supplies.

A developmental laboratory area would be provided in the Beryllium Facility to support the development of process improvements and to troubleshoot existing beryllium mechanical and chemical processes. An analytical laboratory would also be included to support the Beryllium Worker Protection Program and the material production process.

Special Materials Manufacturing/Warehouse Facility Description

The Special Materials Manufacturing/Warehouse Facility would contain only standard industrial hazards. Although certain special materials production requires isolating workers from the process, it would not pose a risk that would exceed a standard industrial design approach.

The Special Materials Manufacturing/Warehouse Facility would be a rigid-framed, pre-engineered building and would occupy approximately 2,508 m^2 (27,000 ft^2). The roof structure over the production area would range from at least 7.3 to 9.75 m (24 to 32 ft). The exterior walls would be insulated with an interior liner panel. The roof would be sloped from one end to the other and be insulated. The foundation for the building columns would be spread footing supported by a well-compacted subgrade. A portion of the production processing area would be contained in a separate room constructed to maintain the required environmental control. This room would be masonry construction.

The Special Materials Manufacturing Facility would produce rough pressed parts that would be transferred to a separate building for machining and inspection. Gloveboxes would contain some special materials processing operations and would be supplied when required. Workers in the Special Materials Manufacturing Facility would use the Core Support Facility change houses.

The Facility would also have warehouse space to serve all the Special Materials Complex. The warehouse would house raw materials for special materials production and nontoxic materials that may be needed for the Beryllium Facility. Flammable solvents would not be stored in this warehouse.

Purification Facility Description

The Purification Facility would replace a production process to purify a special material that has deteriorated since the end of the Cold War. Currently, only a development-scale facility and capability for this special material exists at Y-12. This development facility will not meet the level of production projected to support the enduring stockpile.

The Purification Facility would be a single-story, high-bay building with a partial second-level mezzanine. The Purification Facility would be approximately 929 m² (10,000 ft²) in area. The purification process uses the flammable liquid acetonitrile (ACN). As a result, facility design would be required to meet appropriate safety requirements involved with handling ACN. It would have an adjoining tank farm to store the ACN ;that would have a concrete pad and roof but no exterior walls. The Purification Facility would be constructed from structural steel framing with metal roof deck and siding. The mezzanine would be steel plate supported on structural steel framing (beams and columns). The roof and wall panels would be backed with insulation and interior metal liner panels. One of the exterior walls would be constructed to relieve internal pressure. The foundation for the columns would be spread footings supported on a well-compacted subgrade. Sealed concrete curbing would contain any liquids spilled in the exterior tank farm.

Purification operations would include the following: (1) dissolution, filtration, and recrystallization (2) powder processing in a nitrogen atmosphere; and (3) drying. Because ACN would be present in substantial quantities, the purification operation would be designed with high-hazard electrical components and operations would be performed in a closed system consisting of tanks, process piping, gloveboxes, and suitable storage containers. An inert cover gas would be used in the system, in conjunction with an ACN vapor recovery system. Portions of both the main level and the mezzanine would be enclosed in a room that would contain gloveboxes and other equipment for handling the solvent ACN. All fixtures in these rooms would be explosion proof. An enclosed control room would have egress paths that do not transverse the rest of the purification operating area. The wall between the building and the covered, outdoor area would be designed to withstand an explosion in the tank farm. The main design consideration of this wall would be the protection of workers in the facility from an accidental detonation of solvent. An area for unloading and loading ACN drums would be included in the Purification Facility design.

Press Facility Description

The Press Facility would contain one 0.84-m (33-in)-diameter isostatic press that would be used in the blank forming operations for special materials. The press could also be used by future lithium operations. Because of the large amount of stored mechanical energy in the press vessel during operation, the facility would have a wall capable of absorbing any inadvertent release of energy, directing it toward a metal panel wall away from the remainder of the Special Material Complex.

The isostatic press area would house the pressure vessel, the low-pressure mineral oil supply system, the high-pressure mineral oil supply system, a heated mineral oil supply system, press control console, material handling equipment, and parts staging area, and would provide a barricade to protect operating personnel in the event of a failure of the pressure vessel. The current design of the operating and support areas of the Press Facility divides it into three vertical levels. The Press Facility would occupy approximately 836 m² (9,000 ft²) and would be constructed of structural steel and reinforced concrete. The foundation for the structural columns would have spread footings supported on a well-compacted subgrade.

Core Support Facility Description

A Core Support Facility, approximately 1,728 m² (18,600 ft²) in total area, would support the beryllium, purification, and special materials processes to be located in the Special Materials Complex.

The Core Support Facility would be a 7.3-m (24-ft) two-story building of typical industrial construction, with masonry walls and a steel structural frame. Some of the interior partitions in the administration area would be gypsum board on metal studs. The facility is intended to house as many services for the production facilities of the Special Materials Complex as possible, including a common administration area, support and engineering offices, a lunchroom, a maintenance shop, and a central loading dock and some utilities. It would also include change houses to serve all Special Materials Complex workers, except for the beryllium workers who would have a separate change house in the Beryllium Facility.

On-Site Facilities Description

Several additional on-site facilities would also be part of the Special Materials Complex, such as a chiller building, standby diesel generator building, fire protection pump house, and ozonation building. All of these would be unoccupied, remote, stand-alone buildings.

Special Materials Complex Construction

The current Special Materials Complex design calls for a number of separate operations and support facilities with varying design features (see Figure 3.2.4–1). The new Beryllium Facility would be a two-story building constructed from reinforced concrete. The roof and exterior walls would be reinforced concrete and portions would be designed to resist the wind and missiles generated from a tornado. The first floor slab, beams, and columns would also be reinforced concrete. The ground floor would be a concrete slab, and foundations for the concrete columns would be spread footings supported on a well-compacted subgrade.

The Special Materials Manufacturing/Warehouse Facility would be a rigid-framed, pre-engineered building. The foundation for the new facility would be spread footing supported by a well-compacted subgrade.

The Purification Facility would be a single-story, high-bay building constructed from structural steel framing with metal roof deck and siding. One of the exterior walls would be constructed to relieve internal pressure. The foundation for the structure columns would be spread footings supported on a well-compacted subgrade. The Purification Facility would have an adjoining tank farm that would have a concrete pad and roof but no exterior walls.

The Isostatic Press Facility would be a three-level building constructed from structural steel and reinforced concrete. The foundation for the structural columns would be spread footings supported on a well-compacted subgrade.

Source: LMES 2000c.

FIGURE 3.2.4–1.—*Artist's Rendering of Proposed Special Materials Complex.*

Conventional construction techniques would be used to build the Special Materials Complex. Construction activities would be performed in a manner that assures protection of the environment during the construction phase. Construction techniques would be used to minimize the generation of construction debris that would require disposal. Disposal of construction debris would be made in accordance with waste management requirements in properly permitted disposal facilities. The extent and exact nature of such activities as site clearing, infrastructure improvements, and support facility construction required would depend on the candidate site considered for the Special Materials Complex. Throughout the construction process storm-water management techniques, such as silt fences and runoff diversion ditches, would be used to prevent erosion and potential water pollutants from being washed from the construction site during rainfall events.

As conceptually designed, about 4 to 8 ha (10 to 20 acres) of land would be required for the Special Materials Complex. Additional land area may be required to accommodate parking, access roads, and support structures (e.g., security infrastructure requirements). The actual amount of land required depends on the selected site. During construction, about 0.8 ha (2 acres) of land would be required for a construction lay-down area. The lay-down area would be located within or near the location designated for the facility.

Following construction, the lay-down area would be restored to its pre-construction condition or incorporated into the landscape or infrastructure support design of the site.

Special Materials Complex Operation

The following discussion outlines the different operations in the proposed new Special Materials Complex. The new operations would replace existing Special Materials Operations Mission activities described in Section 3.2.2.1. Appropriate procedures to implement specific operations would be developed after the final design of each facility within the Special Materials Complex is approved.

Beryllium Operations. The Beryllium Facility would have two main production areas: (1) the blank forming and machining operations, and (2) the plasma spray operations. Equipment and supporting services would be provided to form beryllium blanks. All blank forming operations would be enclosed in gloveboxes to protect workers from exposure to beryllium. Blank forming operations would include removing containers of powder from storage units, weighing and blending the powder, loading it into molds to be pressed, pressing, disassembling the molds, removing the formed blanks, cleaning and certifying blanks, and transferring them to machining.

The machining process would rough and finish grind the formed blanks to the required dimensions using speciality grinding machines. The machined parts would be cleaned, inspected, and nondestructively tested. Parts that pass inspection and nondestructive testing would be certified. Beryllium part certification would include physical testing, dimensional metrology, and radiography. The certified parts would be packaged and transported to the beryllium shipping area.

All plasma spraying would be performed in inert atmosphere gloveboxes. Plasma spray operations would require a tooling preparation area, dimensional inspection area, and a radiographic inspection area to certify components. The tooling preparation area would include a demineralized water tank, a nickel plating tank, and an acid-cleaning tank. After acceptance, the completed parts would be cleaned and packaged for shipment.

Special Materials Manufacturing Operations. The manufacturing process produces pressed plastic parts. The blank-forming production process includes hot forming plastic materials into rough forms through a two-step pressing operation. The finished blanks are then x-rayed and visually inspected. Additional equipment used to produce O-rings includes a rolling mill, an oven with vacuum pipes, an extruder, a cutting table, and an O-ring press.

Purification Operations. Purification operations include the following: (1) dissolution, filtration, and recrystallization; (2) powder processing in a nitrogen atmosphere; and (3) drying. Because ACN would be present in substantial quantities, the purification operation would be designated a high-hazard facility for design of electrical components, and operations would be performed in a closed system consisting of tanks, process piping, gloveboxes, and suitable storage containers. An inert cover gas would be used in the system, in conjunction with an ACN vapor recovery system.

Isostatic Press Operations. Parts to be pressed are received in the staging area and placed in thick, flexible PVC containers referred to as bladders. The bladders are attached to a handling fixture that permits multiple bladders to be loaded into the press. The load is then lowered into the pressure vessel and the press closed. The air inside the vessel is displaced with mineral oil under low pressure and then the vessel is subjected to high pressure. When the pressure cycle is completed, the bladders are removed using the handling fixture. The pressed blanks are then removed from the bladders, packaged, and returned to the appropriate Special Materials Complex processing area.

Special Materials Complex Candidate Sites

Site 1

Site 1 for the proposed Special Materials Complex is approximately 16 ha (20 acres) and is located northwest of Building 9114 and on the north side of Bear Creek Road. The site is situated on the drainage divide of EFPC and Bear Creek Watersheds. Approximately 50 percent of the site is currently cleared at the base of Pine Ridge and the other 50 percent is wooded on the slope of the ridge. The site area has been used for a construction lay-down area in the past. Potential construction problems associated with legacy contamination from prior operations support activities are not expected.

This site is outside the existing Y-12 Plant PIDAS. Figure 3.2.4–2 shows the location for Site 1 relative to other buildings at Y-12. Site 1 represents a large site with no permanent building structures and minimal infrastructure. The topography of the site would require a moderate amount of earthwork to prepare the site for construction.

Site 1 preparation for the proposed new Special Materials Complex involves site design, relocation of some existing utilities (e.g., underground pipelines, communications lines, and power lines), and extension of utilities to the new facilities.

Construction and Operation

Construction

Relocation of Utilities and Other Features. The Site 1 area would be cleared of vegetation and electrical utilities that would interfere with construction of the Special Materials Complex. The 161-kV power line that traverses the site would be rerouted around the construction area along with underground telephone lines. An existing sanitary sewer line would be replaced and upgraded to accommodate the proposed new Special Materials Complex facilities.

Source: Tetra Tech, Inc./LMES 2000c.

FIGURE 3.2.4–2.—*Sites 1, 2, and 3 for the Proposed Special Materials Complex.*

The Special Materials Complex storm sewer system would include a comprehensive collection system that would tie into the existing Y-12 Plant sewer system. Storm sewer pipe would be reinforced concrete and would be designed to collect a 100-year storm event. Pipe sizes, number of catch basins, locations, etc., would be a consideration of the design of the storm sewer system along Bear Creek Road.

Traffic Planning, Parking, and Construction Lay-Down Areas. The construction of the Special Materials Complex at Site 1 would not require the rerouting of Bear Creek Road. Sufficient parking space is available at the S-3 and Building 9114 Parking Lots to accommodate construction workers and operations workers when the project is completed. The construction staging area for the Special Materials Complex is shown in Figure 3.2.4–3. The 0.8-ha (2-acre) lay-down area would be sufficiently graded and developed to accommodate a number of temporary construction trailers, small storage buildings, and materials storage yards. The staging area would have electric power and potable water. Sanitary service would be provided by PVC double-wall collection tanks, which would be pumped out as needed.

Utility Extensions. The potable water lines, electrical service, security systems, and telephone systems would be extended from the existing Y-12 Plant to Site 1. When completed, the new Special Materials Complex would have no overhead utilities.

Remediate Construction Lay-Down Area. Once construction of the Special Materials Complex is complete, the construction office trailers would be removed and the material staging areas would be re-graded and incorporated into the landscape design of the Special Materials Complex. Although not anticipated, soils contaminated by construction-related materials such as diesel fuel would be removed and disposed in accordance with Y-12 waste management plans.

Site Preparation and Facility Construction. Table 3.2.4–1 lists the construction resource requirements, number of construction workers, and estimated waste generation to construct the proposed Special Materials Complex at Site 1. Site preparation would follow the advanced work and would include any excavation, filling, and grading needed to meet design requirements for on-grade, reinforced concrete and pre-engineered structures. Historical research of the site indicated that two areas within the site have received non-engineered fill and some unknown amount of construction debris from a past project within the Y-12 Plant. The non-engineered fill/construction debris areas are not expected to be contaminated. Detailed testing would be conducted to fully characterize site geology, hydrology, and soil compaction, as well as sample for potential contamination before construction.

On Site 1, the Special Materials Complex major facilities would consist of a Beryllium Facility, a Manufacturing/Warehouse Facility, a Purification Facility, an Isostatic Press Facility, and a Core Support Facility. A detailed description of these facilities was presented earlier. A brief summary of the structural aspects of the facility is provided here.

The Beryllium Facility would be a two-story building constructed from reinforced concrete. The roof, exterior walls, first floor slab, beams, and columns would be reinforced concrete. The ground floor of the building would be a concrete slab, and foundation for the concrete columns would be spread footings supported on well-compacted subgrade. The Manufacturing/Warehouse Facility would be a rigid-framed, pre-engineered building. The roof structure over the manufacturing area would range from 7.3 to 9.75 m (24 to 32 ft). The foundation of the building columns would be spread footing supported by a well-compacted subgrade.

Source: Tetra Tech, Inc./LMES 2000c.

FIGURE 3.2.4–3.—*Special Materials Complex Construction Lay-Down Areas.*

TABLE 3.2.4–1.—*Special Materials Complex Construction Requirements and Estimated Waste Volumes for Site 1*

Requirements	Consumption
Materials/Resource	
Electrical energy (MWh)	8,000
Concrete m^3(yd^3)	13,800 (18,050)
Steel (t)	3,000
Liquid fuel and lube oil L (gal)	984,200 (259,998)
Industrial gases m^3 (yd^3)	5,700 (7,455)
Water L (gal)	5,700,000 (150,578)
Land ha (acre)	8 (19.8)
Employment	
Total employment (worker years)	125
Peak employment (workers)	210
Construction Period (years)	3.5
Waste Category	**Volume**
Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Mixed Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Hazardous	
Liquid m^3 (gal)	11.4 (3,000)
Solid m^3 (yd^3)	107 (140)
Nonhazardous (Sanitary)	
Liquid m^3 (gal)	1448 (382,400)
Solid m^3 (yd^3)	none
Nonhazardous	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	917.4 (1200)

Source: LMES 2000c.

TABLE 3.2.4–2.—*Special Materials Complex Annual Operation Requirements and Estimated Waste Volumes for Sites 1, 2, and 3*

Requirements	Consumption
Electrical energy (MWh)	30,400
Peak electrical demand (MWe)	5.5
Steam kg (lb)	28,600,000 (63,000,000)
Demineralized water L (gal)	2,000,000 (520,000)
Industrial Gas	
Liquid nitrogen L (gal)	4,550 (1,202)
Mixed gas m^3 (scf)	374 (13,200)
Helium m^3 (scf)	14,725 (520,000)
Oxygen m^3 (scf)	396 (14,000)
Nitrogen gas m^3 (scf)	1,500,800 (53,000,000)
Natural gas (m^3)	none
Water L (gal)	8.3×10^7 (2.2×10^7)
Plant footprint ha (acre)	4 (9.9)
Employment (workers)	36
Waste Category	**Average Annual Volume**
Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	0.8 (1)
Mixed Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Hazardous	
Liquid m^3 (gal)	12.5 (3,302)
Solid m^3 (yd^3)	9.2 (12)
Nonhazardous (Sanitary)	
Liquid m^3 (gal)	932.7 (246,400)
Solid m^3 (yd^3)	none
Nonhazardous (other)	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	175.1 (229)

Source: LMES 2000c.

The Purification Facility would be a single-story, high bay building with a partial second-level mezzanine. The building would be constructed from structural steel framing with metal roof deck and siding. The mezzanine would be steel plate supported on structural steel framing (beams and columns). The foundation for the columns would be spread footings supported on a well-compacted subgrade. An adjoining tank farm to the facility would have a concrete pad and roof but no exterior walls. Concrete curbing would be constructed around the tank farm to contain any liquids.

The Isostatic Press Facility would be a three-level structure constructed from structural steel framing and concrete. The foundation for the building columns would be spread footings supported on a well-compacted subgrade.

The Core Support Facility would be a two-story building of typical industrial construction with masonry walls and a steel structural frame. The ground floor would be a concrete slab, and foundation for the building columns would be spread footings supported on a well-compacted subgrade.

All of the Special Materials Complex facilities would be designed to meet the requirements of the Standard Building Code. In addition, the design for the natural phenomena hazards (earthquake, tornadic winds, floods, and lightning) would be in accordance with DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*.

Operation

The Special Materials Complex operations would be the same as described earlier in this section. Table 3.2.4–2 lists the operation resource requirements, number of operation workers, and estimated waste generation for the proposed new Special Materials Complex.

Site 2

Site 2 for the proposed Special Materials Complex is approximately 4 ha (10 acres) and is located at the Y-12 Scrap Metal Yard southeast of Building 9114 and east of the westernmost portion of the Y-12 PIDAS fence. Figure 3.2.4–2 shows the location of Site 2 relative to other buildings at Y-12.

Site 2 preparation would include site design, relocation of existing utilities (e.g., lights, underground water lines, storm sewers, steam lines, etc.), two structures, and a portion of the Y-12 Scrap Metal Yard. The existing Y-12 Plant PIDAS would not be affected since Site 2 is entirely within the PIDAS. However, a security fence would be erected to isolate the work site during construction.

Construction and Operation

Construction

Relocation of Utilities and Other Features. An abandoned above-ground acid pipeline that traverses Site 2 would be demolished. Numerous overhead electrical lines within the proposed site would have to be removed, and communications and computer lines would have to be rerouted. Portions of a sanitary sewer main that serve the west end of Y-12 would be rerouted. Sanitary sewer services would be provided for the new facilities by connecting to an existing sanitary sewer main in the area. Potable water and firewater service already exist at the site and would be connected to the new facilities. The storm sewer system at Site 2 would include a comprehensive collection system that would tie into the existing Y-12 storm sewer system. Off-site water, which would be from the north of the proposed site, would be rerouted around the new Special Materials Complex. Storm sewer pipe would be reinforced concrete pipe and would be designed for a 100-year storm event.

Electrical service, chilled water lines, security service lines, and computer services would tie into the existing services in the proposed Site 2 area.

Traffic Planning, Parking, and Construction Lay-Down Areas. Bear Creek Road alignment would not be affected by construction of the Special Materials Complex at Site 2. Additional parking areas would not be needed to meet the needs of the operations personnel associated with the new Special Materials Complex. Sufficient parking is available at the S-3 Ponds Parking Lot. However, temporary parking spaces for construction workers would need to be developed in the west tank area and just south of old Post 17 during construction of the new facility at Site 2 (see Figure 3.2.4–3). The temporary parking area would require approximately 0.8-ha (2-acres). The temporary parking would be needed because the S-3 Ponds Parking Lot would be used as a construction lay-down area for the new facility. The construction staging area would have electrical power and potable water. Sanitary sewer services would be provided by PVC double-wall collection tanks, which would be pumped out as needed.

Remediate Construction Lay-Down Area. Once the construction of the Special Materials Complex is complete, the construction office trailers and material lay-down areas would undergo remediation. The potable water lines and the electrical services would be removed. Any construction office trailers would be removed. The parking lot would then be paved with a 4-cm (1.5-in)-thick asphalt concrete surface. The parking lot spaces would then be relined for employee parking.

Site 2 Environmental Remediation. A portion of the existing Y-12 Scrap Metal Yard would have to be cleared of materials and environmentally stabilized before construction of the new Special Materials Complex could be started. Approximately 15,290 m^3 (20,000 yd^3) of scrap and an estimated 46,867 m^3 (61,300 yd^3) of contaminated soil (VOCs, metals, and radionuclides) would be removed from the site. Current planning is to dispose of this material in the new Environmental Management Waste Management Facility being constructed in the West Bear Creek Valley area of Y-12.

Site Preparation and Facility Construction. Table 3.2.4–3 lists the construction resource requirements, number of construction workers, and estimated waste generation to construct the proposed Special Materials Complex at Site 2. Site preparation would follow the advanced work described above and would include any excavation, filling, and grading needed to meet design requirements for on-grade, reinforced concrete and pre-engineered structures. As discussed above, Site 2 would have to be environmentally stabilized prior to facility construction. Detailed testing would be conducted to fully characterize site geology, hydrology, and soil compaction, as well as sample for legacy contamination before construction. The description of facility construction discussed previously in this section under Site 1 would be the same for Site 2.

Operation

The Special Materials Complex operations at Site 2 would be the same as described earlier in this section.

Site 3

Site 3 for the Special Materials Complex (see Figure 3.2.4–2) is the same site as Site B for the proposed HEU Materials Facility (see Figure 3.2.3–4) described in Section 3.2.3.2. (Note: Site A for the HEU Materials Facility was not considered for the Special Materials Complex based on siting evaluation criteria which considered the need to modify the PIDAS. This criteria, among others, ranked Site A for the HEU Materials Facility above the Special Materials Complex.) The discussion of construction activities associated with the HEU Materials Facility in Section 3.2.3.2 would also apply to the construction of the proposed Special Materials Complex at Site 3. Table 3.2.4–4 lists the construction resource requirements, number of construction workers, and estimated waste generation of constructing the Special Materials Complex at Site 3.

Operation

The Special Materials Complex operations at Site 3 would be the same as described earlier in this section.

3.2.5 *Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex)*

This alternative includes the No Action - Planning Basis Operations Alternative Plus construction and operation of a new HEU Materials Facility at one of two proposed sites (Alternative 2A) and construction and operation of a New Special Materials Complex at one of three proposed sites (Alternative 3).

TABLE 3.2.4–3.—*Special Materials Complex Construction Requirements and Estimated Waste Volumes for Site 2*

Requirements	Consumption
Materials/Resource	
Electrical energy (MWh)	8,000
Concrete m^3 (yd^3)	14,500 (18,965)
Steel (t)	3,200
Liquid fuel and lube oil L (gal)	1,583,000 (418,000)
Industrial gases m^3 (yd^3)	5,700 (7,455)
Water L (gal)	5,700,000 (1,505,781)
Land ha (acre)	5 (12.3)
Employment	
Total employment (worker years)	137
Peak employment (workers)	210
Construction period (years)	3.5
Waste Category	**Volume**
Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	none
Mixed Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	46,867[a] (61,300)
Hazardous	
Liquid m^3 (gal)	11.4 (3,000)
Solid m^3 (yd^3)	107 (140)
Nonhazardous (Sanitary)	
Liquid m^3 (gal)	1,448 (382,400)
Solid m^3 (yd^3)	none
Nonhazardous (other)	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	3,420 (4,470)

[a] Excavated contaminated soil to a depth of 3 ft.
Source: LMES 2000c.

TABLE 3.2.4–4.—*Special Materials Complex Construction Requirements and Estimated Waste Volumes for Site 3*

Requirements	**Consumption**
Materials/Resource	
Electrical energy (MWh)	8,000
Concrete m^3 (yd^3)	14,500 (18,965)
Steel (t)	3,200
Liquid fuel and lube oil L (gal)	1,582,300 (418,000)
Industrial gases m^3 (yd^3)	5,700 (7,455)
Water L (gal)	5,700,000 (1,505,781)
Land ha (acre)	5 (12.3)
Employment	
Total employment (worker years)	137
Peak employment (workers)	210
Construction period (years)	3.5
Waste Category	**Volume**
Low-level	
Liquid m^3 (gal)	none
Solid m^3(yd^3)	none
Mixed Low-level	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	22,707[a] (29,700)
Hazardous	
Liquid m^3 (gal)	11.4 (3,000)
Solid m^3 (yd^3)	107 (140)
Nonhazardous (Sanitary)	
Liquid m^3 (gal)	1,448 (382,400)
Solid m^3 (yd^3)	none
Nonhazardous (other)	
Liquid m^3 (gal)	none
Solid m^3 (yd^3)	3,440 (4,500)

[a]Excavated contaminated soil to a depth of 3 ft.
Source: LMES 2000c.

3.3 POTENTIAL FUTURE Y-12 SITE INTEGRATED MODERNIZATION PROJECTS

This section addresses the potential future new facilities of the Y-SIM program and presents the concepts for modernized facilities as they currently stand. Some of the potential new facilities are much further along in design development than others; a few represent only scoping studies at this point. The scope and development strategy for Y-SIM is still evolving; but this discussion is intended to provide the most current information on program activities.

The potential new facilities associated with the Y-SIM are summarized in Table 3.3–1. The potential new facilities in Table 3.3-1 are listed according to the current planning priority based on factors such as age and condition of the existing facilities and operations, projected workload requirements, ES&H issues, and funding requirements. None of the potential future modernization projects listed in Table 3.3-1 are included in The No Action - Planning Basis Operations Alternative or the action alternatives for the Y-12 HEU Storage Mission or Special Materials Mission. Also listed in Table 3.3–1 are the existing facilities that are currently used to perform the functions addressed by potential new facilities.

Siting

Initial space requirements for the manufacturing facilities proposed to constitute a modernized Y-12 were estimated to comprise approximately 139,355 m² (1.5 million ft²) of new space. It was estimated that a minimum of about 26 ha (65 acres) of land would be required to accommodate the new facilities. However, the terrain and other site constraints of much of the ORR in general and the Y-12 Plant site in particular are less than ideal. Therefore, it was further estimated that a minimum 53 ha (130 acres) could possibly be needed if Y-SIM projects were completely constructed.

Four major areas at the Y-12 Plant were initially identified by site planners as possible candidate site areas for modernization projects. Additionally, a greenfield option was considered. The site areas were labeled A - E. Sites A - D are shown in Figure 3.3–1 and described in the information that follows. As shown in Figure 3.3–1, there is some overlap in boundaries for the candidate site areas.

Site A is a 27-ha (67-acre) site area located primarily outside Y-12's PIDAS security area and encompasses uncontaminated parking lots containing approximately 2,100 parking spaces. Site A includes a site area (see Figure 3.2.2–2) for the proposed HEU Materials Facility. This site area possibly represents the most physically unconstrained of the available candidate sites.

TABLE 3.3–1.—*Summary of Potential Future Y-SIM Facilities* [Page 1 of 2]

New Y-SIM Facilities	Scope	Existing Facilities Currently Used to Perform Function
Enriched Uranium Manufacturing Facility	Contains metal processing, chemical recovery operations, and support functions required for the production of enriched uranium components. Specialized metallurgical and chemical operations include casting, rolling, forming, machining, chemical recovery, and conversion of salvage and scrap to uranium compounds and metal. Support functions including storage, maintenance and decontamination, laboratory analysis, product certification, inspection, and process development are also incorporated into the facility.	9212, 9215, 9980, 9981, 9204-2E, 9998, 9995, 9818, 9815, 9812, 9723-25, 9999
Assembly/Disassembly/ Quality Evaluation Facility	Contains the assembly, disassembly, and quality evaluation functions for the stockpile management program.	9204-2E, 9204-2, 9204-4
Depleted Uranium Operations Facility	Depleted uranium operations will be performed in a combination of new and upgraded facilities. The new facility will contain the metallurgical operations and support functions required for the production of depleted uranium components. Specialized metallurgical operations will include casting, rolling, and forming of cast and wrought depleted uranium and wrought uranium-niobium alloys. Existing machine shops in Buildings 9201-5W and 9201-5N will be upgraded to provide machining capability.	9215, 9204-4, 9998, 9201-5, 9201-5N, 9201-5W
Lithium Operations Complex	Would contain the chemical processes, fabrication operations, and support functions associated with the production of LiH and LiD components. Specialized operations include LiCl power production, Li metal production, salt production, forming, machining, inspection, and chemical recovery of lithium compounds from retired and rejected components. Ancillary facilities include deuterium production and tank farms for holding process chemicals.	9204-2, 9805-1, 9404-9, 9720
Administrative/ Technical Facilities	These facilities would provide space for LMES and DOE infrastructure and support functions including administrative and technical offices, records storage, cafeteria, medical, photography, reproduction, and other functions.	9710-2, 9706-2, 9739, 9734, 9733-1, -2, -3, 9704-2, 9766

TABLE 3.3–1.—*Summary of Potential Future Y-SIM Facilities* [Page 2 of 2]

New Y-SIM Facilities	Scope	Existing Facilities Currently Used to Perform Function
Development/Product Certification/Analytical Chemistry	If Assembly/Disassembly facilities are relocated from Building 9204-2E, consideration is being given to reuse of this facility to house the R&D function as well as centralized facilities needed for Product Certification and Analytical Chemistry laboratories.	9202, 9203, 9731, 9102-2, 9203A, 9205, 9625, 9720-34, 9824-4, 9723-24, 9995
Production Support Facility	Would provide general manufacturing support including can manufacturing, graphite machining, and other general fabrication support.	9201-1, 9215
Non-SNM Strategic Materials Storage Facility	Approximately 27,871 m² (300,000 ft²) in Building 9204-4 would be renovated and equipped for storage of non-SNM materials and other strategic assets.	9720-33, Drum Yard, 81-22, 9204-2, 9204-4, 9998, 9201-5, 9720-46, 9720-38, 9720-14, 9720-1, 9720-18, 9720-26, 98
Other facilities (To be determined)	A number of other facilities are also under evaluation including maintenance facilities, fire hall, emergency management, Plant shift Superintendent and others. Evaluations will continue in FY 2001.	Specific facilities have not yet been determined

Note: Li - lithium, LiCl - lithium chloride; LiD - lithium deuteride; LiH - lithium hydride.
Source: LMES 1999c.

Site B is a 32-ha (79-acre) site area located in Y-12's extreme western end. Current uses of the site area include construction services, non-SNM storage, and a scrap yard for contaminated metal. Use of this site would require demolition of approximately 13,935 m² (150,000 ft²) of existing low-value floor space and the provision of replacement space for functions displaced. Remediation of the contaminated metal scrap yard would be required. Site B includes a potential site area for the proposed HEU Materials Facility or the Special Materials Complex (see Figure 3.2.2–4 and 3.2.3–2). The scrap yard is currently scheduled to be cleaned to industrial standards by the end of FY 2005 by the EM program, assuming funding is in place. Site C is 26 ha (65 acres) in area and is wholly contained in the Y-12 Plant PIDAS security perimeter. This area contains three major Y-12 production buildings currently planned for D&D within the next 5-10 years. Building 9201-4, approximately 52,210 m² (562,000 ft²) and currently owned by the EM Program, is planned for demolition. This building is heavily contaminated with mercury. Buildings 9201-5 and 9204-4, 49,240 m² (530,000 ft²) and 28,520 m² (307,000 ft²), respectively, are still owned by DP but are planned for D&D within the next 10 years. Use of the Site C area would necessitate either demolition of or upgrades to these structures, all of which are nearly 50 years old.

The Site D area is approximately 28 ha (69 acres) and lies outside the PIDAS area in the Property Protection Area of Y-12. Much of the space in the Site D area is 1940s era construction and primarily houses Y-12's administrative and support functions. Examples of functions within the Site D area include DOE and LMES Plant Management, Engineering, the main Y-12 Cafeteria, Protective Services Organization, and Medical Services. Most of the site area is uncontaminated.

Source: Tetra Tech, Inc./LMES 2000c.

FIGURE 3.3–1.—*Potential Candidate Siting Areas for New Modernization Facilities at the Y-12 Plant.*

Site E is a generic greenfield site area located in concept on Y-12's Area of Responsibility. A greenfield site represents the ideal choice for maximizing the efficient layout of manufacturing facilities; however, extended construction schedules, the need to provide new infrastructure, and the prospect of possible future contamination of an existing "green" site are major constraints on this candidate site area.

Site screening and evaluation would be performed for each potential future modernization project, and alternative sites analyzed under appropriate NEPA reviews when proposals to construct these facilities are submitted.

Potential New Facilities

Enriched Uranium Manufacturing Facility. The current building concept for the Enriched Uranium Manufacturing Facility is a linear arrangement of process compartments served by a central transport corridor and a secure vault. The process compartments would house modern equipment to perform HEU metallurgical and chemical recovery processing. The facility would also house supporting and administrative functions including maintenance, decontamination, product certification, inspection, analytical services, security posts, shipping and receiving, and offices.

Enriched Uranium Manufacturing Facility Description

The core of the Enriched Uranium Manufacturing Facility would be the specialized chemical and metallurgical operations for enriched uranium processing. The full range of operations would include metal casting, rolling and forming, machining, chemical recovery, and conversion of salvage and scrap to uranium compounds and metals. Specific metal processing operations may be conducted in an inert atmosphere. Separate chemical processing streams would process high-enrichment, mixed-enrichment, and special materials. Inspections and certification activities would take place at appropriate times throughout the product stream.

The Enriched Uranium Manufacturing Facility processing compartments would include the following:

- *Casting Compartment.* Casting operations include breaking and shearing, batch makeup, weighing, billet and parts casting, billet cooling, mold knockout, sample drilling and preparation, and enrichment verification. Also included are crushing broken mold pieces, chip cleaning, drying and briquetting, solvent recovery, and appropriate in-process storage in a vault. Metal operations may be conducted in an argon (inert) environment inside gloveboxes and full enclosures with gloved or remote operation. The area would be served by a special dry vacuum system and possibly by an argon recovery system.

- *Metal Working Compartment.* Metal working includes billet salt-bath preheating, rolling, salt bath annealing, cleaning, leveling, shearing, blanking, oven preheating, forming, debrimming, pickling, and vacuum annealing. Metal operations may be conducted in an argon environment inside gloveboxes and full enclosures with gloved or remote operations. The area would be served by a special dry vacuum system and possibly by an argon recovery system.

- *Machining Compartment.* Machining operations include cast and formed part cropping; casting delugging, inner and outer contour, semi and finish machining, turn lugging, milling, parting, grinding, sawing, cutting, swaging, shearing, and annealing. Machine operations require special machine coolant and vacuum systems and may be conducted in an argon environment inside gloveboxes and full enclosures with gloved or remote operations. A dedicated chuck vacuum system also would be installed in the facility. Each machine tool that requires coolant would be supplied with a stand-alone coolant system.

- *Chemical Recovery (High-Enrichment) Compartments.* Relatively concentrated (high-equity) HEU scrap and salvage comprises the feed for high-enrichment chemical recovery. Chemical operations include chip burning, screening, dissolving, separation and filtration, evaporation, extraction, denitration, hydrogen reduction, and direct oxidation reduction (see Figure 3.2.1–4). Also included are selective effluent treatment processes and special vacuum services. Processes requiring hands-on highly enriched uranium operations would be contained in gloveboxes and full enclosures with gloved or remote operations. The new facility processes which will use anhydrous hydrogen flouride (AHF) to convert uranium dioxide to uranium tetrafluoride would be state-of-the-art and designed for minimum hands-on operation. Engineered control measures and design features would minimize chemical emissions, worker exposure, and accidental releases.

- *Chemical Recovery (Mixed-Enriched and Special Processing) Compartments.* Low-concentration (low-equity) highly enriched uranium salvage from all sources, in liquid and solid form (both combustible and noncombustible), would be processed in the mixed-enrichment chemical recovery compartments. Processing is continued until discard limit concentrations are reached. In addition, a small-scale production capability of specialty oxide materials (referred to as special processing) would be provided. Chemical Recovery operations include crushing and grinding, multipurpose furnacing, leaching, sorting, shredding, thermal recovery, residue mixing and thermal treatment, multipurpose dissolution and separation, high-capacity evaporation, feed adjustment, extraction, evaporation, precipitation, and calcination. Also included would be selective effluent treatment processes and special vacuum services. Processes requiring hands-on HEU operations would be contained in gloveboxes and full enclosures with gloved or remote operations.

The processing compartments would be designed as secondary containment for the processes. Totally enclosed processes would allow operations personnel to fulfill their duties without the need for personal protective equipment, including donning and doffing of protective clothing. The design intent would be to require the use of personal protective equipment only during equipment maintenance activities. The processing compartments and other areas within the Material Access Area where SNM is processed would be designed to function as vault-type rooms for secure storage of SNM while it is being processed.

The vault storage area for solid Categories I and II SNM materials in the Enriched Uranium Manufacturing Facility would use an automated material retrieval and storage system. The vault would be designed to store special containers that fit the new storage racks and interface with process compartments and long-term storage in the HEU Materials Facility. Categories III and IV materials would be stored in a vault-type area separate from the vault just described. (See the Glossary for a definition of Categories I, II, III, and IV materials.)

The Enriched Uranium Manufacturing Facility is expected to be a multi-story, reinforced concrete building with average overall dimensions of approximately 221 x 7,632 x 15 m (725 x 250 x 50 ft) high. The main building is expected to be a sheer-wall-type structure with reinforced concrete exterior walls, floor slabs, and roof. Exterior walls are expected to be a minimum 0.2-m (8-in)-thick reinforced concrete to protect the interior from tornado- and wind-borne missiles. The first- and second-floor slabs would be approximately 0.3-m (12-in)-thick and the building base slab 0.46-m (18-in)-thick reinforced concrete. The roof would be a minimum 0.15-m (6-in)-thick reinforced concrete.

The Enriched Uranium Manufacturing Facility primary structure would be designed for seismic-induced earthquake ground motions associated with a PC-3 (2000-year return period) earthquake and the loads from a PC-3 wind/tornado (50,000-year return period) plus design-basis tornado missiles defined in DOE-STD-1020-94. The facility would be designed to provide protection from stream flooding, local flooding (runoff), and roof ponding associated with a PC-3 level flood (10,000-year return period).

Liquid effluent recycle and treatment systems would recover and recycle high-use chemicals from process liquid effluents and treat all other liquid effluents to meet standards for acceptance by the Y-12 Plant central treatment facilities or for direct discharge to surface waters. The recovery for recycle systems include a nitric acid still for concentrating dilute acid from evaporator condensate and crystallizers for concentrating aluminum nitrate from process effluents.

Treatment systems include neutralizers for caustic solutions from process off-gas scrubbers. Some of these processes may be located outside the Enriched Uranium Manufacturing Facility security boundary. The chemical processing of uranium and its direct support processes consumes substantial amounts of nitric acid, and smaller amounts of other materials such as aluminum nitrate, sodium hydroxide, sulfuric acid, and possibly acetic acid. These chemicals would be purchased and/or prepared in bulk and stored outside the main building for distribution to the using processes in the new facility.

Utilities Description

Utilities to support the Enriched Uranium Manufacturing Facility would be extended to the location of the facility and supplied from existing Y-12 Plant infrastructure.

Potential Siting

Possible siting of the Enriched Uranium Manufacturing Facility is focusing on areas within Y-SIM alternative candidate Site A area described earlier. The facility would require some on-site services such as chiller tower, steam supply, sanitary sewer services, and potable and fire water services. Approximately 4 ha (10 acres) would be required to accommodate the Enriched Uranium Manufacturing Facility.

Assembly/Disassembly/Quality Evaluation Facility. This project would provide a modernized facility to perform Assembly, Disassembly, and Quality Evaluation activities for weapons components. In addition, supporting activities such as Container Refurbishment, Product Certification, Analytical Services, and select R&D would be included in the facility. All Assembly/Disassembly/Quality Evaluation Facility capabilities required to maintain the enduring stockpile described below would be integrated into the facility.

Assembly

The Assembly area would fabricate and assemble weapons secondaries and components. Activities are primarily divided into four general work areas: material preparation, assembly, additional assembly, and certification.

Disassembly

The main function of the Disassembly area is to dismantle components originally assembled at the Y-12 Plant. Dismantled components would be segregated into material streams for disposition.

Quality Evaluation

Quality Evaluation performs specially designed tests and inspections to collect data and determine the condition of units and components in order to assess the future reliability of the weapons systems in the stockpile. Activities include the disassembly and evaluation of weapons selected for retirement and, subsequently, long-term evaluation of weapon parts under controlled-temperature environments. Additionally, salvageable materials contained in selected weapons assemblies would be reclaimed.

Container Refurbishment

Container Refurbishment is an ancillary support function for Assembly/Disassembly/Quality Evaluation Facility activities. The primary mission is refurbishment and certification of off-site radioactive shipping containers to support both Assembly/Disassembly/Quality Evaluation Facility activities and SNM movements between DOE sites.

Assembly/Disassembly/Quality Evaluation Facility Description

The Assembly/Disassembly/Quality Evaluation Facility is expected to be a two-story, reinforced concrete structure, with a total area of approximately 21,370 m^2 (230,000 ft^2) and an overall footprint of approximately 171 by 73 m (560 by 240 ft). Key features include:

- Assembly, Disassembly, and Quality Evaluations capabilities in one building
- Work space for facility staff and operations
- Additional space allocation for security
- Storage space in work areas
- Consolidated utility rooms
- Tooling storage in work areas

Two one-story vault structures, nondestructive evaluation vaults, and a storage vault—collectively 1,855 m^2 (20,000 ft^2)—would be located adjacent to the primary structure. These vaults would be constructed of reinforced concrete with entrances only from the first floor of the primary structure.

The structure and vaults would be designed for seismic-induced ground motions associated with a PC-3 (2000-year return period) earthquake. The structure and vaults would be designed to withstand PC-3 wind/tornado and design-basis tornado missiles as defined in DOE-STD-1020-94. The facility would be designed to provide protection from stream flooding, local flooding (runoff), and roof ponding associated with a PC-3 flood (10,000-year return period) event.

Utilities Description

Utilities to support the Assembly/Disassembly/Quality Evaluation Facility would be extended to the location of the facility and supplied from existing Y-12 Plant infrastructure.

Potential Siting

Possible siting of the Assembly/Disassembly/Quality Evaluation Facility is focusing on areas within Y-SIM alternative candidate Site A area described earlier. The facility would require some on-site services such as chiller tower, steam supply, sanitary sewer services, and potable and fire water services. Approximately 4 ha (10 acres) would be required to accommodate the Assembly/Disassembly /Quality Evaluation Facility.

Depleted Uranium Operations Facility. The modernized Depleted Uranium Operations Facility would be a combination of a new facility, encompassing metal casting, rolling, and forming, and existing machining and plating operations now conducted in Buildings 9201-5W and 9201-5N. The current concept for the new building includes three primary production areas: the Foundry Area, the Rolling Mill Area, and the Press and Heat Treat Area. In addition, the facility would include operations support areas.

Depleted Uranium Operations Facility Description

The Depleted Uranium Operations Facility would be a partial two-story, reinforced-concrete building with overall dimensions of approximately 101 by 177 m (330 by 580 ft). The first floor would contain the Metal Preparation operations area with a 12-m (40-ft)-high-bay area that uses about 65 percent of the building footprint. Three 60-ton overhead bridge cranes would serve this high bay area. Offices, change houses, and other functions would be on the second floor, which extends over about 35 percent of the first floor area. A dock would be located on portions of two sides of the building. A 2,790 m^2 (30,000 ft^2) tool storage building would be housed in a structure located adjacent to the primary Depleted Uranium Operations Facility.

The primary structure would be a reinforced concrete shear-wall type structure with reinforced concrete exterior walls, floor slabs, and roof. Exterior walls and the roof would be, at a minimum, 0.2-m (8-in)-thick reinforced concrete. The tool storage building would be a 48 by 49 m (160 by 180 ft) one-story reinforced masonry structure supported on an approximately 0.3-m (12-in)-thick reinforced concrete floor slab.

The Depleted Uranium Operations Facility primary structure would be designed for seismic-induced earthquake ground motions associated with a PC-3 (2000-year return period) earthquake and the loads from a PC-3 wind/tornado (50,000-year return period) and design-basis tornado missiles as defined in DOE-STD-1020-94. The tool storage building design would withstand seismic and wind effects from a PC-2 event. A PC-2 facility does not have to be designed for tornado missiles. The Depleted Uranium Operations Facility would be designed to provide protection from stream flooding, local flooding (runoff), and roof ponding associated with a PC-3 flood (10,000-year return period) and the tool storage building would be designed and constructed to PC-2 (2,000-year return) requirements.

Utilities Description

Utilities to support the Depleted Uranium Operations Facility would be extended to the location of the facility and supplied from existing Y-12 Plant infrastructure.

Potential Siting

Possible siting of the Depleted Uranium Operations Facility is focusing on areas within Y-SIM alternative candidate Sites A, B, and C areas described earlier. The facility would require some on-site services such as chiller tower, steam supply, sanitary sewer services, and potable and fire water services. Approximately 4 ha (10 acres) would be required to accommodate the Depleted Uranium Operations Facility.

Lithium Operations Complex. The core of the Lithium Operations Complex would be a building specializing in chemical operations and machining. The full range of operations would include wet chemistry, metal production, salt production, forming, inspection, machining, and chemical recovery of lithium compounds from retired and rejected weapons components. Wet chemistry processes would convert retired and rejected weapons parts and machine dust into lithium chloride powder. In metal production, dry lithium chloride powder is reduced to lithium metal. Salt production then converts the lithium metal to either lithium hydride or lithium deuteride powder. Forming presses the dry powder into a shaped part. A smaller building for deuterium production and a tank farm to hold process chemicals and provide temporary liquid storage would also be included.

Lithium Operations Complex Description

The Lithium Operations Complex would include an approximately 9,290 m^2 (100,000 ft^2) one-story building with a mezzanine having overall dimensions of approximately 122 by 76 by 15 m (400 by 250 by 50 ft) high. A one-story Deuterium Plant with Gas Garage and four storage tanks with dikes and canopies would be located adjacent to the primary structure. Wet chemistry, lithium metal production, salt production, machining, salvage areas, a laboratory, a computer room, offices and storage areas, maintenance room, X-ray vault, and a mechanical room would be located on the ground floor of the Process Building. Forming areas, along with storage, office space, and room for a dehumidifying system would be on the mezzanine. Lithium Operations would share the use of an Isostatic Press proposed as part of the Special Materials Complex.

The Deuterium Plant would be a one-story structure with overall dimensions of approximately 17 by 35 m (55 by 114 ft). The building would be supported on an 8-in-thick reinforced concrete floor slab, its exterior walls would be reinforced concrete masonry units, and it would have a built-up roof. A mezzanine storage area would be included in one corner of the building. Adjacent to the Deuterium Plant would be a bottle storage area with overall dimensions of approximately 13 by 15 m (44 by 50 ft). The bottle storage area would be steel frame construction with corrugated metal siding.

There would be four storage tanks with dikes and canopies. The lithium hydroxide (LiOH) and the sodium hydroxide (NaOH) tank would share a 18 by 30 m (60 by 100 ft) dike and canopy. The hydrochloric acid (HCl) tank would have a separate dike and canopy measuring 6 by 15 m (20 by 50 ft). A sodium hypochlorite (NaOCl) storage tank would be surrounded by a 9 by 9 m (30 by 30 ft) dike and canopy. The three canopies would be steel frames with open sides supported on the dike walls. The diked area of the tanks would drain into a basin located at a lower elevation.

The natural phenomena design for the lithium facility has not been finalized; however, it is qualitatively judged to be at least PC-2 since there is clearly the potential for impact to workers from the accidental release of hazardous chemicals. It is possible that it could be PC-3 if the quantified consequence evaluations (to be performed in later stages of the project safety analysis) show that off-site chemical thresholds are exceeded for credible accidents.

Utilities Description

Utilities to support the Lithium Operations Complex would be extended to the location of the facility and supplied from existing Y-12 Plant infrastructure.

Potential Siting

Possible siting of the Lithium Operations Complex is focusing on areas within Y-SIM alternative candidate Sites A, B, and C areas described earlier. The facility would require some on-site services such as chiller tower, steam supply, sanitary sewer services, and potable and fire water services. Approximately 4 ha (10 acres) would be required to accommodate the Lithium Operations Complex.

Other Missions and Facilities Considered

Product Certification Organization. The Product Certification Organization mission is to provide independent test, inspections, and quality assurance for weapons program and other approved Y-12 customers. The organization provides testing and inspection services for all weapons materials, components, and subassemblies manufactured, assembled, disassembled, and stored in the Y-12 Plant. Within the organization are two major operating entities: Dimensional Metrology operations and Physical Testing operations.

Product Certification Description

All materials utilized in Y-12 weapons activities are inspected and tested by Product Certification operations, including fissile, nuclear, nonnuclear, and hazardous materials, as well as materials requiring special environmental handling. Precision dimensional inspection of machined components and assemblies is performed with sophisticated measuring equipment controlled and calibrated to be among the most accurate in the world. Large precision machines installed with special foundations, very closely controlled room temperature, and sophisticated data capture and analysis capabilities are required for these operations.

The physical testing requirements for weapons support include radiography, radiation gaging, ultrasonic testing, liquid penetrant inspection, magnetic particle testing, magnetic/eddy current testing, bulk density determination, pressure/leak testing, vibration testing, and dynamic analysis. In addition, a full range of mechanical properties testing capabilities for all materials is maintained, including tensile strength, hardness, impact strength, metallography, strain gaging, and other material tests. Special radiation facilities, unique special testing systems, special materials handling capabilities, and data capture and analysis capabilities are required for these operations.

There are 15 major Product Certification Organization facilities currently operational within the Y-12 Plant that occupy more than 9,290 m^2 (100,000 ft^2). Many principal Product Certification facilities are located within Buildings 9204-2E and 9201-5N. Additional smaller support facilities or facilities that are no longer needed also exist. These facilities are generally located in proximity to production capabilities developed at Y-12. Many facilities were consolidated in the 1990s, and that consolidation is continuing.

Product Certification Mission Alternatives

Alternatives being considered for the continued Product Certification Organization mission for the long term include the following:

- Continue to maintain and upgrade existing facilities and add new capabilities as new requirements are defined.

- Plan and construct new Product Certification Organization facilities along with new manufacturing process facilities as they are developed.

- Plan and construct new Product Certification Organization facilities in a centralized complex that would serve the Y-12 Plant well into the 21st century.

The first alternative would incur the largest operating and maintenance costs and certain health and safety compromises and operational inefficiencies. In addition, the manufacturing processes supported by these product certification facilities will likely be relocated to modernized facilities as discussed earlier in this section.

The second alternative is the one being considered in the early stages of Y-SIM planning. It offers improved facilities and efficiencies associated with the manufacturing processes being upgraded. However, it does offer inefficiencies associated with Product Certification operations and would require some duplication of facilities and increased staffing requirements. If Product Certification facilities become a part of each new Y-SIM proposed facility, then duplicate testing and certification facilities must be constructed. For example, if X-ray facilities are separated, their support facilities such as film processing must be duplicated.

The third alternative incurs the least capital costs, less duplication of facilities, and reduced operating costs for Product Certification. However, weapons materials and components movements and health, safety, and security considerations may cause this alternative to be less attractive. Safeguards and security considerations probably would dictate that the facilities serving enriched uranium be located near facilities they serve and inside the PIDAS area. Also, health and safety considerations require that some facilities be within the Special Materials Complex (i.e., certification of beryllium parts).

Analytical Chemistry. The Analytical Chemistry Organization mission is to provide comprehensive analytical services including project management, sampling, analyses, data evaluation, and technical solutions in support of DP and other customers. The organization provides analytical testing and certification for all weapons materials, components, and subassemblies manufactured, assembled, disassembled, and stored at the Y-12 Plant.

Analytical Chemistry Description

All materials used in Y-12 weapons activities are analyzed by Analytical Chemistry, including fissile, nuclear, nonnuclear and hazardous materials, as well as materials requiring special environmental handling. Samples received from various Y-12 Plant operations are not normally suitable for direct quantitative determination of elemental composition, compound identification, or analysis and therefore require pretreatment. Sample types submitted to Analytical Chemistry include, but are not limited to, ^{235}U metal, alloys, compounds, and solutions; depleted uranium metal, alloys, compounds, and solutions; lithium metal, lithium hydride, lithium chloride, and lithium deuteride; steel; nickel alloys; plating solutions; oils; hydraulic fluids; plastics and polymers; water; air; waste; bioassay; soils; sludges; and beryllium and organometallic compounds. Preparation of this wide range of sample types requires a correspondingly wide variety of chemical or physical treatments.

Building 9995 houses a large portion of Analytical Chemistry Organization operations. Building 9995 is constructed with hollow clay tile and concrete block walls, with 0.05 m (2-in)-thick gypsum roof deck covering the majority of the building and concrete decking on the remainder. The primary operations area approximately 7,800 m^2 (84,000 ft^2) is divided between first-floor and basement levels. The building presently houses Analytical Services Organization administrative services, approximately 3,345 m^2 (36,000 ft^2) of operating laboratory space, and support spaces.

The building is divided into several functional areas: the Uranium Area, laboratories, support and storage areas, utility areas, and offices. The Uranium Area consists of a vault used to store enriched uranium samples and the adjacent laboratories. The other laboratories are typical analytical chemistry laboratories with benches, fume hoods, chemical sinks, and storage cabinets for reagents, etc. The support areas consist of nonenriched uranium samples receiving and storage areas, maintenance shops, storage rooms, and utility equipment rooms. The office areas consist of standard offices and records processing and storage rooms.

The other major Analytical Services Chemistry facility is the Union Valley Facility. The Union Valley Facility, where bioassay, radiochemistry, and some organic analyses are performed in support of health, safety, environmental, and waste programs, is a leased facility with 2,508 m^2 (27,000 ft^2) of laboratory space 3,716 m^2 (40,000 ft^2 total). The analytical capability of this facility is not available elsewhere in Y-12.

Analytical Chemistry Mission Alternatives

Alternatives being considered for Analytical Chemistry Organization support to the Y-12 Stockpile Stewardship Program include:

- Continue to maintain and upgrade existing facilities and add capability as new requirements are defined.

- Plan and construct new Analytical Chemistry Organization facilities along with the new Y-SIM manufacturing process facilities as they are developed.

- Plan and construct a new Development/Product Certification/Analytical Chemistry facility in a centralized complex to serve the Y-12 Plant well into the 21st century.

The first alternative would incur significant cost to address infrastructure concerns, as well as major costs for maintenance and continuation of inefficient operations.

The second alternative is being reviewed for feasibility. While it offers new, modernized facilities efficiently located near production operations, it introduces significant quality concerns and laboratory inefficiencies. From a quality perspective, there is always a concern of cross-contamination between production operations and the supporting laboratory. There may be no new production facility that can provide the extremely low background levels required for analysis of bioassay and environmental samples. Inherent in this alternative are the inefficiencies associated with having low-throughput analytical capabilities located in multiple facilities, which would require redundant equipment and quality control programs and increased staffing. In addition, construction of laboratory facilities is extremely costly due to HVAC requirements and installation of laboratory fume hoods.

The third alternative would result in the least investment in capital equipment, less duplication of laboratory facilities, and fewer personnel and would offer efficiencies in maximizing sample throughput. Movement of SNM and health, safety, and security considerations may cause this alternative to be less attractive. Health and safety considerations would require some processes to be located within the Special Materials Complex.

Utilities and Other Services. The Y-12 Plant is supported by a broad range of utilities and other services including:

- Steam and condensate
- Raw and treated water
- Sanitary sewer
- Demineralized water
- Natural gas
- Plant and instrument air
- Industrial gases
- Electrical power
- Telecommunications systems

The Y-SIM study team evaluated each of these systems to determine how they could support a modernized Y-12 Plant and determined a planning base for further evaluation of alternatives and subsequent planning activities. Alternatives considered for each system generally included:

- Continued operation of current systems

- Replacement of the current systems with new capability

- A combination of continued use and replacement to support existing operations and provide new capability for new Y-SIM facilities

On the basis of an evaluation of the condition and age of the current systems and projected Y-SIM needs, recommendations were developed to establish a planning base for each service. A summary of these planning bases is shown in Table 3.3–2.

The only major new utilities facility under Y-SIM is the steam plant, recommended by 2010. The new plant would have a nominal on-line capacity of 272,155 kg/hr (600,000 lb/hr) and would be capable of supplying steam at a rate as low as 27,215 kg/hr (60,000 lb/hr). The new plant would include multiple boilers. During normal operations, one spare boiler would be available as a backup to the operating boilers. Two fuel sources also would be provided; the primary fuel would be natural gas and the backup would be fuel oil. At the same time the new steam plant would be installed, the existing steam distribution and condensate return systems would be renovated. Portions of the existing steam distribution system would be replaced with new piping and insulation to minimize loss of steam from condensation. Portions of the existing system that are no longer needed because of the reduced plant footprint would be eliminated. The condensate system would be refurbished.

Steam Plant Facility Description

A new, pre-engineered building, approximately 61 by 46 by 12 m (200 by 150 by 40 ft) tall, would house the boilers and steam generator auxiliaries. The building would have steel framing and metal siding and include a mezzanine and access to stack levels. Areas for an office, control room, rest rooms, and electrical equipment would be provided within the building. Building utilities would include steam, condensate, sanitary sewer, instrument air, and treated water. The potential location of the proposed new steam plant is shown in Figure 3.3–2.

The new steam plant would consist of four packaged boilers, each with a capacity of 90,718 kg/hr (200,000 lb/hr) of saturated steam at 250 psig. The boilers would be designed to operate on either natural gas (primary fuel) or fuel oil (back-up fuel). Normal, full-load operation would have three boilers on-line; the fourth boiler would provide spare capacity for off-normal conditions.

Each boiler would include:

- Low-NOx burners
- Fuel gas recirculation
- Air atomization
- Economizers
- Factory mutual approved burn management and combustion control systems
- Forced-draft fans
- Relief valves, blowdown, and vent connections

A central boiler feedwater system consisting of a supply water system, feedwater treatment system, deaerator system, and boiler feedwater system would support operation of the boilers. The makeup to the boiler feedwater system would be supplied from the Y-12 Plant treated water system. The supply water system would include a 7,571-L (2,000-gal) break tank, a backflow preventer, and supply water pumps.

TABLE 3.3–2.—*Summary of Y-SIM Planning Base for Utilities and Other Services*

Utility System/Service	Planning Base
Steam and condensate	• Continue to operate the current system through 2010. • Provide a new gas-fired steam generation plant sized for the existing and new facilities by 2010. • Refurbish the existing steam distribution piping systems. • Refurbish the existing steam condensate system.
Raw and treated water	• Improvement and upgrades to the existing treated water system are "to be determined" pending the transfer of the system to the city of Oak Ridge. • A new raw water supply to the plant would be added to supplement existing supply systems to ensure adequate flow to East Fork Poplar Creek.
Sanitary sewer	• Renovation of the sanitary sewer system was completed in FY 1999, and no additional system-level upgrades and replacements are planned. Each Y-SIM project would be responsible for connection to the current system.
Demineralized water	• The current system is mechanically adequate. New state-of-the-art controls will be provided.
Natural gas	• No system-level upgrades/replacements are planned. Each Y-SIM facility requiring natural gas would be responsible for connection to the existing system.
Plant and instrument air	• Continue to use current systems for existing facilities. • Provide new instrument air systems for new facilities. • Provide new independent breathing air systems, if required, for new facilities.
Industrial gases (argon, helium, hydrogen, nitrogen, and oxygen)	• Upgrade argon system to replace the pier-mounted vaporizers with the suspended vaporizers. Reuse the vaporizers originally installed for the oxygen system but never used. • The helium system would continue to be used as is. • The existing hydrogen system is adequate. The distribution system would be reduced to include only those facilities with a current need. • The current nitrogen gas system, which consists of vaporization liquid, would be replaced with a new, more efficient nitrogen gas generation system. A smaller liquid storage system will continue to be used. • The oxygen system would continue to be used as is.
Electrical power	• The existing 161-kV/13.8-kV system would continue to serve current Y-12 Plant facilities. • A new 161-kV/13.8-kV substation and 13.8-kV distribution system would be provided to serve new Y-SIM facilities.
Telecommunication systems	• Upgrade the unclassified Y-12 Intrasite Network fiber-optic backbone.

Source: LMES 1999d.

Source: Tetra Tech, Inc./LMES 2000a.

FIGURE 3.3–2.—*Candidate Site for a New Y-12 Steam Plant.*

The feedwater would be treated to prevent scale formation in the boiler using a cold zeolite softening system. After treatment, the boiler feedwater would go to a deaerator system where it would be heated to remove dissolved oxygen and other objectionable gases. The deaerator system would consist of two tanks and would include a flash tank, heat exchanger, and degassifier tanks. A blowdown system would be provided to reduce the concentration of impurities in the boiler water by continuously and intermittently "blowing down" the boiler. Blowdown water would be treated in the Steam Plant Wastewater Treatment Facility and then discharged to the Y-12 Plant sanitary sewer system. Each boiler would be equipped with a separate stack that would be equipped with a continuous emission monitoring system for NOx and opacity.

Steam Plant Utilities Description

Natural gas fuel for the steam plant would be supplied by the Y-12 Plant natural gas system. The fuel-oil system would consist of storage tanks with a capacity of approximately 4,542,494 L (1.2 million gal) (a 7-day supply at full load); fuel-oil pumps; underground, double-contained supply piping; and a 4,542-L (1,200-gal) tank. Electrical power would be supplied by two separate feeder lines from the Y-12 Plant 13.8-kV system. A diesel generator and uninterruptible power source would supply backup power to critical system.

Potential Siting

Siting of the new steam plant would be near the existing steam plant (Building 9401-3) located in Y-SIM alternative candidate Site C area described earlier. Support and Infrastructure Facilities. The following functions and facilities have been identified as potentially needing upgrades and/or replacement as part of a long-term Y-12 revitalization program.

- Manufacturing support (can manufacturing, graphite shop, general machining)
- Non-SNM storage
- Development facilities
- Plant Shift Superintendent/Management facilities
- Fire Station
- Administrative and technical facilities (offices, records, storage, cafeteria, medical, photography, reproduction)
- Maintenance facilities (general shops, mobile equipment garage, fuel station)
- Change house facilities
- Material management facilities (shipping and receiving, material warehouse, stores, etc.)

An infrastructure study will be completed in FY 2001 to determine the needs, requirements, and scope of the infrastructure facilities needing upgrade or replacement and establish a planning base for the Y-SIM program. Until completion of additional work in FY 2001, the need and timing of these support facilities cannot be determined.

3.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED CONSIDERATION

DOE is the Federal agency responsible for providing the Nation with nuclear warheads and ensuring that those weapons remain safe, secure, and reliable. By law, DOE is required to support the Nuclear Weapons Stockpile Plan. To do this, DOE must maintain a nuclear weapons production, maintenance, and surveillance capacity consistent with the President's *Nuclear Weapons Stockpile Plan*. For the proposed action (Continued Operation of Y-12 Missions), the following alternatives were considered but eliminated from detailed study for the reasons stated.

Site Closure with Complete Environmental Restoration. Members of the public have in the past and during public scoping for the SWEIS stated that DOE should analyze shutting down all operations at Y-12, deactivating some or all of the facilities, and cleaning up the site for other potential uses. DOE has already considered these suggestions in previous DOE programmatic NEPA documents, specifically the SSM PEIS (DOE 1996e) and the S&D PEIS (DOE/EIS-0229, DOE 1996h). DOE recognizes that Y-12 has unique capabilities and diverse roles supporting a variety of national programs, and that there is an essential near-term need to manage and maintain the safety and stability of the existing nuclear materials inventory. In addition, the *National Security Strategy for a New Century*, issued by the White House in October 1998, emphasizes the need to "ensure the continued viability of the infrastructure that supports U.S. nuclear forces and weapons." Until relieved of its mission to support the enduring nuclear weapons stockpile by the President and Congress, DOE must maintain its DP operations at the Y-12 Plant. Accordingly, the DOE view at this time is that a decision to shut down or further reduce Y-12 missions within the timeframe of the SWEIS would be highly unlikely and an unreasonable alternative.

Construction of an All New, Smaller Y-12 Plant. Some members of the public proposed that DOE analyze building an all new Y-12 Plant (implementing all of the Y-SIM Program projects), cleaning up the vacated facilities, and encouraging reindustrialization of the old Y-12 Site.

The long-term planning for the Y-12 Plant is being addressed in the Y-SIM Program; however, this program spans 30 years or more and includes many potential production, support, and infrastructure projects (see Section 3.3). The new smaller and more modern Y-12 envisioned by the Y-SIM Program is only conceptual at best. Although some components of the program are more defined and further along in the planning process, there is no proposal or data to support analyses of a "new" Y-12. Components of the program are prioritized based on Y-12 mission requirements and ES&H needs and are subject to limited funding levels. Therefore, creating an all new Y-12 Plant would be highly unlikely, financially remote, and unsupported by design information and data for analysis to be considered a reasonable alternative.

Upgrade Existing Facilities for Special Materials Missions. DOE considered the feasibility of renovating existing facilities needed to meet Special Materials Operations requirements as part of the Y-SIM Program. The review indicated that extensive and costly renovation of the facilities would be required to meet ES&H and mission requirements. The existing special materials facilities range from 27 to more than 50 years old and incur significant maintenance and operating costs while failing to meet future missions and safety requirements. Although renovation of some existing facilities is possible to meet capability, capacity, and ES&H requirements, other facilities cannot be upgraded. Those facilities that can be upgraded would incur extensive costs and inefficiencies because of the use of multiple aging facilities. Facilities that cannot be upgraded must be replaced by new facilities or newly constructed operations areas in existing buildings. Even though requirements could be satisfied, inefficiency from the use of multiple facilities, duplication of support services, and continued degradation of the structural integrity of old buildings and infrastructure renders this a nonviable alternative.

3.5 COMPARISON OF ALTERNATIVES AND ENVIRONMENTAL IMPACTS

This comparison of potential environmental impacts is based on the information in Chapter 4, Affected Environment, and analyses in Chapter 5, Environmental Consequences. Its purpose is to present the impacts of the alternatives in comparative form.

Table 3.5–1 (located at the end of this section) presents the comparison summary of the environmental impacts for construction and operation associated with the No Action - Status Quo Alternative, the No Action - Planning Basis Operations Alternative, and alternatives for the HEU Storage Mission and Special Materials Mission evaluated in this SWEIS. The No Action - Status Quo Alternative is presented in Table 3.5–1 as a benchmark for comparison of the impacts associated with the No Action - Planning Basis Operations Alternative and other alternatives that reflects full Y-12 DP mission operations at required levels, and activities by EM and the Office of Science at Y-12. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it would not meet Y-12 mission needs. The following sections summarize the potential impacts by resource area.

3.5.1 Land Use

Construction. No new DP facilities or major upgrades to existing DP facilities would occur under the No Action - Planning Basis Operations Alternative. Potential land disturbance associated with construction of the Environmental Management Waste Management Facility and activities of the Office of Science Field Research Center would be approximately 31 to 47 ha (77 to 116 acres) and 4 ha (10 acres), respectively. The land disturbance would occur in areas that are already disturbed and designated for waste management and industrial use.

Potential land disturbance associated with the alternatives for the HEU Storage Mission range from 0 ha (No Action) to 5 ha (12 acres) (construct HEU Materials Facility). The Upgrade Expansion of Building 9215 would potentially disturb less than 1 ha. The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility would potentially disturb up to 56 ha (138 acres) during construction. The Upgrade Expansion of Building 9215 Plus the No Action - Planning Basis Operations Alternative would disturb up to 52 ha (128 acres).

Construction of the Special Materials Complex would potentially disturb between 0 ha (No Action) and 8 ha (20 acres) (Site 1 location). Site 2 and Site 3 locations for the proposed Special Materials Complex would disturb approximately 5 ha (12.4 acres). Except for a 2-ha (5-acre) portion of Site 1 which is covered by trees, all proposed sites are located in previously disturbed areas of Y-12 that are designated for industrial use. The clearing of the forest cover on Site 1 would result in a land use change for that area. The No Action - Planning Basis Operations Alternative Plus the Special Materials Complex would potentially disturb up to 59 ha (146 acres) (Site 1) and 56 ha (138 acres) for Sites 2 and 3.

The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility and the Special Materials Complex would disturb up to 64 ha (158 acres) during construction activities.

Operation. Under the No Action - Planning Basis Operations Alternative, the Environmental Management Waste Management Facility and the Field Research Center activities would require approximately 14 to 25 ha (35-62 acres) and less than 4 ha (10 acres) of land, respectively. These activities are consistent with ORR land use plans.

The potential permanent land requirement for the HEU Storage Mission alternatives range from 0.5 ha for the Upgrade Expansion of Building 9215 to 4 ha (10 acres) for the HEU Materials Facility. There would be no difference in land requirements between Site A or Site B for the HEU Materials Facility. Operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would be consistent with current

ORR land use plans, and Oak Ridge End-Use Working Group recommendations (PEC 1998). The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility would result in a potential permanent land requirements of up to 33 ha (82 acres) for operations. The Upgrade Expansion of Building 9215 plus the No Action - Planning Basis Operations Alternative would require up to 29.5 ha (73 acres).

Operation of the Special Materials Complex would require 4 ha of land. There would be no difference in land requirement between Sites 1, 2, or 3. Operation of the Special Materials Complex would be consistent with current ORR land use plans, and Oak Ridge End-Use Working Group recommendations (PEC 1998). The No Action -Planning Basis Operations Alternative plus the Special Materials Complex would result in a potential permanent land requirement of up to 33 ha (82 acres) for operations.

The No Action - Planning Basis Operations Alternative plus the HEU Materials Facility and the Special Materials Complex would result in a potential permanent land requirement of up to 37 ha for operations.

3.5.2 Transportation

Construction. Under the No Action - Planning Basis Operations Alternative, approximately 75 additional vehicles per day would use area roads to support construction of the Environmental Management Waste Management Facility. Less than 10 vehicles per day would be added to area traffic for the Field Research Center activities. The additional construction-related traffic for these two activities would have a negligible impact on area roads and traffic. The Level-of-Service (LOS) on area roads would not change under this alternative from the No Action - Status Quo Alternative.

Construction-related traffic for the HEU Storage Mission Alternative would range from 0 (No Action) to 165 additional worker vehicles per day to support construction of the HEU Materials Facility at either site or the Upgrade Expansion of Building 9215. In addition, three to eight trucks per day would be expected to bring construction materials to the project site. The No Action - Planning Basis Operations Alternative Plus the Construction of the HEU Materials Facility would potentially add 258 vehicles per day on area roads. The additional construction-related traffic would have a minor impact on area roads and traffic because most project traffic would occur at off-peak travel periods.

Construction-related traffic for the Special Materials Mission Alternative would range from 0 (No Action) to 157 additional worker vehicles per day to support construction of the Special Materials Complex at any of the 3 sites. An additional five trucks per day would bring construction materials to the project site. The The No Action - Planning Basis Operations Alternative Plus construction of the Special Materials Complex would potentially add 247 vehicles per day on area roads. The additional construction-related traffic would have a minor impact on area roads and traffic because most project traffic would occur at off-peak travel periods.

Operation. Under the No Action - Planning Basis Operations Alternative, an additional 28 vehicles per day and 6 vehicles per day would be expected from operation of the Environmental Management Waste Management Facility and the Field Research Center activities, respectively. Because a majority of this traffic would occur on the Y-12 Site, the additional traffic would have a negligible impact on area roads and traffic.

Radiological materials and waste transportation impacts associated with the Environmental Management Waste Management Facility would include routine and accidental doses of radioactivity. The risks associated with radiological materials transportation would be less than 0.1 fatality per year. The risks associated with radiological waste transportation would be less than 0.1 fatality per year.

Operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would result in no additional work traffic since the existing workforce would be used. The No Action - Planning Basis Operations Alternative plus the operation of HEU Materials Facility or the Upgrade Expansion of Building

9215 would result in approximately 34 additional vehicles per day on area roads. The additional traffic would not change the LOS on area roads. There would be a one-time relocation of stored HEU to the new facility (HEU Materials Facility or Expansion of Building 9215) which would require approximately 3,000 on-site truck trips to complete.

Radiological materials and waste transportation impacts would include routine and accidental doses of radioactivity. The risks associated with routine radiological materials transportation would be less than 0.1 fatality per year. The risks associated with radiological waste transportation would be less than 0.01 fatality per year. The one-time relocation of stored HEU to the new HEU Materials Facility or the Upgrade Expansion of Building 9215 would result in less than 0.001 fatality.

Operation of the Special Materials Complex would result in no additional worker traffic since the existing workforce would be used. The No Action - Planning Basis Operations Alternative plus the operation of the Special Materials Complex would result in approximately 34 additional vehicles per day on area roads. The additional traffic would not change the LOS on area roads.

There would be no additional radiological materials and waste transportation impacts associated with the Special Materials Complex since the facilities do not use radioactive materials.

3.5.3 Socioeconomics

Construction. A peak construction workforce of approximately 100 would be needed for the Environmental Management Waste Management Facility, and less than 10 would be needed for the Field Research Center activities included under the No Action - Planning Basis Operations Alternative. The workforce increase represents less than one percent of the The No Action - Status Quo Alternative ORR workforce and would have no substantial benefit or negative impact on the socioeconomics of the Oak Ridge area or regional economy.

The construction of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would have negligible impact on the socioecomonics of the Oak Ridge area or regional economy. Both projects would have a peak construction workforce of 220 workers and generate a total of 460 jobs (220 direct and 240 indirect) in the Region of Influence (ROI). This represents an increase of 0.2 percent in The No Action - Status Quo Alternative ROI employment. The existing ROI labor force is sufficient to accommodate the labor requirements and no change to the level of community services provided in the ROI is expected.

The No Action - Planning Basis Operations Alternative plus the construction of a new HEU Materials Facility or Upgrade Expansion of Building 9215 would require a total of approximately 330 construction workers. A total of 690 jobs (330 direct and 360 indirect) would generated. This would increase the No Action - Status Quo Alternative ROI employment by approximately 0.2 percent. The total No Action - Status Quo Alternative ROI income would increase by approximately $17.8 million, or 0.1 percent.

The construction of the Special Materials Complex would have a peak construction workforce of 210 workers and generate a total of 440 jobs (210 direct and 230 indirect) in the ROI. This represents an increase of 0.2 percent in ROI employment. The existing labor force is sufficient to accommodate the labor requirements, and no change in the level of community services provided in the ROI is expected. The Special Materials Complex construction would have a negligible impact on the socioeconomics of the Oak Ridge area or regional economy.

The No Action - Planning Basis Operations Alternative plus the construction of a new Special Materials Complex would result in a total of approximately 320 construction workers. A total of 670 jobs (320 direct and 350 indirect) would be generated. This would increase The No Action - Status Quo Alternative ROI employment by approximately 0.2 percent. The Total No Action - Status Quo Alternative ROI income would increase by approximately $17.2 million, or 0.1 percent.

The construction periods of the HEU Materials Facility and Special Materials Complex could overlap with the construction activities included under the No Action - Planning Basis Operations Alternative. In that case, there would be a greater construction workforce at Y-12 at one time, resulting in a greater increase in ROI employment, and income in any one year. The peak construction employment could reach approximately 540 direct employees, generating a total of 1,130 jobs (540 direct and 590 indirect). This would be an increase of approximately 0.4 percent in the No Action - Status Quo Alternative ROI employment and would result in an increase in ROI income of almost $30 million, or 0.2 percent. These changes would be temporary, lasting only the duration of the construction period. The existing ROI labor force could likely fill all of the jobs generated by the increased employment and expenditures. Therefore, there would be no impacts to the ROI's population or housing sector. Because there would be no change in the ROI population, there would be no change to the level of community services provided in the ROI.

Operation. Under the No Action - Planning Basis Operations Alternative, potential benefits of employment associated with the Environmental Management Waste Management Facility or the Field Research Center activities would be very small. Approximately 25 workers and 6 workers, respectively, would be needed for the two activities. Workers for the Environmental Management Waste Management Facility would be drawn from the local workforce. Some of the workforce associated with the Field Research Center would be researchers from outside the ROI. Visiting staff and scientists would contribute in a beneficial manner to the local economy, but the impact would be negligible.

The operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would result in no change in the No Action - Status Quo Alternative ROI employment, income, or population. The anticipated operation workforce of 30 for the HEU Materials Facility and 49 for the Upgrade Expansion of Building 9215 would come from existing employees. Operation of the Special Materials Complex would not result in any change in workforce requirements since existing workers would staff the facilities. No impacts to ROI employment, income, or population are expected.

Because both the HEU Materials Facility and the Special Materials Complex would be staffed by the existing Y-12 workforce during operations, there would be no change from the No Action - Planning Basis Operations Alternative Y-12 workforce and no impacts to ROI employment, income, or population.

3.5.4 Geology and Soils

Construction. The Environmental Management Waste Management Facility and the Field Research Center activities included under the No Action - Planning Basis Operations Alternative would result in a potential increase in soil erosion at the construction sites. However, soil impacts are expected to be small with proposed design controls. No impacts to geology are expected.

Construction of the HEU Materials Facility at Site A would result in a potential increase in soil erosion from the lay-down area and new parking lot. Detention basins and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected because the facility is above ground and foundation construction would not disturb bedrock. Site B soil erosion impacts would be negligible with appropriate standard construction control measures. The Upgrade Expansion of Building 9215 would have negligible soil erosion impacts with standard construction control measures. No geology impacts are expected at Site B or at the Building 9215 expansion construction sites because the facility is above ground and foundation construction would not disturb bedrock.

Construction of the Special Materials Complex at Site 1 would result in a potential increase in soil erosion from the lay-down area and project site land clearing, detention basins, silt fences, and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected because the facility is above ground and foundation construction would not disturb bedrock.

Activities included under the No Action - Planning Basis Operations Alternative plus the construction of the HEU Materials Facility and the Special Materials Complex would result in a potential increase in soil disturbance and soil erosion from construction activities. Appropriate mitigation, including detention basins, runoff control ditches, silt fences, and protection of stockpiled soils would minimize soil erosion and impacts. No impacts to geology area expected because all new facilities would be above ground structures and foundation construction would not disturb bedrock.

Operation. Under the No Action - Planning Basis Operations Alternative, minor soil erosion impacts are expected from the Environmental Management Waste Management Facility. Detention basins, runoff control ditches, and cell design components would minimize impacts. The Field Research Center would have no impacts on geology and soils with standard construction-type soil erosion control measures.

The HEU Storage Mission Alternatives and Special Materials Mission Alternatives would have no impact on geology or soils during operation because of site design and engineered control measures.

The No Action - Planning Basis Operations Alternative plus the operation of the HEU Materials Facility and Special Materials Complex would have no impact on geology or soils. Appropriate facility site design and engineered control measures (e.g., detention basins) would be used to minimize soil erosion impacts.

3.5.5 Water Resources

Construction

Surface Hydrology. Under the No Action - Planning Basis Operations Alternative, surface water usage at the Y-12 Plant would increase slightly from the No Action-Status Quo Alternative (20.8 MLD [5.5 MGD]) to (21.2 MLD [5.6 MGD]). This would represent less than a 2 percent increase in raw water use. The Environmental Restoration Program would continue to address surface water contamination sources and, over time, improve the quality of water in both UEFPC and Bear Creek, the two surface water bodies most directly impacted by activities at the Y-12 Plant.

The Environmental Management Waste Management Facility in eastern Bear Creek Valley activities are included under the No Action - Planning Basis Operations Alternative. Potential short-term impacts to surface water resources could result from sediment loading to surface water bodies or migration of contaminants. Land clearing and construction activities would expose varying areas depending on the ultimate size of the facility. Best management practices, including standard erosion controls such as siltation fences and buffer zones of natural riparian vegetation, during construction activities would minimize the potential impacts to surface water resources. Some impacts to surface water would be expected. Tributary NT-4 would be rerouted and partially eliminated during construction at the East Bear Creek Valley site. Construction and rerouting of NT-4 would impact some areas of wetland (approximately 0.4 ha [1 acre]) which will be mitigated as part of a wetlands mitigation plan for all CERCLA activities in Bear Creek Valley (DOE 1999j).

The No Action - Planning Basis Operations Alternative also includes activities of the Field Research Center at the Y-12 Site. The primary activities of the Field Research Center at Y-12 comprise subsurface injections of possible treatment additives into the groundwater at the contaminated area. Although only small volume injections are planned, it is possible that the groundwater additives might pass through the subsurface and reach the surface waters of Bear Creek. However, previous experiences with larger tracer injections near Bear Creek (DOE 1997a; LMER 1999c) and close monitoring of environmental conditions at the contaminated area suggest that the impacts to surface waters are predictable and would be minor.

Y-12 Plant surface water withdrawals and discharges would not increase substantially during construction of the HEU Materials Facility whether at construction Sites A or B or during the Upgrade Expansion of Building 9215. Construction water requirements are very small and would not raise the average daily water use for the Y-12 Plant. During construction, stormwater control and erosion control measures would be implemented to minimize soil erosion and transport to UEFPC. Neither of the proposed construction sites (Sites A or B) or the upgrade expansion site (Building 9215) is located within either the 100-year or 500-year floodplains.

Surface water withdrawals and discharges would not increase substantially during construction of the Special Materials Complex. Construction water requirements are very small and would not raise the average daily water use for the Y-12 Plant. During construction, stormwater control and erosion control measures would be implemented to minimize soil erosion and transport to surface water (UEFPC). None of the proposed sites (Sites 1, 2, or 3) is located within either the 100-year or 500-year floodplains.

Groundwater. All water for the No Action - Planning Basis Operations Alternative would be taken from the Clinch River, with no plans for withdrawal from groundwater resources. All process, utility, and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with NPDES permits.

Groundwater resources could be degraded by the Environmental Management Waste Management Facility in the short-term by contaminant releases from the surface or disposal cell that migrate to groundwater. Contaminant sources include construction materials (e.g., concrete and asphalt), spills of oil and diesel fuel, releases from transportation or waste handling accidents, and accidental releases of leachate from the disposal cell. Compliance with an approved erosion and sedimentation control plan and a spill prevention, control, and countermeasures plan would mitigate potential impacts from surface spills. Engineered controls and active controls, including the leachate collection system, would drastically reduce the potential for impact to groundwater resources that could result from contaminant migration from the disposal cell. Construction and operation of the disposal cell would result in few or no overall short-term impacts to groundwater resources.

Long-term, the design, construction, and maintenance of the new disposal facility would prevent or minimize contaminant releases to groundwater. These control elements would include a multilayer cap to minimize infiltration, synthetic and clay barriers in the cell liner, a geologic buffer, and institutional controls that would include monitoring and groundwater use restrictions. If releases were detected during the period of active institutional controls, mitigative measures would be implemented to protect human health and the environment. Long-term impacts to groundwater quality resulting from the disposal cell are expected to be insignificant.

Research activities of the Field Research Center at the Y-12 Site would focus on injections of additives to the groundwater at both the background and contaminated areas. Although the additives would modify the chemistry of the groundwater in the immediate study area, injections of additives would be so small that impacts would be limited to the immediate study areas.

Groundwater would be extracted in the Field Research Center contaminated area at Y-12 as part of characterization-related hydraulic tests. In addition, groundwater sample collection would increase. However, groundwater extractions associated with major hydraulic tests would collect no more than 76,000 L(20,000 gal) of groundwater per year (DOE 2000b). Sampling activities in years with no major hydraulic testing would collect no more than 7,600 L (2,000 gal) of groundwater. All extracted groundwater would be collected and treated in on-site facilities prior to surface water discharge to meet existing NPDES permit limits.

All water for construction of the HEU Materials Facility would be taken from the Clinch River as part of the normal water uses at the Y-12 Plant. Some groundwater may be extracted during construction activities at either construction site (Sites A or B) or during the Upgrade Expansion of Building 9215 to remove water from excavations. Based on the results of the Remedial Investigation of UEFPC (DOE 1998b), groundwater extracted from excavations at Site A and in the area of the Upgrade Expansion of Building 9215 probably would not be contaminated. Groundwater extracted from excavations at Site B would probably be contaminated with VOCs, metals, and radionuclides from the nearby former S-3 Ponds and the Y-12 Scrap Metal Yard (DOE 1998b). Minimal impacts to groundwater quality are expected because regardless of site, extracted groundwater would be collected and treated in on-site treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water; no plans exist for routine withdrawal from groundwater resources.

All water for construction of the Special Materials Complex would be taken from the Clinch River as part of the normal water uses at the Y-12 Plant. Some groundwater may be extracted during construction activities to remove water from excavations. Based on the historical site use and the results of the Remedial Investigation of the UEFPC (DOE 1998b), groundwater extracted from excavations at Site 1 probably would not be contaminated. Groundwater extracted from excavations at Sites 2 and 3 would be the same as that described for the HEU Materials Facility Site B. The groundwater is contaminated with VOCs, metals, and radionuclides from the nearby former S-3 Ponds and the Y-12 Scrap Metal Yard (DOE 1998b). Minimal impacts to groundwater quality are expected because regardless of site, extracted groundwater would be collected and treated in on-site treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water.

Under the No Action - Planning Basis Operations Alternative plus the construction of the HEU Materials Facility and Special Materials Complex, no groundwater would be used for construction activities. Some groundwater may be extracted during construction from excavation and field research activities. Depending on the construction site, extracted groundwater may be contaminated with VOCs, metals, and radionuclides. Minimal impacts to groundwater and groundwater quality are expected because extracted groundwater would be collected and treated in on-site treatment facilities to meet discharge limits of the NPDES permit prior to release to surface water.

Operation

Surface Hydrology. Under the No Action - Planning Basis Operations Alternative, surface water usage at the Y-12 Plant would increase slightly from The No Action - Status Quo Alternative (20.8 MLD [5.5 MGD]) to (21.2 MLD [5.6 MGD]). This would represent less than a 2 percent increase in raw water use.

HEU storage operations, whether located in a new HEU Materials Facility or in the Upgrade Expansion of Building 9215, would require an estimated 550,000 L to 720,000 L (146,000 GPY to 190,000 GPY), a small percentage of the No Action - Status Quo Alternative Y-12 Plant water usage of approximately 5,680 MLY (1,500 MGY).

The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility or the Upgrade Expansion of Building 9215 would increase water use requirements by approximately 140 MLY (37 MGY) from the 5,678 MLY (1,500 MGY) water use under the No Action - Status Quo Alternative. This represents an increase of approximately 2.5 percent. Sufficient excess water capacity exists to accommodate the additional 140 MLY (37 MGY). No adverse impacts to surface water resources or surface water quality are expected because all discharges would be maintained to comply with NPDES permit limits.

Operations of the Special Materials Complex would require an estimated 59 MLY (15.5 MGY) (approximately 53 MLY [14 MGY] for cooling tower make-up water and 6 MLY [1.5 MGY] for processes). This would be approximately 1 percent of the No Action - Status Quo Alternative Y-12 Site water usage of 5,680 MLY (1,500 MGY). This water use would potentially be offset by the vacating of operations in existing special materials operations facilities. No adverse impacts to surface water or surface water quality are expected because all discharges would be monitored to comply with the NPDES permit limits.

The No Action - Planning Basis Operations Alternative plus the Special Materials Complex would increase water use requirements by approximately 197 MLY (52 MGY) from the 5,678 MLY (1,500 MGY) water use under the No Action-Status Quo Alternative. This represents an increase of approximately 3.5 percent. Sufficient excess water capacity exists to accommodate the additional 197 MLY (52 MGY). No adverse impacts to surface water resources or surface water quality are expected because all discharges would be monitored to comply with NPDES permit limits.

Under Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility plus Special Materials Complex), surface water withdrawals and discharges would increase slightly. Water requirements would increase by approximately 197.5 MLY (52.2 MGY) from the 5,678 MLY (1,500 MGY) water usage under the No Action-Status Quo Alternative. This represents an increase of 3.5 percent. Historical water use by Y-12 has been as high as 8,328 MLY (2,200 MGY). Sufficient excess water capacity exists to accommodate the additional 197.5 MLY (52.2 MGY) increase. No adverse impacts to surface water or surface water quality are expected because all discharges would be monitored to comply with the NPDES permit limits.

Groundwater. All water for the No Action - Planning Basis Operations Alternative would be taken from the Clinch River, with no plans for withdrawal form groundwater resources at the Environmental Management Waste Management Facility. Sampling at the Field Research Center would remove a minimal amount (7,570 [2,000 gal]) a year for research purposes. All process, utility, and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with NPDES permits.

All water for operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would be taken from the Clinch River. As a storage facility, there would be no process water; utility and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with the existing NPDES permits.

All water for operation of the Special Materials Complex would be taken from the Clinch River. No plans exist for groundwater withdrawal to support operation of the Special Materials Complex. Utility and sanitary wastewater would be treated prior to discharge into the UEFPC in accordance with the existing NPDES permits.

Under Alternative 4 (The No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex) no groundwater would be used for operations of facilities. No plans exist for routine withdrawal from groundwater resources; and utility and sanitary wastewater would be treated prior to discharge in accordance with NPDES permits.

3.5.6 Biological Resources

Construction. Under Alternative 1B (No Action - Planning Basis Operations Alternative), potential impacts to terrestrial, wetlands, and threatened/endangered species are expected. Land clearing activities for the Environmental Management Waste Management Facility and soil borrow area would remove grassland, old field habitat, forest habitat, and a 0.4-ha (1-acre) wetland. Potential threatened/endangered species affected by construction activities include the Tennessee endangered pink lady slipper and Tennessee threatened tuberculed rein-orchid and carolina quillwort. There would be a minor impact on terrestrial resources from Field Research Center activities because test plots would be located in areas where site clearing and past construction have occurred.

Construction of the HEU Materials Facility at Site A would potentially impact terrestrial resources and three wetlands (0.4 ha [1 acre]) at the materials lay-down and new parking lot areas due to land clearing activities. No impact to aquatic resources or threatened/endangered species is expected at Site A. Impacts to biological resources from construction of the HEU Materials Facility at Site B or the Upgrade Expansion of Building

9215 are not expected because these areas have been previously disturbed and do not contain habitat sufficient to support a biologically diverse species mix.

If the Special Materials complex is constructed at Site 1, approximately 4 ha (1 acre) of terrestrial habitat would be eliminated and wildlife would be dislocated and/or disturbed. Two man-made wetlands (0.4 ha [1 acre]) would potentially be impacted due to construction land clearing and sedimentation from the construction site. No impacts to aquatic or threatened/endangered species are expected at Site 1. If the Special Materials Complex is constructed at Site 2 or Site 3, no impacts to biological resources are expected because of the highly disturbed and industrialized nature of these sites and the minimal biological resources present.

Operation. Under the No Action - Planning Basis Operations Alternative, minor impacts to terrestrial resources are expected due to operation noise and human activities associated with the Environmental Management Waste Management Facility and soils borrow area. No impacts to wetlands, aquatic, or threatened/endangered species are expected. The Field Research Center operations activities would have a minor impact on terrestrial resources due to noise and human activity but would have no impacts on aquatic, wetlands, or threatened/endangered species.

Operation of the HEU Materials Facility, the Special Materials Complex, or the Upgrade Expansion of Building 9215 would not impact biological resources because they would be located in previously disturbed or heavily industrialized portions of the Y-12 Site that do not contain habitat sufficient to support a biologically diverse species mix.

Activities associated with the Environmental Management Waste Management Facility, Field Research Center activities under the No Action - Planning Basis Operations Alternative, and construction and operation of the HEU Materials Facility and Special Materials Complex is anticipated to disturb natural habitat as discussed above during land cleaning activities for new facilities. If the HEU Materials Facility is constructed at Site A potential impact may occur to three man-made wetlands approximately 0.4 ha (1 acre) in size. Additionally, construction of the Environmental Management Waste Management Facility would require rerouting of 330 m (1,000 ft) of NT-4, and the associated wetland, approximately 0.4 ha (1 acre) in size, would be impacted by potential construction related sediment and loss of adjacent wooded areas.

3.5.7 Air Quality

Construction. Under the No Action - Planning Basis Operations Alternative, the Environmental Management Waste Management Facility and the Field Research Center activities would potentially have an impact on the project areas due to fugitive dust emissions. However, engineered controls, such as the application of water or chemical dust suppressants and seeding of soil piles and exposed soils, would be implemented to minimize fugitive dust emissions. Based on the activities and the dust control measures, DOE expects that dust emissions at the Y-12 Site boundary would be below the PM_{10} NAAQS at the DOE boundary and only negligible levels of airborne dust would be expected at the nearest residential area.

Construction of the HEU Materials Facility at Site A and Site B would result in small fugitive dust impacts in the construction area. Site A construction activities would generate slightly more fugitive dust emissions because of more earth moving activities associated with the materials lay-down area and new parking lot. If the expansion to Building 9215 is constructed, small fugitive dust impacts in the construction area would be expected. Effective control measures commonly used to reduce fugitive dust emissions include wet suppression, wind speed reduction using barriers, vehicle speed, and chemical stabilization. Necessary control measures would be applied to ensure that PM_{10} concentrations remain below applicable standards.

Construction of the Special Materials Complex at Site 1, Site 2, or Site 3 would generate fugitive dust emissions which would have a small impact in the construction area. Site 1 construction would generate more fugitive dust emissions than Site 2 or Site 3 due to the larger scale of land clearing and earth moving activities to prepare the site for construction. All fugitive dust emissions would not exceed applicable standards when dust suppression methods are used.

Operation. Under the No Action - Planning Basis Operations Alternative, nonradiological air pollutant concentration would be well within established criteria under normal operations. Radiological dose to the MEI and off-site population under the No Action - Planning Basis Operations Alternative would increase from the No Action - Status Quo Alternative due to the restart of all Y-12 mission operations. The dose to the MEI (1,080 m [3,543 ft] from Y-12) would increase from 0.53 mrem/yr (under the No Action - Status Quo Alternative) to 4.5 mrem/yr, and the dose to the population within 80 km (50 mi) would increase from 4.3 person-rem/yr (under the No Action - Status Quo Alternative) to 33.7 person-rem/yr. Statistically, this equates to 0.017 latent cancer fatality (LCF) for each year of Y-12 normal operation.

The impacts under Alternative 2A (No Action - Planning Basis Operations Alternative Plus Construct and Operate a New HEU Materials Facility) and Alternative 2B (No Action - Planning Basis Operations Alternative Plus Upgrade Expansion of Building 9215) would remain unchanged from the No Action - Planning Basis Operations Alternative impacts (i.e., 4.5 millirem per year for the MEI, and 33.7 person-rem for the off-site population). The collective dose to the workers (35) under Alternative 1B (No Action - Planning Basis Operations Alternative) for the existing HEU Storage Mission is 0.74 person-rem. The collective dose to workers due to relocation of existing stored HEU to the new HEU storage facility is 5.25 person-rem. The collective dose to workers (14) during normal operations due to storage of HEU in the HEU Materials Facility is 0.29 person-rem.

There would be no radiological material associated with the Special Materials Complex operation. No change from the No Action - Planning Basis Operations Alternative radiological emissions described above at Y-12 are expected.

Under Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex), the collective dose to workers at the Y-12 Plant would be the same as Alternative 1B (No Action - Planning Basis Operations Alternative). There would be a slight decrease in HEU storage mission worker collective dose from 0.74 person-rem to 0.29 person-rem if the HEU Materials Facility were constructed and operated. This reduction is due to the decrease in number of workers from 35 under the No Action - Planning Basis Operations Alternative to 14 workers for the new HEU Materials Facility. The overall collective Y-12 worker dose however would not change from the 59.48 person-rem under the No Action - Planning Basis Operations Alternative because of the increased production levels and radiological emissions associated with enriched uranium operations. The Special Materials Complex is a non-rad facility and does not handle radioactive materials.

The MEI and population dose within 80 km (50 mi) of the Y-12 Site under this alternative would be the same as Alternative 1B (No Action - Planning Basis Operations Alternative). The dose received by the hypothetical MEI is 4.5 mrem/yr. The collective population dose would be 33.7 person-rem. This would be a substantial increase from the No Action - Status Quo Alternative dose to the MEI and population of 0.53 mrem/yr and 4.3 person-rem, respectively. The increase is due to the Y-12 Plant operating at planned and required workload levels under Alternative 1B (No Action - Planning Basis Operations Alternative).

3.5.8 Visual Resources

Construction. No additional impact to visual resources is expected under the No Action - Planning Basis Operations Alternative or from the HEU Storage Mission and Special Materials Mission Alternatives because of the design of the proposed new facilities and the existing setting of Y-12.

Operation. No additional impact to visual resources is expected under the No Action - Planning Basis Operations Alternative or from the HEU Storage Mission and Special Materials Mission Alternatives because of the design of the proposed new facilities and the existing setting of Y-12. Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Material Facility Plus Special materials Complex) would have no additional impacts to visual resources.

3.5.9 Noise

Construction. Under the No Action - Planning Basis Operations Alternative, small noise impacts are expected from construction equipment and activities associated with the Environmental Management Waste Management Facility and the Field Research Center activities. Impacts would be limited to the general construction area. Feasible administrative or engineered controls would be used in addition to personal protective equipment (e.g., ear plugs) to protect workers against the effects of noise exposure.

Construction of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would have small noise impacts in the general construction area. Construction of the Special Materials Complex would have small noise impacts in the general construction area. Feasible administrative or engineered controls would be used in addition to personal protective equipment (e.g., ear plugs) to protect workers against the effects of noise exposure. No off-site noise impacts are expected because peak attenuated noise levels from construction of these facilities would be below background noise levels (53 to 62 dBA) at off-site locations within the city of Oak Ridge.

Construction related noise impacts under Alternative 4 (No Action - Planning Basis Operations Alternative Plus HEU Materials Facility Plus Special Materials Complex) would result from relatively high and continuous levels of noise in the range of 89 to 108 dBA. Because of the distance between construction sites and locations relative to Y-12 Plant facilities commutative noise impacts to Y-12 employees population would be the mitigated to acceptable levels (approximately 70 dBA). Potential construction activity locations under the alternative are at sufficient distance from the ORR boundary and the city of Oak Ridge to result in no change to background noise levels at these areas.

Operation. Under the No Action - Planning Basis Operations Alternative, small noise impacts are expected from heavy equipment and activities associated with the Environmental Management Waste Management Facility and the Field Research Center. Impacts would be limited to the general operation areas.

Operation of the HEU Materials Facility and the Special Materials Complex would generate some noise, caused particularly by site traffic and mechanical systems associated with operation of the facility (e.g., cooling systems, transformers, engines, pumps, paging systems, and materials-handling equipment). In general, sound levels for all action alternatives are expected to be characteristic of a light industrial setting within the range of 50 to 70 dBA and would be within existing No Action-Status Quo Alternative levels. Effects upon residential areas are attenuated by the distance from the facility, topography, and by a vegetated buffer zone.

3.5.10 Site Infrastructure

Construction. There would be no measurable change in Y-12 Site energy usage or other infrastructure resources under the No Action - Planning Basis Operations Alternative due to the construction of the Environmental Management Waste Management Facility or the Field Research Center activities. Existing site infrastructure would be used and energy usage would be minimal during the construction phase.

Construction of the HEU Materials Facility at Site A would result in less infrastructure impacts than Site B since no buildings would be demolished and utility relocation would be minimal. Site B would require demolition of eight buildings and realignment of Old Bear Creek Road. Construction materials and resources for the HEU Materials Facility would be the same for Site A and Site B. If the Upgrade Expansion of Building 9215 is constructed, some utility relocation would be necessary but no permanent buildings would require demolition. Construction materials and resources for the HEU Materials Facility would be the same for Site A and Site B. Construction materials and resources requirements for the Expansion of Building 9215 would be less than that for the HEU Materials Facility.

Construction materials and resource requirements for the Special Materials Complex would be the same for Site 1, Site 2, or Site 3. Construction of the Special Materials Complex at Site 1 would result in the least impact to infrastructure since no buildings would be demolished and only small utility relocation would be required. At Site 2, five buildings would be removed. At Site 3, eight buildings would be removed and a portion of Old Bear Creek Road would be realigned.

Operation. Under the No Action - Planning Basis Operations Alternative, there would be a slight increase from the No Action - Status Quo Alternative in energy and resource requirements. Electrical energy consumption would increase by approximately 189,000 MWh/yr to 566,000 MWh/yr and water use would increase by 4.5 MLD (1.2 MGD) to 20.2 MLD (5.3 MGD).

Operation of the HEU Materials Facility would require approximately 5,900 MWh/yr of electricity and 1,510 L/day (400 gal/day) of water. Operation of the Upgrade Expansion of Building 9215 would require approximately 10,900 MWh/year and 1,975 L/day (520 gal/day) of water. Sufficient electrical energy and water capacity exists at Y-12 to support the expected increases. Combined with the No Action - Planning Basis Operations Alternative, the preferred alternative (new HEU Materials Facility) would require a total of 572,000 MWh/yr of electricity and 20.2 MLD (5.38 MGD) of water.

Operation of the Special Materials Complex would require approximately 30,400 MWh/yr and 228,600 L/day (63,000 gal/day) of water. Sufficient electrical energy and water capacity exists at Y-12 to support the expected increases. Combined with the No Action - Planning Basis Operations Alternative, this alternative would require a total of 596,000 MWh/yr of electricity and 20.43 MLD (5.4 MGD) of water.

Operation of the new HEU Materials Facility and the Special Materials Complex when combined with The No Action - Planning Basis Operations Alternative would require an increase in electrical usage to 602,000 MWh/yr and an increase of water usage to 20.43 MLD (5.4 MGD).

The vacating of existing HEU storage facilities and special materials operations facilities, if new projects are constructed, could potentially effect the projected increases and minimize potential impacts on site infrastructure and resources.

3.5.11 Cultural Resources

Construction. No impacts to cultural resources are expected under the No Action - Planning Basis Operations Alternative. NRHP-eligible properties in the proposed historic district encompassing the Y-12 Plant would continue to be actively used for DOE mission activities.

The impacts to cultural resources resulting from the Environmental Management Waste Management Facility and Field Research Center activities has been assessed in consultation with the SHPO (DOE 1999j; DOE 2000b). Although there are no known archaeological resources in the Y-12 Site area, there would be a remote possibility of encountering buried cultural resources during ground-disturbing activities. Procedures for addressing the unanticipated discovery of cultural resources are described in the Y-12 Cultural Resource Management Plan (CRMP).

No impacts to cultural resources are expected from construction of the HEU Materials Facility at Site A or Site B. The Upgrade Expansion of Building 9215 would be considered a major alteration of a historic property and require consultation with the SHPO in accordance with the Y-12 CRMP. Although there are no known archaeological resources in the Y-12 Site area, there would be a remote possibility of encountering buried cultural resources during ground-disturbing activities. Procedures for addressing the unanticipated discovery of cultural resources are described in the Y-12 CRMP.

No impacts to cultural resources are expected from construction of the Special Materials Complex at Site 1, Site 2, or Site 3. Because use of Site 1 would probably involve ground disturbance in an undisturbed area and may involve disturbance exceeding the depth and extent of previous ground disturbances the DOE-ORO would consult with SHPO and other parties to determine whether an archaeological survey is warranted. If a survey is conducted, any resources found would be evaluated for NRHP-eligibility and the effects determined in consultation with the SHPO and other parties. Although there are no known archaeological resources in the Y-12 Site area, there would be a remote possibility of encountering buried cultural resources during ground-disturbing activities. Procedures for addressing the unanticipated discovery of cultural resources are described in the Y-12 CRMP.

Operation. No impacts to cultural resources are expected under the No Action - Planning Basis Operations Alternative because NRHP-eligible properties would not be modified or demolished and ground-disturbing activities would be minimal. No impacts to cultural resources are expected from operation of HEU Materials Facility, the Upgrade Expansion of Building 9215, or the Special Materials Complex. Upon completion of the new HEU Materials Facility or Upgrade Expansion of Building 9215, NRHP-eligible buildings (9204-2, 9204-2E, 9204-4, 9215, 9720-5, and 9998) would no longer be used for the HEU storage mission. Upon completion of the Special Materials Complex, NRHP-eligible buildings (9201-5, 9202, 9731, and 9995) would no longer be used for the Special Materials Mission. Depending on the disposition of these historic properties, there could be impacts associated with moving the HEU Storage Mission and Special Materials Operations from these buildings. Potential impacts include changes in the character of the properties' use, the physical destruction of historic properties, and the neglect of properties leading to deterioration. If adverse effects on historic properties could result from the change of mission or subsequent disposition of these buildings, the SHPO must be consulted regarding the application of the criteria of adverse effect and in mitigation efforts to avoid or reduce any impacts in accordance with 36 CFR 800.

3.5.12 Waste Management

Construction. The Environmental Management Waste Management Facility and the Field Research Center activities would generate small amounts of nonhazardous construction waste under the No Action - Planning Basis Operations Alternative.

If the HEU Materials Facility is constructed at Site A, construction waste would be less than Site B. At Site A, approximately 3,823 m^3 (5,000 yd^3) of nonhazardous construction debris and 14.8 million L (3.9 million gal) of nonhazardous sanitary waste would be generated during the 4-year construction period. At Site B an additional 22,707 m^3 (29,700 yd^3) of contaminated soil (mixed LLW) would be excavated before building construction could begin. Construction of the Upgrade Expansion of Building 9215 would generate the least amount of construction waste; approximately 3,058 m^3 (4,000 yd^3) of nonhazardous construction debris and 14.8 million L (3.9 million gal) of nonhazardous sanitary waste.

Construction of the Special Materials Complex at Site 2 would generate the most construction waste and Site 1 the least. At Site 2, approximately 46,867 m^3 (61,300 yd^3) of contaminated soil (mixed LLW) would be excavated and an additional 3,420 m^3 (4,470 yd^3) of nonhazardous construction debris and 1.4 million L (382,400 gal) of nonhazardous sanitary waste would be generated. At Site 3, approximately 22,707 m^3 (29,700 yd^3) of contaminated soil would be excavated. The amount of construction debris and sanitary waste would be the same as Site 2. No contaminated soil would be excavated at Site 1 and approximately 1,447,541 L (382,400 gal) of nonhazardous sanitary waste would be generated. Small amounts of hazardous waste would be generated by the use of construction equipment, etc.

If both a new HEU Materials Facility and a new Special Materials Complex were constructed, the waste generated would be added to waste generated under the No Action - Planning Basis Operations Alternative. The contaminated soils would be mixed LLW. Use of construction equipment would generate small amounts of hazardous waste. Non-hazardous waste would consist primarily of construction debris and wastewater.

Operation. Under the No Action - Planning Basis Operations Alternative, mixed LLW and hazardous waste are expected to increase slightly from the No Action - Status Quo Alternative. LLW generation rate is expected to remain approximately the same as the No Action - Status Quo Alternative. Sanitary/industrial wastes are expected to decrease by a small amount (see Table 3.5–1 for amounts). The operation of the Environmental Management Waste Management Facility would be a beneficial impact on Y-12 Waste Management operations because it would expand on-site CERCLA waste disposal capacity.

Operation of the HEU Materials Facility would be expected to generate small amounts of LLW, hazardous, and nonhazardous waste per year (see Table 3.5–1 for amounts). The Upgrade Expansion of Building 9215 would generate similar small amounts of the same types of waste (see Table 3.5–1 for amounts). Adequate waste management capacity exists to support the expected waste volumes. The No Action - Planning Basis Operations Alternative Plus the HEU Materials Facility operation waste generation is shown in Table 3.5–1.

Operation of the Special Materials Complex would generate small amounts of hazardous and nonhazardous waste per year (see Table 3.5–1 for amounts). Less than 1 yd^3 of LLW would be generated per year from Analytical Chemistry testing in support of special materials operations. Special materials operations use no radiological materials. Adequate waste management capacity exists to support the expected waste volumes. The No Action - Planning Basis Operations Alternative Plus the Special Materials Complex operation waste generation is shown in Table 3.5–1.
Operation of both an HEU Materials Facility and a new Special Materials Complex would add to waste generated under the No Action - Planning Basis Operations Alternative (Table 3.5–1).

3.5.13 Environmental Justice

Construction. None of the proposed action alternatives would result in environmental justice impacts related to construction activities. There would be no significant health or environmental impacts on any populations. In addition, prevailing wind patterns are not in the direction of primarily minority or low-income populations. Therefore, any adverse impacts would not disproportionately affect these populations.

Operation. None of the proposed action alternatives would result in environmental justice impacts related to operation of Y-12 Plant facilities. There would be no significant health or environmental impacts on any populations. In addition, prevailing wind patterns are not in the direction of primarily minority of low-income populations. Therefore, any adverse impacts would not disproportionately affect these populations.

3.5.14 Worker and Public Health

Construction. Under the No Action - Planning Basis Operations Alternative, construction activities of the Environmental Management Waste Management Facility would be expected to result in approximately nine non-fatal occupational injuries/illnesses per year.

Construction of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would be expected to result in approximately three additional non-fatal occupational injuries/illnesses per year. Both facilities would require a 4-year construction period.

Construction of the Special Materials Complex would be expected to result in approximately three additional non-fatal occupational injuries/illnesses per year. The construction period for the Special Materials Complex is 3.5 years.

Operation. Under the No Action - Planning Basis Operations Alternative, the estimated number of non-fatal occupational injuries/illnesses per year for the total Y-12 workforce is 440. Because of the restart of all Y-12 mission operations, radiological impacts are expected. The annual average dose to workers would increase from the No Action - Status Quo Alternative (8.0 mrem [0.016 LCF per year]) by 3.6 mrem and result in an estimated 0.024 LCFs per year. The MEI dose would increase from the No Action - Status Quo Alternative (0.53 mrem [$2.65x10^{-7}$]) by 3.17 mrem/yr to 4.5 mrem/yr and result in an estimated $2.25x10^{-6}$ LCFs per year. The dose to the population within 80km (50 mi) would increase from The No Action - Status Quo Alternative (4.3 person-rem/yr [$2.15x10^{-6}$ LCFs per year]) by 29.4 person-rem/yr to 33.7 person-rem/yr and result in an estimated $1.69x10^{-5}$ LCFs per year.

Once constructed, the HEU Materials Facility or the Upgrade Expansion of Building 9215 would require the transfer of stored HEU in existing facilities to the new storage facility. This one-time transfer would expose workers involved in the transfer to an estimated dose of 150 mrem. An estimated 0.002 LCFs are expected from the transfer. For normal operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215, the worker dose is expected to be 21 mrem/yr and the same as for The No Action - Planning Basis Operations Alternative or The No Action - Status Quo Alternative. The MEI dose and the dose to the population within 80km (50 mi) would not change from the No Action - Planning Basis Operations Alternative or the No Action - Status Quo Alternative.

Operation of the Special Materials Complex involves no radiological materials. The MEI dose and the dose to the population within 80km (50 mi) would not change from that described above for the No Action - Planning Basis Operations Alternative.

3.5.15 Facility Accidents

Operation. Under the No Action - Planning Basis Operations Alternative, the beyond-design-basis earthquake accident would result in an estimated 0.202 LCFs to the population living within 80km (50 mi), the same as The No Action - Status Quo Alternative. The MEI of the public would receive a dose of 17 rem and result in an estimated 0.008 LCFs.

The postulated criticality accident Under the No Action - Planning Basis Operations Alternative would result in an estimated 0.0043 LCFs to the population living within 80km (50 mi), the same as The No Action - Status Quo Alternative. The MEI of the public would receive a dose of 3 rem and result in an estimated 1.5 x 10^{-3} LCFs.

The fire accident scenario involving radiological materials would result in an estimated 9 x 10^{-5} to 0.28 LCFs to the population living within 80km (50 mi), the same as The No Action - Status Quo Alternative. The dose to the MEI of the public would be 0.01 to 16 rem and result in an estimated 5 x 10^{-6} to 0.008 LCFs.

The potential accident involving a chemical release due to loss of contaminant would potentially expose between 200 and 1,000 workers at Y-12 to ERPG-2 concentrations or greater, the same as The No Action - Status Quo Alternative (See Appendix Section D.7.2.3 for definition of ERPG-2).

Except for the potential release of chlorine from the water treatment plant, no off-site exposure is expected. The release of chlorine from the water treatment plant would potentially expose up to 6,500 members of the public to ERPG-2 concentrations or greater.

Due to the design and facility construction, the HEU Materials Facility or the Upgrade Expansion of Building 9215 is expected to reduce the likelihood of a beyond-design-basis earthquake accident by approximately a factor of 5, the criticality accident by a factor of 2 to 5, and the accident involving radiological material by a factor of 2 to 5 compared to the current situation under the No Action - Status Quo Alternative. There would be no change from The No Action - Planning Basis Operations Alternative for chemical accidents.

There would be no change from the No Action - Planning Basis Operations Alternative for radiological accidents if the Special Materials Complex is constructed. The likelihood of chemical accidents for the Special Materials Complex would be lower by approximately a factor of 2 to 5 compared to the current situation under the No Action - Status Quo Alternative due to design and facility construction.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 1 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Land Use						
Construction:						
Potential Land Disturbance	None	26 to 40 ha (64 to 99 acres) for EMWMF	5 ha (12.4 acres) at Site A	0.8 ha (2 acres)	8 ha (20 acres) at Site 1	10-13 ha (24.7-32.1 acres)
		5 to 7 ha (12.4 to 17 acres) Y-12 West End Borrow Area	5 ha (12.4 acres) at Site B		5 ha (12.4 acres) at Site 2 and Site 3	
		4 ha (10 acres) Field Research Center				
		Total: 35-51 ha	**Total with No Action - Planning Basis Operations Alternative: 40-56 ha**	**Total with No Action - Planning Basis Operations Alternative: 36-52 ha**	**Total with No Action - Planning Basis Operations Alternative: 56-59 ha**	**Total with No Action - Planning Basis Operations Alternative: 45-64 ha**
Operation:						
Potential Permanent Land Requirement	No change from existing 2,136 ha (5,279 acres) comprising Y-12 Site	9 to 18 ha (22 to 44 acres) for EMWMF	4 ha (10 acres) at Site A	0.5 ha (1.2 acres)	4 ha (10 acres) at Sites 1, 2 or 3	8 ha (20 acres)
		5 to 7 ha (12.4 to 17 acres) for Borrow Area	4 ha (10 acres) at Site B			
		< 4 ha (<10 acres) Field Research Center				
		Total: 18-29 ha	**Total with No Action - Planning Basis Operations Alternative: 22-33 ha**	**Total with No Action - Planning Basis Operations Alternative: 18.5-29.5 ha**	**Total with No Action - Planning Basis Operations Alternative: 22-33 ha**	**Total with No Action - Planning Basis Operations Alternative: 26-37 ha**

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 2 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Transportation						
Construction:						
Additional Vehicles/Day	None	75 for EMWMF	165 worker vehicles at Site A and Site B; 8 Material Trucks	165 worker vehicles; 3 Material Trucks	157 worker vehicles at Site 1, Site 2, Site 3; 5 Material Trucks	335
		< 10 for Field Research Center				
		Total: 85 vehicles	**Total with No Action - Planning Basis Operations Alternative: 258 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 253 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 247 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 420 vehicles**
Operation:						
Additional Vehicles/Day	No change from average daily traffic volume of 32,100	28 for EMWMF	No additional worker traffic	No additional worker traffic	No additional worker traffic	No additional worker traffic
		6 for Field Research Center	3,000 additional truck trips on site to relocate stored HEU to new facility	3,000 additional truck trips on site to relocate stored HEU to new facility		
		Total: 34 vehicles	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**	**Total with No Action - Planning Basis Operations Alternative: 34 vehicles**

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 3 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Transportation Risk	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.	No additional risk from No Action - Status Quo Alternative associated with radiological material transportation under this alternative.	The risk associated with radiological material transportation would be less than 0.1 fatality per year.
	The risk associated with radiological waste transportation would be less than 0.1 fatality per year.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year. The risk associated with the one-time on site transport of stored HEU to new facility would be less than 0.001 fatality.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year. The risk associated with the one-time on site transport of stored HEU to new facility would be less than 0.001 fatality.	No additional risk from No Action - Status Quo Alternative with radiological waste transportation under this alternative.	The risk associated with radiological waste transportation would be less than 0.1 fatality per year.
Socioeconomics						
Construction:	No new construction	100 for EMWMF	220 for Site A and Site B	220	210 for Site 1, Site 2, Site 3	430
Peak Workforce		< 10 for Field Research Center				
		Total: 110 workers	**Total with No Action - Planning Basis Operations Alternative: 330 workers**	**Total with No Action - Planning Basis Operations Alternative: 330 workers**	**Total with No Action - Planning Basis Operations Alternative: 320 workers**	**Total with No Action - Planning Basis Operations Alternative: 540 workers**
Operation: (Workers)	No change from existing workforce of 8,900	25 for EMWMF	100 for one year transition period	100 for one year transition period	36 for Site 1, Site 2, Site 3	66

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 4 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
		6 for Field Research Center **Total: 31** Impact on Regional Economy < 1 percent	30 for normal operation **Total with No Action - Planning Basis Operations Alternative: 61** Impact on Regional Economy < 1 percent	49 for normal operation **Total with No Action - Planning Basis Operations Alternative: 70** Impact on Regional Economy < 1 percent	**Total with No Action - Planning Basis Operations Alternative: 97** Impact on Regional Economy < 1 percent	**Total with No Action - Planning Basis Operations Alternative: 97** Impact on Regional Economy < 1 percent
Geology and Soils						
<u>*Construction:*</u>	No new construction or potential increase in soil erosion	Potential increase in soil erosion due to storm water runoff from EMWMF and Y-12 borrow area. Detention basins and runoff control ditches would minimize soil erosion and impacts. Small potential increase in soil erosion from Field Research Center. Soil erosion controls would minimize impacts.	Potential increase in soil erosion due to storm water runoff at Site A construction lay down area and new parking lot. Detention basins and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected.	Small potential for increase in soil erosion. Standard soil erosion control measures would be used to minimize impacts. No impacts to geology are expected.	At Site 1, potential impact to soil profile and increase in soil erosion due to storm water runoff at construction lay down area and new parking lot. Detention basins and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected. Small potential increase in soil erosion at Site 2 and Site 3. No impacts to geology are expected.	Potential increase in soil erosion due to storm water runoff. Detention basins, silt fences, and runoff control ditches would minimize soil erosion and impacts. No impacts to geology are expected.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 5 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	No increase in soil erosion or impact to geology.	Minimal impacts expected from EMWMF and Y-12 borrow area activities. Detention basins, runoff control ditches, and cell design components would minimize impacts to geology and soils.	No impacts to geology or soils are expected at Site A or Site B with engineered design measures.	No impacts to geology or soils are expected with engineered design measures.	No impacts to geology or soils are expected at Site 1, Site 2, or Site 3 with engineered design measures.	Minimal impact expected due to EMWMF and borrow site activities. Engineered controls would minimize impacts.
Water Resources						
Surface Water:						
Construction:	No change from 15.7 MLD treated water requirement or 17.9 MLD raw water requirement. Surface water discharges meet NPDES permit limits.	No substantial change to surface raw water requirements, discharge, or water quality conditions. Small increase (4.5 MLD) to 20.2 MLD in treated water requirement. Minimal impacts from sediment loading or contaminated runoff from EMWMF or Y-12 borrow area due to engineered barriers (e.g., detention basins, stormwater runoff control ditches).	No substantial change to surface raw water requirements, discharge, or water quality conditions. Small amount (5,140 L/day) of treated water requirement (7.5 million L during 4-yr. construction period) if HEU Materials Facility is constructed at Site A or Site B. Potential for increased storm water runoff at Site A.	No substantial change to surface raw water requirements, discharge, or water quality conditions. Small amount (3,980 L/day) of treated water requirements (5.7 million L during 4-yr. construction period) if Upgrade Expansion to Building 9215 is constructed.	No substantial change to surface raw water requirements, discharge, or water quality. Small amount (4,460 L/day) of treated water requirement (5.7 million L during 3.5-yr. construction period) if Special Materials Complex is constructed at Site 1, Site 2 or Site 3. Potential for increased stormwater runoff at Site 1.	No substantial change to surface raw water requirements, discharge, or water quality. Small increase (4,510,000 L/day) to 20.21 MLD in treated water requirement.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 6 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation*</u>:	No change from 15.7 MLD treated water requirement or 17.9 MLD raw water requirement. Surface water discharges meet NPDES permit limits.	No impacts from Field Research Center activities.	Negligible impact to surface water with soil erosion and surface water control measures.	Negligible impact to surface water with soil erosion and surface water control measures.	Negligible impact to surface water with soil erosion and surface water control measures.	Negligible impact to surface water with soil erosion and surface water control measures.
		No substantial change to surface raw water requirements, discharge, or water quality conditions. Small increase (4.5 MLD [1.2 MGD]) to 20.2 MLD (5.34 MGD) in treated water requirement. Minimal impacts from sediment loading or contaminated runoff from EMWMF or Y-12 borrow area due to engineered barriers (e.g., detention basins, stormwater runoff control ditches).	Small increase (1,510 L/day [400 gal/day]) in treated water requirements and discharge but negligible increase from No Action - Planning Basis Operations Alternative surface water requirements, discharges, or water quality conditions at Site A or Site B. All water quality parameters within established limits with pretreatment.	Small increase (1,975 L/day [520 gal/day]) in treated water requirements and discharge but negligible increase from No Action - Planning Basis Operations Alternative water requirements, discharge, or water quality conditions. All water quality parameters within established limits with pretreatment.	Small increase (228,600 L/day [63,000 gal/day]) in treated water requirements and discharge but negligible increase from No Action - Planning Basis Operations Alternative surface water requirements, discharges, or water quality conditions. All water quality parameters within established limits with pretreatment.	Small increase (20.43 MLD [5.4 MGD]) in treated water requirements over No Action - Status Quo Alternative but negligible increase to raw water requirements, discharges, or water quality conditions. All water quality parameters within established limits with pretreatment. Negligible impacts to surface water with soil erosion and surface No Action - Planning Basis Operations Alternative water control measures.
Groundwater						
<u>*Construction:*</u>	No new construction or change in groundwater use or quality.	Negligible impact from tracer material used in Field Research Center tests. No groundwater requirement or additional impacts to groundwater quality conditions from the EMWMF or Y-12 borrow area. No groundwater requirement or additional impacts to groundwater quality conditions from the Field Research Center.	Negligible impacts to surface water with soil erosion and surface water control measures. No groundwater requirement or additional impacts to groundwater quality conditions if new HEU Materials Facility is constructed at Site A or Site B.	Negligible impacts to surface water with soil erosion and surface water control measures. No groundwater requirement or additional impacts to groundwater quality conditions if new Building 9215 expansion is constructed.	Negligible impacts to surface water with soil erosion and surface water control measures. No groundwater requirement or additional impacts to groundwater quality conditions if new Special Materials Complex is constructed at Site 1, Site 2, or Site 3.	No groundwater requirement or additional impacts to groundwater quality conditions.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 7 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	No groundwater requirement or change in groundwater use or quality.	No groundwater requirement or additional impacts to groundwater quality conditions from the EMWMF. The EMWMF design measures (e.g., natural and man-made synthetic liners) would prevent releases that could impact groundwater quality.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.	No groundwater requirement or additional impacts to groundwater quality conditions from new facility.
		Field Research Center sampling activities would remove approximately 7,570 L (2,000 gal) of groundwater per year. Minor impacts to groundwater quality due to injected additives and tracers for research study. Groundwater quality may improve with some research study treatment tests.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.	Same No Action - Planning Basis Operations Alternative Field Research Center potential groundwater impacts.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 8 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Biological Resources						
Terrestrial						
Construction:	No new construction or impacts to terrestrial resources.	Impacts due to land clearing activities associated with EMWMF and Y-12 borrow area, loss of grassland, old field habitat, and mixed hardwood/conifer forest habitat. Small animal dislocation and reduction in abundance can be expected.	Impacts due to land clearing activities for construction and new parking lot if HEU Materials Facility is constructed at Site A. Loss of grassland, habitat (~2 ha [5 acres]) and small animal dislocation and disturbance can be expected.	Negligible impacts if new addition to Building 9215 is constructed.	Impacts due to land clearing activities at constructions site and construction lay down area if Special Materials Complex is constructed at Site 1. Loss of approximately 4 ha (10 acres) terrestrial habitat and dislocation/disturb-ance of wildlife.	Impacts due to land clearing activities and construction sites. Loss of grassland, old field habitat, and mixed hardwood/conifer forest habitat. Dislocation and disturbance to wildlife can be expected.
		Minimal impact to terrestrial species or habitat from Field Research Center activities.	Negligible impacts if HEU Materials Facility is constructed at Site B.		Negligible impacts if Special Materials Complex is constructed at Site 2 or Site 3.	
Operation:	No new impacts to terrestrial resources from Y-12 operations.	Minor impact to terrestrial resources from the EMWMF or Y-12 borrow area. Operations noise and human activity may disturb or displace some wildlife. Negligible impact to terrestrial resources from Field Research Center activities. Noise and human activity may disturb or displace some wildlife.	Negligible impacts at Site A or Site B from operations due to noise and human activity.	Negligible impacts from operations due to noise and human activity.	Negligible impacts at Site 1, Site 2, or Site 3 from operations due to noise and human activity.	Negligible impacts due to operation noise and human disturbance.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 9 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Wetlands						
<u>*Construction:*</u>	No change in the 18 wetlands (6.14 ha [15.2 acres]) within the Y-12 area of analysis.	Potential impact to 0.4 ha (1 acre) wetland from EMWMF. No impact from Y-12 borrow area activities. No impact from Field Research Center activities. **Total: 0.4 ha (1 acre)**	Potential impact to 3 man-made wetlands (0.4 ha [1 acre]) if the HEU Materials Facility is constructed at Site A. Impacts due to construction of lay down area and new parking lot. No impacts to wetlands if HEU Materials Facility is constructed at Site B. **Total with No Action - Planning Basis Operations Alternative: 0.8 ha (2 acres)**	No impacts to wetlands if new expansion to Building 9215 is constructed. **Total with No Action - Planning Basis Operations Alternative: 0.4 ha (1 acre)**	Potential impact on 2 man-made wetlands (0.4 ha [1 acres]) if Special Materials Complex is constructed at Site 1. Impacts due to land clearing and potential sedimentation from construction activities. No impact on wetlands if Special Materials Complex is constructed at Site 2 or Site 3. **Total with No Action - Planning Basis Operations Alternative: 0.8 ha (2 acres)**	Potential impact to 0.8 ha (2 acres) of wetlands within the Y-12 area of analysis. **Total with No Action - Planning Basis Operations Alternative: 1.2 ha (3 acres)**
<u>*Operation:*</u>	No change in the 18 wetlands within the Y-12 area of analysis.	No impacts on wetlands from EMWMF or Y-12 borrow area operation activities. No impacts on wetlands from Field Research Center operation activities.	No impacts on wetlands at Site A or Site B from HEU Materials Facility operation.	No impacts to wetlands from operation.	No impacts on wetlands from Special Materials Complex operation.	No impacts on wetlands.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 10 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Aquatic						
Construction:	No new construction or change to aquatic resources.	No impacts to aquatic resources from EMWMF or Y-12 borrow area activities. No impact from Field Research Center activities.	No impacts to aquatic resources if HEU Materials Facility is constructed at Site A or Site B.	No impacts to aquatic resources if expansion to Building 9215 is constructed.	No impacts to aquatic resources if Special Materials Complex is constructed at Site 1, Site 2, or Site 3.	No impacts to aquatic resources.
Operation:	No change in aquatic resources from Y-12 operation activities. No impacts to aquatic resources.	No impacts to aquatic resources from EMWMF or Y-12 borrow area operation. No impact from Field Research Center operations activities.	No impacts to aquatic resources from HEU Materials Facility operation.	No impacts to aquatic resources from new storage expansion operation.	No impacts to aquatic resources from Special Materials Complex operation.	No impacts to aquatic resources.
Threatened/Endangered Species						
Construction:	No new construction or impacts to threatened/ endangered species within Y-12 area of analysis.	Potential impacts to Tennessee Endangered species pink lady slipper and Tennessee Threatened species tuberculed rein-orchid and carolina quillwort from EMWMF construction activities. Impacts due to forest clearing and construction activities in close proximity to sensitive habitat.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species if HEU Materials Facility is constructed at Site A or Site B.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species if storage expansion to Building 9215 is constructed.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species if Special Materials Complex is constructed at Site 1, Site 2 or Site 3.	Potential impacts from EMWMF under No Action - Planning Basis Operations Alternative. No impacts to threatened/endangered species from HEU Materials Facility or Special Materials Complex.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 11 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	No impacts to threatened/ endangered species from operation activities.	No impact from Y-12 borrow area activities to threatened/endangered species. No impact from Field Research Center operation activities.	No impact to threatened/endangered species from HEU Materials Facility operation.	No impact to threatened/endangered species from storage expansion operation.	No impact to threatened/endangered species from Special Materials Complex operation.	No impact to threatened/endangered species from operations.
Air Quality						
Nonradiological Emissions						
Construction:	No new construction. All criteria pollutant levels within acceptable standards.	Potential fugitive dust emissions from EMWMF and Y-12 borrow area during construction. Standard dust control measures would be used. No off-site impact. Potential fugitive dust emissions from Field Research Center due to minor site clearing and drilling activities. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions if HEU Materials Facility is constructed at Site A or Site B. Site A construction activities would generate more fugitive dust emissions due to site preparation for new parking lot and lay down area. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions if expansion to Building 9215 is constructed. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions if Special Materials Complex is constructed at Site 1, Site 2, or Site 3. Site 1 construction activities would generate more fugitive dust emissions than Site 2 or Site 3 due to larger construction site, land clearing, and lay-down area site preparation. Standard dust control measures would be used. No off-site impacts.	Potential fugitive dust emissions due to land disturbance and construction activities. Standard dust control measures would be used to minimize fugitive dust impacts. No off-site impacts.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 12 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	Concentrations of regulated nonradiological air pollutants are within standards except for 1-hour ozone. Concentrations of mercury vapor are well below the ACGIH TLV of 50 $\mu g/m^3$.	No change to No Action - Status Quo Alternative air quality conditions from Y-12 mission normal operations. Nonradiological air pollutant concentrations would increase but would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Planning Basis Operations Alternative air quality conditions from HEU storage operations. Nonradiological air pollutant concentrations would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Planning Basis Operations Alternative air quality conditions from new storage expansion operations. Nonradiological air pollutant concentrations would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Planning Basis Operations Alternative air quality conditions from special materials operations. Nonradiological air pollutant concentrations would be well within established criteria. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.	No change to No Action - Status Quo Alternative air quality conditions. Nonradiological air pollutant concentrations would increase but would be within established standards. Potential impact if Y-12 Steam Plant operated at 522 million BTU/hr heat input capacity from higher ozone concentrations.
Radiological Emissions						
Construction:	No new construction or change in Y-12 radiological emissions.	No radiological emissions from EMWMF construction activities.	No radiological emissions from construction of HEU Materials Facility at Site A or Site B.	No radiological emission from construction of storage expansion to Building 9215.	No radiological emissions from construction of Special Materials Complex at Site 1, Site 2, or Site 3.	No radiological emissions.
		No radiological emissions from Field Research Center construction activities.				
Operation:	Radiation dose to the MEI is 0.53 mrem. The dose is well below the NESHAP standard of 10 mrem/yr.	Radiation dose to the MEI (1,080 m [3,543 ft] from Y-12) would increase from 0.53 mrem/yr under No Action - Status Quo Alternative to 4.5 mrem/yr. The dose is well below the NESHAP standard of 10 mrem/yr.	No change from No Action - Planning Basis Operations Alternative if HEU Materials Facility is constructed. Radiation dose to MEI would be 4.5 mrem/yr.	No change from No Action - Planning Basis Operations Alternative if storage expansion to Building 9215 is constructed. Radiation dose to MEI would be 4.5 mrem/yr.	No change from No Action - Planning Basis Operations Alternative. No radioactive materials would be used or stored at the complex. Radiation dose to MEI would be 4.5 mrem/ yr.	Radiation dose to the MEI would increase from 0.53 mrem/yr under No Action - Status Quo Alternative to 4.5 mrem/yr. The dose is well below the NESHAP standard of 10 mrem/yr.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 13 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
	Radiation dose to the population within 80 km (50 mi) is 4.3 person-rem/yr.	Radiation dose to the population (80 km [50 mi] radius) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.	Radiation dose to the population within 80 km (50 mi) would be 33.7 person-rem/yr.
Visual Resources						
Construction:	No change in Y-12 Site visual setting or visual resources.	The EMWMF, Y-12 borrow area, and Field Research Center Project areas are not visible to the public. The site construction activities would be compatible with current uses and consistent with existing visual character of the area. No additional impact to visual resources.	Site A and Site B for the HEU Materials Facility are not visible to the public. No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.	The Building 9215 expansion site is not visible to the public. No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.	Site 1, Site 2, and Site 3 for the new Special Materials Complex are not visible to the public. No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.	No additional impact to visual resources from No Action - Status Quo Alternative under this alternative.
Operation:	No change in Y-12 Site visual setting or visual resources.	No additional impact to visual resources from No Action - Status Quo Alternative.	No additional impact to visual resources from No Action - Status Quo Alternative. The new HEU materials facility would be consistent with the existing visual character of the area.	No additional impact to visual resources from No Action - Status Quo Alternative. The Building 9215 expansion would be consistent with the existing visual character of the area.	No additional impact to visual resources from No Action - Status Quo Alternative. The new Special Materials Complex would be consistent with the existing visual character of the area.	No additional impact to visual resources from No Action - Status Quo Alternative. New facilities would be consistent with the existing visual character of the area.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 14 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Noise						
<u>*Construction:*</u>	No change in on-site noise levels of 50 to 70 dBA. Off-site noise levels would remain at 35 to 50 dBA in rural locations and 53 to 62 dBA in city of Oak Ridge.	Increase in noise levels due to construction equipment and activities associated with EMWMF and Y-12 borrow area. Impact would be limited to general construction area and not noticeable to the public. Small increase in noise levels from Field Research Center activities but localized in study area.	Increase in noise levels (89 to 108 dBA) if HEU Materials Facility is constructed at Site A or Site B. Impacts would be limited to general construction area. No off-site noise impacts except for construction vehicle traffic.	Localized increase in noise levels (89 to 108 dBA) if storage expansion to Building 9215 is constructed. No off-site noise impacts except for construction vehicle traffic.	Increase in noise levels (89 to 108 dBA) if Special Materials Complex is constructed at Site 1, Site 2, or Site 3. Impacts would be limited to general construction area. No off-site impacts except for construction vehicle traffic.	Increase in noise levels (89 to 108 dBA) due to construction equipment and activities. Impacts would be limited to the general construction area sites. Cumulative noise levels 70 dBA. No off-site impacts except for construction vehicle traffic.
<u>*Operation:*</u>	No change in on-site noise levels of 50 to 70 dBA. Off-site noise levels would remain at 35 to 50 dBA in rural locations and 53 to 62 dBA in city of Oak Ridge.	No off-site increase in noise levels from No Action - Status Quo Alternative due to operation of the EMWMF, the Field Research Center, or activities at Y-12 borrow area.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.	No off-site change from No Action - Status Quo Alternative noise levels. On-site noise levels would be in range of 50 to 70 dBA.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 15 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Site Infrastructure						
Construction:	No measurable change in Y-12 site energy usage or other infrastructure resources.	No measurable change in Y-12 site energy usage or other infrastructure resources from the construction of the EMWMF or Field Research Center.	If the HEU Materials Facility is constructed at Site A, existing utilities would require relocation but no buildings would be demolished. Construction resources include 25,100 m^3 (32,830 yd^3) of concrete and 7.5 million L (2 million gal) of water during the 4-year construction period. If the HEU Materials Facility is constructed at Site B existing infrastructure (Old Bear Creek Road) and utilities would require relocation. Eight buildings would be demolished. Construction resources include 25,100 m^3 (32,830 yd^3) of concrete and 7.5 million L (2 million gal) of water during the 4-year construction period.	If the Building 9215 expansion is constructed existing utilites would require relocation. No permanent building would be demolished. Construction resources include 7,650 m^3 (10,005 yd^3) of concrete and 5.7 million L (1.5 million gal) of water during the 4-year construction period.	If the Special Materials Complex is constructed at Sites 1, 2, or 3, existing utilities would require relocation. A number of buildings would be demolished at Site 2 and Site 3. Construction resources include 13,800 m^3 (18,050 yd^3) of concrete for Site 1 and 14,500m^3 (18,966 yd^3) for Site 2 and Site 3.	If the HEU Material Facility is constructed at Site A or B and the Special Materials Complex is constructed at Site 1, 2, or 3, existing utilities would require relocation and up to 16 buildings would be demolished. Construction resources would include 46,630 m^3 (61,000 yd^3) of concrete and 13.2 million L (3.5 million gal) of water during the construction period which could run from 4 to 7.5 years.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 16 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	Continue electrical usage of 377,000 MWh/yr and water usage of 15.7 MLD (4.2 MGD). Both amounts well within existing Y-12 site capacities.	Small increase in overall Y-12 energy and resource requirements. Electrical energy consumption would increase to 566,000 MWh/yr from 377,000 MWh/yr under No Action - Status Quo Alternative. Increases would be well within existing capacities at Y-12. Water usage would increase to 20.2 MLD (5.3 MGD) from 15.7 MLD (4.2 MGD) under No Action - Status Quo Alternative.	Increase of electrical usage by 5,900 MWh/yr and water usage of 1,510L/day (400 gal/day). Vacating existing HEU storage facilities could partially offset these increases. Sufficient capacity exists to support the increases.	Increase in electrical usage by 10,900 MWh/yr and water usage of 1,975L/day (520 gal/day). Vacating existing HEU storage facilities could partially offset these projected increases. Sufficient capacity exists to support the increases.	Increase in electrical usage by 30,400 MWh/yr and water usage of 228,600L/day (60,400 gal/day). Vacating existing Special Materials operations facilities could partially offset these projected increases. Sufficient capacity exists to support the increases.	Increase in electrical usage by 36,300 Mwh/yr Water usage would increase by 230,110 L/day (60,788 gal/day). Sufficient capacity exists to support the increases.
		Total: 566,000 MWh/y in electrical usage (an increase of 189,000). Combined water use increase of 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 572,000 MWh/yr in electrical usage (an increase of 194,900). Combined water use increase would still be approximately 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 577,000 Mwh/yr in electrical usage (an increase of 199,900). Combined water usage increase would still be approximately 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 596,000 Mwh/yr in electrical usage (an increase of 217,900). Combined water usage increase would still be approximately 5.3 MGD.	**Total with No Action - Planning Basis Operations Alternative:** 602,000 Mwh/yr in electrical usage (an increase of 225,300). Combined water usage increase would be approximately 5.4 MGD.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 17 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Cultural Resources						
Construction:	No new construction or building modification; no impacts to cultural resources is expected	No impact to cultural resources is expected from the EMWMF, Y-12 Borrow area, or Field Research Center activities.	No impact to cultural resources is expected from construction of HEU Materials Facility at Site A or Site B. Utility relocation associated with construction could encounter buried cultural resources. Any potential adverse effects are anticipated to be minor and mitigatable.	The expansion of Building 9215 would be a major alteration of a historic property. Consultation with the Tennessee Historical Commission (SHPO)would be conducted in accordance with procedures in the Y-12 Cultural Resources Management Plan.	No impact to cultural resources is expected from construction of the Special Materials Complex at Site 1, Site 2, or Site 3. No historic properties would be affected. Utility relocation or site construction activities could encounter buried cultural resources. Any potential effects are anticipated to be minor and mitigatable.	No impact to cultural resources is expected. Utility relocation or site construction activities could encounter buried cultural resources. Any potential effects are anticipated to be minor and mitigatable.
Operation:	The continued use of buildings in their historic role would have a positive impact on the integrity of historic properties. Ongoing minor impacts due to aging of historic structures.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.	No additional impact from No Action - Status Quo Alternative to cultural resources is expected.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 18 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Waste Management						
Construction:	No new construction waste would be generated as a result of operations.	Small amounts of non-hazardous construction waste generated from the EMWMF, Y-12 borrow area, and Field Research Center construction activities.	At Site A, approximately 3,823m^3 (5,000 yd^3) of non-hazardous construction debris and 14.8 million L (3.9 million gal) of non-hazardous sanitary waste would be generated during the 4-year construction period.	Approximately 3,058 m^3 (4,000 yd^3) of non-hazardous construction debris and 14.8 million L (3.9 million gal) of non-hazardous sanitary waste would be generated during the 4-year construction period.	At Site 1, approximately 917m^3 (1,200 yd^3) of non-hazardous construction debris and 1,447,541 L (382,400 gal) of non-hazardous sanitary waste would be generated during the 3.5-year construction period.	Under this alternative approximately 7,268m^3 (9,506 yd^3) of non-hazardous construction debris and 15,995,000L (4.2 million gal) of non-hazardous sanitary waste and would be generated.
			At Site B, approximately 3,823m^3 (5,000 yd^3) of non-hazardous construction debris and 14.8 million L (3.9 million gal) of non-hazardous sanitary waste would be generated during the 4-year construction period.		At Site 2, approximately 3,420 m^3 (4,470 yd^3) of non-hazardous construction debris and 1,447,541 L (382,400 gal) of non-hazardous sanitary waste would be generated during the 3.5-year construction period.	
			An additional 22,707m^3 (29,700 yd^3) of contaminated soil (mixed LLW) would be excavated.		An additional 46,867 m^3 (61,300 yd^3) of contaminated soil (mixed LLW) would be excavated.	An additional 69,574m^3 (90,999 yd^3) of contaminated soil would be excavated (mixed LLW).

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 19 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
					At Site 3, approximately 22,707m3 (29,700 yd^3) of contaminated soil (mixed LLW) would be excavated. An additional 3,445m^3 (4,500 yd^3) of non-hazardous construction debris and 1,447,541m3 (382,400 gal) of non hazardous sanitary waste would be generated during the 3.5 year construction period.	
			An estimated 3,000L (800 gal) and 38m^3 (50 yd^3) of hazardous waste would be generated from the use of construction equipment.	An estimated 1,100L (300 gal) and 15m^3 (20 yd^3) of hazardous waste would be generated from the use of construction equipment.	Up to 11,400L (3,000 gal) and 107m^3 (140 yd^3) of hazardous waste would be generated at any one site from the use of construction equipment.	An estimated 14,400L (3,804 gal) and 145m^3 (190 yd^3) of hazardous waste would be generated from use of construction equipment.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 20 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation:*</u>	Annual waste generation at Y-12 (1998) included:	Projected annual waste generation (1998) plus waste forecast:	Operation of the HEU Materials Facility would generate the following additional amounts of waste per year:	Operation of the Building 2915 storage expansion would generate the following additional amounts of waste per year:	Operation of the Special Materials Complex would generate the following additional amounts of waste per year:	Operation of the HEU Materials Facility and Special Materials Complex would generate the following total amounts of waste per year:
	LLW Liquid 1,000,000L (264,172 gal) Solid 1,224 m^3 (1,601 yd^3)	**LLW** Liquid 1,118,800L (295,556 gal) Solid 2,099 m^3 (2,745 yd^3)	**LLW** Liquid 757L (200 gal) Solid 119 m^3 (156 yd^3)	**LLW** Liquid 606L (160 gal) Solid 119m^3 (156 yd^3)	**LLW** Liquid - None Solid 0.8 m^3 (1 yd^3)	**LLW** Liquid 757 L (200 gal) Solid 120 m^3 (157 yd^3)
	Mixed LLW Liquid 22,500L (5,944 gal) Solid 33 m^3 (43 yd^3)	**Mixed LLW** Liquid 936,783 L (247,477 gal) Solid 162 m^3 (212 yd^3)	**Mixed LLW** Liquid - None Solid - None	**Mixed LLW** Liquid - None Solid - None	**Mixed LLW** Liquid - None Solid - None	**Mixed LLW** Liquid - None Solid - None
	Hazardous Liquid 3,300L (872 gal) Solid 8 m^3 (10 yd^3)	**Hazardous** Liquid 10,400L (2,748 gal) Solid 26 m^3 (34 yd^3)	**Hazardous** Liquid 2,498L (660 gal) Solid 1.5 m^3 (2 yd^3)	**Hazardous** Liquid 2,498L (660 gal) Solid 1.5 m^3 (2 yd^3)	**Hazardous** Liquid 12,500L (3,302 gal) Solid 9.2 m^3 (12 yd^3)	**Hazardous** Liquid 14,998 L (3,962 gal) Solid 10.7 m^3 (48 yd^3)
	Sanitary/Ind Liquid 1,406,000L (371,426 gal) Solid 5,389 m^3 (7,049 yd^3).	**Sanitary/Ind** Liquid 2,318,000L (612,298 gal) Solid 8,883 m^3 (11,619 yd^3). The EMWMF would have a beneficial impact on Y-12 waste management by providing on-site disposal capacity.	**Sanitary/Ind** Liquid 781,309L (206,400 gal) Solid 179 m^3 (234 yd^3).	**Sanitary/Ind** Liquid 1,273,601L (336,450 gal) Solid 179 m^3 (234 yd^3).	**Sanitary/Ind** Liquid 932,725L (246,400 gal) Solid 175 m^3 (229 yd^3).	**Sanitary/Ind** Liquid 1,714,034 L (452,800 gal) Solid 354 m^3 (463 yd^3)

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 21 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
			Total with No Action - Planning Basis Operations Alternative: **LLW** Liquid 1,119,557L (295,756 gal) Solid 2,218 m^3 (2,901 yd^3) **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162 m^3 (212 yd^3) **Hazardous** Liquid 12,898L (3,408 gal) Solid 27.7 m^3 (36.2 yd^3) **Sanitary/Ind** Liquid 3,099,309L (818,698 gal) Solid 9,062 m^3 (11,853 yd^3) These increases could be partially offset by reductions due to the phase-out of existing HEU storage operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.	**Total with No Action - Planning Basis Operations Alternative:** **LLW** Liquid 1,119,406L (295,716 gal) Solid 2,218 m^3 (2,901 yd^3); **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162 m^3 (212 yd^3) **Hazardous** Liquid 12,898L (3,408 gal) Solid 27.7 m^3 (36.2 yd^3) **Sanitary/Ind** Liquid 3,591,601L (948,748 gal) Solid 9,062 m^3 (11,853 yd^3) These increases could be partially offset by reductions due to the phase-out of existing HEU storage operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.	**Total with No Action - Planning Basis Operations Alternative:** **LLW** Liquid 1,118,800L (295,556 gal) Solid 2,100 m^3 (2,746 yd^3) **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162 m^3 (212 yd^3) **Hazardous** Liquid 22,900L (6,050 gal) Solid 35.3 m^3 (46.2 yd^3) **Sanitary/Ind** Liquid 3,250,725L (858,698 gal) Solid 9,058 m^3 (11,848 yd^3) These increases could be partially offset by reductions due to the phase-out of existing Special Materials operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.	**Total with No Action - Planning Basis Operations Alternative:** **LLW** Liquid 1,119,557L (295,756 gal) Solid 2,219 m^3 (2,902 yd^3) **Mixed LLW** Liquid 936,783L (247,477 gal) Solid 162m^3 (212 yd^3) **Hazardous** Liquid 25,398L (6,710 gal) Solid 37 m^3 (48 yd^3) **Sanitary/Ind** Liquid 4,032,034L (1,065,100 gal) Solid 9,237 m^3 (12,082 yd^3) These increases could be partially offset by reductions due to the phase-out of existing HEU storage and Special Materials operations and facilities. Adequate waste management capacity exists to support the expected waste volumes.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 22 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Worker and Public Health						
Construction:	Nonfatal occupational injury/illness rate (per 100 workers) 4-year average is 8.58. Total number of injuries/illnesses calculated for a Y-12 worker population of 5,105 under No Action - Status Quo Alternative is 438 per year.	Construction of the EMWMF and activities associated with the Field Research Center would be expected to result in approximately 9 additional non-fatal occupational injuries/illnesses per year during construction.	Construction of the HEU Materials Facility would be expected to result in approximately 3 additional non-fatal occupational injuries/illnesses per year during the 4-year construction period. **Total with No Action - Planning Basis Operations Alternative: 12 additional nonfatal injuries/illnesses per year during construction.**	Construction of the Building 9215 storage expansions would be expected to result in approximately 3 additional non-fatal occupational injuries/illnesses per year during the 4-year construction period. **Total with No Action - Planning Basis Operations Alternative: 12 additional nonfatal injuries/illnesses per year during construction.**	Construction of the Special Materials Complex would be expected to result in approximately 3 additional non-fatal injuries/illnesses per year during the 3.5-year construction period. **Total with No Action - Planning Basis Operations Alternative: 12 additional nonfatal injuries/illnesses per year during construction.**	Construction activities would result in approximately 16 additional nonfatal injuries/illnesses per year during construction under this alternative. **Total with No Action - Planning Basis Operations Alternative: 15 additional nonfatal injuries/illnesses per year during construction.**

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 23 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Operation:	Nonfatal occupational injury/illness rate (per 100 workers) 4-year average is 8.58. Total number of injuries/illnesses calculated for a Y-12 worker population of 5,105 under No Action - Status Quo Alternative is 438.	The estimated total number of non-fatal occupational injuries/illnesses per year for the Y-12 workforce (5,128) is 440.	The estimated total number of nonfatal occupational injuries/illnesses per year for the Y-12 workforce would be 440.	The estimated total number of nonfatal occupational injuries/illnesses per year for the Y-12 workforce would be 440.	The estimated total number of nonfatal occupational injuries/illnesses per year for the Y-12 workforce would be 440.	The estimated total number of nonfatal occupational injuries/illnesses per year would be 440.
	No change in the annual average dose to workers of 8.0 mrem. LCF's per year of exposure would be 0.016. HEU storage operations worker dose of 21 mrem (0.0003 LCF's).	The annual average dose to workers would increase by 3.6 mrem to 11.6 mrem. The estimated number of LCFs per year of exposure would increase to 0.024.	The annual average dose to Y-12 workers would be the same as No Action - Planning Basis Operations Alternative (11.6 mrem) an increase of 3.6 mrem from No Action - Status Quo Alternative. The estimated number of LCFs would be 0.024 per year.	The annual average dose to Y-12 workers would be the same as No Action - Planning Basis Operations Alternative (11.6 mrem) an increase of 3.6 mrem from No Action - Status Quo Alternative. The estimated number of LCFs would be 0.024 per year.	The annual average dose to Y-12 workers would be the same as No Action - Planning Basis Operations Alternative (11.6 mrem) an increase of 3.6 mrem from No Action - Status Quo Alternative. The estimated number of LCFs would be 0.024 per year.	The annual average worker dose to all Y-12 workers would increase from 8.0 mrem under No Action - Status Quo Alternative to 11.6 mrem under this alternative. The estimated number of LCFs per years of exposure would increase to 0.024 from 0.016 (No Action - Status Quo Alternative).
			For the HEU Materials Facility normal operations the worker dose would be 21 mrem. The estimated number of LCFs would decrease from 0.0003 for No Action - Status Quo Alternative HEU storage operations to 0.0001 under this alternative.	For Building 9215 storage expansion normal operations, the worker dose would be 21 mrem. The estimated number of LCFs would decrease from 0.0003 for No Action - Status Quo Alternative to 0.0001 under this alternative HEU storage operations.		

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 24 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
			The one-time transfer of stored HEU to the new HEU Materials Facility would result in a worker dose of 150 mrem to the 35 involved workers. The estimated number of LCFs is 0.002.	The one-time transfer of stored HEU to the new Building 9215 expansion would result in a worker dose of 150 mrem to the 35 involved workers. The estimated number of LCFs is 0.002.		This one-time transfer of stored HEU to the new HEU Materials Facility would result in a worker dose of 150 mrem to the 35 involved workers. The estimated number of LCFs is 0.002.
	The MEI dose is 0.53 mrem/yr. The estimated number of LCF's is $2.65x10^{-7}$.	The MEI dose would increase by 3.97 mrem/yr to 4.5 mrem/yr. The estimated number of LCFs per year of exposure would increase by $1.985x10^{-6}$ to $2.25x10^{-6}$.	The MEI dose would not change from the 4.5 mrem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 3.97 mrem/yr from the 0.53 mrem/yr under No Action - Status Quo Alternative).	The MEI dose would not change from the 4.5 mrem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 3.97 mrem/yr from the 0.53 mrem/yr under No Action - Status Quo Alternative).	The MEI dose would not change from the 4.5 mrem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 3.97 mrem/yr from the 0.53 mrem/yr under No Action - Status Quo Alternative).	The MEI dose would increase by 3.97 mrem/yr from 0.53 mrem/yr under No Action - Status Quo Alternative to 4.5 mrem/yr under this alternative. The estimated number of LCFs per year of exposure would increase by 0.0158 from 0.0002 (No Action- Status Quo Alternative) to 0.016.
	The 80 km (50 mi) population dose is 4.3 person-rem/yr. The estimated number of LCF's is $2.15x10^{-6}$.	The 80 km (50 mi) population dose would increase by 29.4 person-rem/yr to 33.7 person-rem/yr. The estimated number of LCFs per year of exposure would increase by $1.75x10^{-5}$ to $1.69x10^{-5}$.	The 80 km (50 mi) population dose would not change from the 33.7 person-rem/yr under No Action - Planning Basis Operations Alternative (this would be an increase of 29.4 person-rem/yr under No Action - Status Quo Alternative).	The 80 km (50 mi) population dose would not change from the 33.7 person-rem/yr under No Action - Planning Basis Operations Alternative (this would be an increase from of 29.4 person-rem/yr under No Action - Status Quo Alternative).	The 80 km (50 mi) population dose would not change from the 33.7 person-rem/yr under No Action - Planning Basis Operations Alternative (this would be an increase from of 29.4 person-rem/yr under No Action - Status Quo Alternative).	The 80 km (50 mi) population dose would increase by 29.4 person-rem/yr from 4.3 person-rem/yr under No Action - Status Quo Alternative to 33.7 person-rem/yr under this alternative. The estimated number of LCFs per year would increase by 0.0168 from 0.0002 (No Action - Status Quo) to 0.017.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 25 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Environmental Justice						
Operation:	Routine operations pose no significant health risks or adverse socioeconomic impacts to the public; no disproportionately high and or adverse effects on minority or low-income populations.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.	Routine operations would pose no significant health risks or adverse socioeconomic impacts to the public under this alternative; therefore no disproportionately high or adverse effects on minority or low-income populations is expected.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 26 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
Facility Accidents						
Operation: (Radiological):	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**	**Beyond Design-Basis Earthquake Accident:**
Dose and increased likelihood of a cancer fatality per year:	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11	Collocated Worker Maximally Exposed Individual: Dose-30 rem LCF-0.012 Y-12 Plant Population: Dose-26,500 person-rem LCF-11
	Public Maximally Exposed Individual: Dose-17 rem LCF-0.008	Public Maximally Exposed Individual: Dose-17 rem LCF-0.008	Public Maximally Exposed Individual: Dose-17 rem LCF-0.008	Public Maximally Exposed Individual: Dose-17 rem LCF-0.008	Public Maximally Exposed Individual: Dose-17 rem LCF-0.008	Public Maximally Exposed Individual: Dose-17 rem LCF-0.008
	80km (50-mi) population: Dose-404 person-rem LCF-0.202	80km (50-mi) population: Dose-404 person-rem LCF-0.202	80km (50-mi) population: Dose-404 person-rem LCF-0.202	80km (50-mi) population: Dose-404 person-rem LCF-0.202	80km (50-mi) population: Dose-404 person-rem LCF-0.202	80km (50-mi) population: Dose-404 person-rem LCF-0.202
			Likelihood of Beyond Design - Basis Earthquake Accident lower than Alternative 1A by approximately a factor of 5.	Likelihood of Beyond Design - Basis Earthquake Accident for the HEU Storage Mission lower than Alternative 1A by approximately factor of 5.		Likelihood of Beyond Design - Basis Earthquake Accident for the HEU Storage Mission lower than Alternative 1A by approximately factor of 5.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 27 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
	Criticality Accident:	**Criticality Accident:**	**Criticality Accident:**	**Criticality Accident:**	**Criticality Accident:**	**Criticality Accident:**
	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-4x10^{-3} Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-4x10^{-3} Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-4x10^{-3} Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-4x10^{-3} Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-4x10^{-3} Y-12 Plant Population: Dose-870 person-rem LCF-0.35	Collocated Worker Maximally exposed individual: Dose-8 rem LCF-4x10^{-3} Y-12 Plant Population: Dose-870 person-rem LCF-0.35
	Public Maximally Exposed Individual: Dose-3 rem LCF-1.5x10^{-3}	Public Maximally Exposed Individual: Dose-3 rem LCF-1.5x10^{-3}	Public Maximally Exposed Individual: Dose-3 rem LCF-1.5x10^{-3}	Public Maximally Exposed Individual: Dose-3 rem LCF-1.5x10^{-3}	Public Maximally Exposed Individual: Dose-3 rem LCF-1.5x10^{-3}	Public Maximally Exposed Individual: Dose-3 rem LCF-1.5x10^{-3}
	80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043	80km (50-mi) Population: Dose-8.6 person rem LCF-0.0043
			Likelihood of criticality accident lower than Alternative 1A by approximately a factor of 2 to 5.	Likelihood of criticality accident lower than Alternative 1A by approximately a factor of 2 to 5.		Likelihood of criticality accident for the HEU Storage Mission lower than Alternative 1A by approximately a factor of 2 to 5.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 28 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
	Radiological Fire Accident: Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-$5x10^{-6}$ to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-$5x10^{-6}$ to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-$5x10^{-6}$ to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-$5x10^{-6}$ to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-$5x10^{-6}$ to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3	**Radiological Fire Accident:** Collocated Worker Maximally Exposed Individual: Dose-0.01 to 41 rem LCF-$5x10^{-6}$ to 0.02 Y-12 Plant Population: Dose-12 to 3,300 person/rem LCF-0.005 to 1.3
	Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-$5x10^{-6}$ to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- $9x10^{-5}$ to 0.28	Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-$5x10^{-6}$ to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- $9x10^{-5}$ to 0.28	Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-$5x10^{-6}$ to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- $9x10^{-5}$ to 0.28	Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-$5x10^{-6}$ to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- $9x10^{-5}$ to 0.28	Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-$5x10^{-6}$ to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF- $9x10^{-5}$ to 0.28	Public Maximally Exposed Individual: Dose-0.01 to 16 rem LCF-$5x10^{-6}$ to 0.008 80km (50-mi) population: Dose-0.18 to 70 person/rem LCF-$9x10^{-5}$ to 0.28
			Likelihood of radiological fire accident lower than Alternative 1A by approximately a factor of 2 to 5.	Likelihood of radiological fire accident lower than Alternative 1A by approximately a factor of 2 to 5.		Likelihood of radiological fire accident for the HEU Storage Mission lower than Alternative 1A by approximately a factor of 2 to 5.

TABLE 3.5–1.—*Summary of Environmental Consequences for the Y-12 Site-Wide Alternatives* [Page 29 of 30]

	Alternative 1		Alternative 2		Alternative 3	Alternative 4
Resource/ Material Categories	**1A No Action - Status Quo Alternative**	**1B No Action - Planning Basis Operations Alternative**	**2A Alternative 1B Plus Construct and Operate New HEU Materials Facility**	**2B Alternative 1B Plus Upgrade Expansion to Building 9215**	**Alternative 1B Plus Construct and Operate New Special Materials Complex**	**Alternative 1B Plus HEU Materials Facility and Special Materials Complex**
<u>*Operation*</u>: (Chemical)	**Fires involving chemicals:** Potentially expose between 10 and 220 workers to ERPG-2 concentrations of toxic materials. No exposures are expected off-site **Chemical release due to loss of containment:** Potentially expose between 200 and 1,000 workers to ERPG-2 concentrations or greater. Except for chlorine, no toxic gas release is expected to reach the public occupied areas. A release of chlorine could expose up to 6,500 members of the public to ERPG-2 concentrations or greater.	**Fires involving chemicals:** Potentially expose between 10 and 220 workers to ERPG-2 concentrations of toxic materials. No exposures are expected off-site **Chemical release due to loss of containment:** Potentially expose between 200 and 1,000 workers to ERPG-2 concentrations or greater. Except for chlorine, no toxic gas release is expected to reach the public occupied areas. A release of chlorine could expose up to 6,500 members of the public to ERPG-2 concentrations or greater.	No change from No Action - Status Quo Alternative or No Action - Planning Basis Operations Alternative.	No change from No Action - Status Quo Alternative or No Action - Planning Basis Operations Alternative.	Likelihood of chemical accidents for the new Special Materials Complex lower than Alternative 1A by approximately a factor of 2 to 5. Operation of the Special Materials Facility at Site 1 would potentially increase the likelihood of exceeding ERPG-2 (or TEEL-2) concentrations at the Y-12 boundary.	Likelihood of chemical accidents for the Special Materials Mission lower by approximately factor of 2 to 5. Potential increase in the likelihood of exceeding ERPG-2 (or TEEL-2) concentrations at the Y-12 boundary if Special Materials Complex is located at Site 1.

Note: EMWMF - Environmental Management Waste Management Facility; SHPO - State Historic Preservation Officer.

3.6 PREFERRED ALTERNATIVE

Council on Environmental Quality (CEQ) NEPA regulations require that an agency identify its preferred alternative, if one or more exists, in the Draft EIS (40 CFR 1502.14 [e]). As discussed in "Forty Most Asked Questions Concerning CEQ's NEPA Regulations. (46 FR 18026, March 23, 1981 as amended), the preferred alternative is the alternative which the agency believes would fulfill its statutory missions and responsibilities giving consideration to economic, environmental, technical, and other factors. Consequently, to identify a preferred alternative, DOE is developing information on potential impacts, costs, technical risks, and schedule risks for the alternatives under consideration. This Draft Y-12 SWEIS provides information on the potential environmental impacts. Cost, schedule, and technical analyses are also being prepared and will be considered in the identification of preferred alternatives.

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. The Final SWEIS will identify all preferred alternatives. The ROD will describe DOE's decisions for the Y-12 SWEIS proposed actions.

CHAPTER 4: AFFECTED ENVIRONMENT

The descriptions of the affected environment provide a basis for understanding the direct, indirect, and cumulative effects of the Y-12 proposed actions and alternatives. The scope of the discussion varies by resource to ensure that all relevant issues are included.

For land resources, geology and soils, biological resources, and cultural and paleontological resources, discussions of the Y-12 Site and ORR are included along with descriptions of the potential areas within the Y-12 Site that could be affected by the Y-12 SWEIS alternatives. This information provides a basis for understanding both direct effects and the overall resource base that could be affected by ancillary activities that may be defined in later stages of the Y-12 SIM Program (LMES 1999c).

Ambient conditions are described for air/noise and water resources. Discussions focus on air/noise conditions at the ORR and Y-12 Site boundary and the surface water bodies and groundwater aquifers that could be affected. This information serves as a basis for analyzing important air/noise and water quality parameters to obtain results that can be compared to regulatory standards.

Socioeconomic conditions are described for the counties and communities that could be affected by regional population changes associated with the Y-12 SWEIS proposed actions. The affected environment discussions include projections of regional growth and related socioeconomic indicators. The described region is large enough to account for growth related to direct project employment as well as secondary jobs that may be created by the proposed actions.

In addition to those natural and human environmental resources discussed above, the affected environment sections include a number of issues related to ongoing DOE activities at ORR and Y-12. These issues involve facility operations and site support infrastructure, intersite transportation of nuclear materials, waste management, and radiological and hazardous chemicals impacts during normal operation and from accidents. Where reasonably foreseeable changes to any of these factors can be predicted, they are discussed.

4.1 LAND USE

4.1.1 Land-Use Designations

Oak Ridge Reservation. The ORR consists of 13,943 ha (34,513 acres) and is located mostly within the corporate limits of the city of Oak Ridge, approximately 24 km (15 mi) west of the city of Knoxville. Approximately one-third of ORR is occupied by the facilities of Y-12, ORNL, and ETTP. All of this land is titled to the United States of America and under the jurisdictional control of DOE for administration and management. Figure 4.1.1–1 shows the location of ORR.

Ownership of ORR. Originally, the Federal Government acquired 23,664 ha (58,575 acres) of land between 1942 and 1947. However, 9,721 ha (24,062 acres) were transferred over the years with 25 percent (almost 2,408 ha [5,960 acres]) going to the city of Oak Ridge for developmental purposes. The transferred land included 109 ha (270 acres) for schools; 438 ha (1,083 acres) for utilities, drainage, and roads and streets; 596 ha (1,475 acres) for municipal properties; and 12 ha (29 acres) for public housing. Most of the remaining land tracts were conveyed to the State of Tennessee for health, forestry, agricultural research, and a biomedical graduate school (935 ha [2,315 acres]), private ownership (5,125 ha [12,686 acres]), and the Tennessee Valley Authority (TVA) (1,209 ha [2,992 acres]). Anderson County (11 ha [28 acres]), the town of Oliver Springs (4 ha [9 acres]), and Federal agencies (25 ha [63 acres]) also received land tracts (LMER 1999a, Hartman 1999). Land conveyed for private entities and homeowners totals 5,136 ha (12,692 acres). The reservation's boundaries, both past and present, are shown in Figure 4.1.1–2.

Source: DOE 1996e.

FIGURE 4.1.1–1.—*Oak Ridge Reservation, Tennessee, and Region.*

Source LMER1999a.

FIGURE 4.1.1–2.—*Original U.S. Department of Energy Land Purchase and Current Reservation Boundaries*.

As a result of a decision by the Secretary of Energy in 1979 allowing DOE to make financial assistance payments to the city of Oak Ridge for a 5-year period under the *Atomic Energy Community Act* of 1955, the city submitted a self-sufficiency plan which proposed that DOE sell land to the city for industrial/commercial development. This allowed direct transfer of excess land to the city at fair market price rather than turning it over to the General Services Administration for disposal. The self-sufficiency program ended; however, those parcels that were under review at the time were "grandfathered," thus permitting DOE to still consider transfer of land to the city of Oak Ridge should it become excess to the needs of DOE (LMER 1999a).

Current Land Use at ORR. DOE classifies land use on the ORR according to five categories: Institutional/Research, Industrial, Mixed Industrial, Institutional/Environmental Laboratory, and Mixed Research/Future Initiatives (LMER 1999b). Development on the ORR accounts for about 35 percent of the total acreage leaving approximately 65 percent of the Reservation undeveloped (DOE 1999b).

Land bordering ORR is predominantly rural, with agricultural and forest land dominating. The city of Oak Ridge has residential areas primarily along the northern and eastern boundaries. There are four residential areas along the northern boundary that have several houses within approximately 30 m (98 ft) of the ORR boundary. There are a few residences within Roane County that border the ORR to the west. The Clinch River, which confines the ORR to the south and southeast, forms a boundary between Knox County, Loudon County, and portions of Roane County.

Remote sensing data from 1994 showed 70 percent of the ORR in forest cover while 20 percent was transitional, consisting of old fields, agricultural areas, cutover forest lands, roadsides, and utility corridors (LMER 1999a). Less than 2 percent of ORR remains as open agricultural fields. Currently 234 ha (580 acres) of wetlands on the ORR provide water quality benefits, storm water control, wildlife and rare species habitats, and landscape and biological diversity. About 1,414 ha (3,500 acres) are used as waste sites or are remediation areas (LMER 1999a).

Most of the ORR is designated a Tennessee Wildlife Management Area through a cooperative agreement between DOE and the Tennessee Wildlife Resources Agency (TWRA). The agreement provides protection of wildlife habitat and species as well as restoration of other wildlife habitat and species. Wildlife management is carried out under these agreements by TWRA in cooperation with ORNL's Environmental Sciences Division.

In 1980, DOE established the Oak Ridge National Environmental Research Park (NERP) which includes approximately 8,000 ha (20,000 acres) of ORR (LMER 1998b). The Research Park is an ORNL user facility which serves as an outdoor laboratory for the study of present and future impacts on the environment stemming from the various missions at ORR. Major environmental field research areas within the Research Park include (LMER 1999a):

- Walker Branch Watershed
- Free-Air CO_2 Enrichment Facility
- Global Change Field Research Facility
- Bear Creek Valley Hydrology Field Sites
- Melton Branch Watershed Field Sites
- National Oceanic and Atmospheric Administration Field Research Facility
- Natural and Accelerated Bioremediation Field Research Center

In 1986, seven State Natural Areas were registered on the ORR through an agreement between DOE and TDEC (LMER 1999a). Qualification for this designation requires meeting specific criteria which may include existence of rare plant species, animal species, or community types on the premises. Figure 4.1.1–3 shows the research and forested areas within the ORR.

Source: LMER 1999a.

FIGURE 4.1.1–3.—*Research Areas and Forested Areas.*

On June 23, 1999, Secretary of Energy Bill Richardson set aside 1,214 ha (3,000 acres) of ORR as a conservation and wildlife management area, in an agreement between DOE and TWRA. The proclamation calls for the land to be cooperatively managed for preservation purposes under a use permit. This area, called the Three Bend Scenic and Wildlife Management Refuge Area, is located in the ORR buffer zone on Freels, Gallaher, and Solway bends on the north shore of Melton Hill Lake in Anderson County. TWRA, in consultation with DOE, will prepare a cooperative agreement to serve as a natural resources management plan to establish guidelines for managing this area in the hopes to preserve and enhance its natural attributes.

Two major firearms ranges, along with their surface danger zones or buffer areas, encompass approximately 1,010 ha (2,500 acres) on ORR. The range areas, which are located at the south side of Bear Creek Road about 8 km (5 mi) west of Y-12, extend from the DOE ORR boundary on the west to Highway 95 on the east and from Bear Creek Road on the north to the Clinch River on the south. The eastern portion of the site is operated by DOE's Transportation Safeguards Division Southeastern Courier Section and consists of four individual live-fire ranges and associated support facilities. The western portion of the range site, formerly operated by LMES, is now operated for DOE by Wackenhut Services International (effective January 10, 2000) as a Central Training Facility and consists of an indoor range, five outdoor ranges, a shooting tower, three live-fire facilities, and assorted tactical facilities.

Federal statutes require each state, tribal, or local government to protect its citizens from releases of hazardous materials (40 CFR 301, 302, 304, and 355). Emergency planning zones spanning 8 km (5 mi) are defined around ORNL, ETTP, and Y-12. Each zone is then subdivided into emergency planning sectors, with each defined by easily recognizable terrain features (LMER 1999a).

Under an agreement with DOE and the State of Tennessee, the city of Oak Ridge transports municipal biosolids to approved sites on ORR and applies the material as a soil conditioner and fertilizer. The city of Oak Ridge has been applying biosolids at selected sites on ORR since 1983. Municipal biosolids are not considered RCRA waste but are regulated by EPA under 40 CFR 503 of the *Clean Water Act* regarding disposal, including risk-based, metal-loading criteria for the receiving soil. Since the application process is occurring on Federally owned land, DOE provides oversight of the process. However, daily operations, including permitting, disposal, sampling, and monitoring at each site, are the responsibility of the city of Oak Ridge. The application program currently utilizes a total of 65 ha (160 acres); approximately 20 ha (50 acres) have been closed due to self-imposed solids loading limits rather than exceeding metal or radionuclide limits (Bechtel Jacobs 1999). Table 4.1.1–1 shows all previously identified and approved sites on ORR along with the status of each.

Although ORR is not open to the public, opportunities for public use of numerous facilities and land areas do exist. The following are examples of land/facilities open to public use (LMER 1999a):

- New Bethel Church Interpretive Center (historical site)
- Walks and tours including Community Day, which allows public access to ORNL facilities and land areas such as Freels Bend/Solway Bend (bird-watching, wildflower walks, etc.)
- Ecological and Physical Sciences Study Center
- ORNL Graphite Reactor (National Historic Landmark)
- Clark Center Park (or Clark Center Recreation Area)
- George Jones Memorial Church
- ETTP Visitors Overlook and Y-12 Visitors Center

TABLE 4.1.1–1.—*Biosolids Application Sites*[a]

Site Name	Site No.	Total Acres On-site	Tons Allowed per Year	Total Tons[b] Life of Site	Total Tons to Date	Remaining Capacity in Tons	Years Remaining On-site
McCoy	1	20	Closed	Closed	Closed	Closed	Closed
Pine Plantation	2	20	Closed	Closed	Closed	Closed	Closed
High Pasture	2	25	94	1,250	483	767	8.2
Rogers	2	30	142	1,500	765	735	5.2
Scarboro	3	45	167	2,250	960	1,290	7.7
Upper Hayfield #1	3	25	93	1,250	540	710	7.6
Upper Hayfield #2	3	20	69	1,000	505	495	7.7
Future Site	4	N/A	N/A	N/A	N/A	N/A	N/A
Future Site	5	N/A	N/A	N/A	N/A	N/A	N/A
Future Site	6	N/A	N/A	N/A	N/A	N/A	N/A
Future Site	7	N/A	N/A	N/A	N/A	N/A	N/A
Site #8	8	12	Closed	Closed	Closed	Closed	Closed
Watson Road	9	60	134	3,000	929	2,071	15.4
Future Site	10	N/A	N/A	N/A	N/A	N/A	N/A
Cottonwoods	11	17	Closed	Closed	Closed	Closed	Closed
Future Site	12	N/A	N/A	N/A	N/A	N/A	N/A
Future Site	13	N/A	N/A	N/A	N/A	N/A	N/A
Future Site	14A	N/A	N/A	N/A	N/A	N/A	N/A
Future Site	14B	N/A	N/A	N/A	N/A	N/A	N/A

Active Site Total Tonnage to Date: **4,182**

[a] Information is based on COR *Sludge Application Site Monitoring Report in Appendix I.*
[b] Calculations are based on a maximum of 50 tons (dry wt) applied x the number of acres on the site.
Source: Bechtel Jacobs 1999.

Source: LMER 1999a.

FIGURE 4.1.1–4.—*Public, Educational, and Recreational Opportunities.*

DOE has also granted a license for TWRA to sponsor and manage hunting on the ORR. Figure 4.1.1–4 shows the locations of some of the public, educational, and recreational opportunities on ORR.

4.1.2 Future Land Use and Leasing Agreements

Future land use of ORR will continue to incorporate the principles associated with ecosystem management. For the most part, these land uses will expand and build on current uses, not replace them. New future land uses include research facilities, environmental research and partnership areas, waste management facilities, future initiatives, transportation improvements, education and recreation, and land transfers and lease areas (LMER 1999a).

Future research facilities include:

- *Spallation Neutron Source* (SNS). Location will require approximately 45 ha (110 acres) which will encompass a new linear accelerator facility, user facilities, central utility building, support laboratories and shops, and a central office building as well as a 132,500-L (35,000-gal) fire water reservoir, electric service switchyard, and storm water retention pond required to service the facility. As a result of the *Final Environmental Impact Statement for the Construction and Operation of the Spallation Neutron Source*, a ROD was issued for construction and operation where ORR, more specifically Chestnut Ridge, was selected as the site. Funding has been approved and construction is underway.

- *Joint Institute for Neutron Sciences*. Joint venture with the University of Tennessee, the State of Tennessee (the institute providing funding for the facility), and DOE for a user facility which will serve both the High Flux Isotope Reactor and the proposed SNS. The site will be integrated into the SNS campus. Funding has been approved and construction is underway.

- *Laboratory for Comparative and Functional Genomics*. Facility to house 50,000 mice in support of ORNL's mouse genetics mutagenesis. The laboratory will be adjacent to Life Sciences Division Building 1062 at the west end of ORR. The facility is currently in the President's budget for FY2001.

- *Oak Ridge Institute for Sciences and Education*. Future development and expansion for the Institute at Scarboro Operations Site, currently covering approximately 100 ha (247 acres).

- *ORNL Expansion*. Bethel Valley areas east and west of the central ORNL site are identified for future R&D use to include support and service facilities and will cover a total of 283 ha (700 acres).

- *Engineering Technology Complex*. Planned for the main Bethel Valley campus; more specifically, a parking lot between the 4000 and 6000 areas. This is planned to be a privately funded, leased facility to be constructed in the 2001-2002 time frame.

- *Fusion Materials Irradiation Facility*. Proposed to house a linear accelerator, a supply system for lithium targets, and an experimental complex for irradiation and handling test specimen assemblies. It will be used to address the technological problems associated with the development of fusion reactor materials. This project is still in the early planning stages without funding as of yet. However, plans to relocate the Fusion Energy Division to the 7600 area in the next 3-4 years will open up construction of a GPP funded office building in the 7600 area and modifications/additions to other facilities for preparation of relocation.

4-10

Source: LMER 1999a.

FIGURE 4.1.2–1.—*New Future Use at Oak Ridge Reservation.*

- *Melton Valley R&D Facilities (Ramsey Drive Site)*. Approximately 16 ha (39 acres) adjoining the proposed Fusion Materials Irradiation Facility have been identified for future use. Specific facility designations are not yet determined (LMER 1999a).

New field research areas, in addition to that previously mentioned within the Research Park, include Bull Bluff Watersheds, watershed manipulation experiments; Copper Ridge Research Area, forest nutrient dynamics; Freels Bend Research Area, agricultural research; Raccoon Creek Research Area, global change research; White Wing Research Area, biodiversity, global change, and fundamental ecological process research; Pine Ridge Experimental Catchments, expansion to Walker Branch Watershed research; Unexploded Ordnance Research and Demonstration Area, testing and validation methodology of locating unexploded ordnance (LMER 1999a).

Proposed waste management facilities including the Environmental Management Waste Management Facility at East Bear Creek and the Transuranic Waste Packaging Facility at ORNL and are in various stages of planning (LMER 1999a).

The following proposed transportation improvements have been identified by the Tennessee Department of Transportation (DOT): I-75/I-40 connector, Highway 58 widening, and Bethel Valley Road/Illinois Avenue interchange (LMER 1999a). Figure 4.1.2–1 shows some of the proposed land uses for the ORR.

Also, the following are areas that have been identified by DOE that have recently been, or will soon be, leased or re-leased (LMER 1999b):

Public Areas:

- 3.5 ha (8.5-acre) parcel of Federal land near Wisconsin Avenue in Oak Ridge to the city of Oak Ridge for a park

Industrial Development:

- Parcel ED-1, located near the former K-25 Site (Horizon Center),was leased in April of 1998 to the Community Reuse Organization of East Tennessee, a private sector organization established by DOE to lease underutilized facilities on ORR, for industrial development. The parcel is now known as the Horizon Center.

- Parcel ED-2, 6 ha (15 acres) leased to the Community Reuse Organization of East Tennessee in September of 1997

- 40 ha (100 acres) of Parcel 8, pending

- Tower Shielding Facility (10.5 ha [26 acres] leased in 1998 to BioNeutrics, Inc.)

- Boeing Property. Oak Ridge Properties is interested in purchasing approximately 492 ha (1,216 acres) from the Boeing Company at the former K-25 Site (Horizon Center) and has proposed a mixed-use development plan which would include approximately 1,500 residential units including houses, apartments/condominiums, about 187 ha (450 acres) of industrial zoned property, and a shopping area (*Oak Ridge* 12/10/99, 12/17/99, and 01/04/00). The Boeing Property was rezoned from industrial to mixed-use in February 2000. The Oak Ridge Land Company is also pursuing the acquisition of a 74-ha (182-acre) floodplain strip abutting the Boeing Property for use a s a buffer zone and green space. DOE controls the floodplain strip and is currently preparing an EA on the transfer of the property to the abutting landowner.

- DOE is considering leasing Parcel ED-3, an 187-ha (450-acre) piece of land located south of the former K-25 Site, to be developed for mixed use purposes. A buffer zone of approximately 615 ha (1,520 acres) would surround the site. The land would be transferred to the Community Reuse Organization of East Tennessee and leased to private companies. Currently, DOE is preparing an EA to evaluate the impacts of this action.

Mobile Service Antenna Sites:

- Commercial service antennas proposed for three appropriate sites at ORR (attachment to existing structures when possible). BellSouth has erected a tower in the ETTP area while SprintCom has requested use of the Chestnut Ridge site (LMER 1999a).

Y-12. The Y-12 Area of Responsibility on the ORR covers a total of 2,197 ha (5,428 acres). The main area of Y-12 is largely developed and encompasses 328 ha (811 acres), with 255 ha (630 acres) fenced, (4 km [3 mi] long and 2 km [1 mi] wide), with approximately 580 buildings that house about 1 million m^2 (7.6 million ft^2) of laboratory, machining, dismantlement, and R&D areas (LMER 1999b). For the purposes of this SWEIS, the boundary of analysis includes a total of approximately 1,472 ha (3,638 acres). As a result of the site's defense support, manufacturing, and storage facilities, the land in the Y-12 area is classified in DOE's industrial category.

The Research Park surrounds the Y-12 SWEIS area. Areas outside the main plant site but within its area of responsibility are used primarily for a buffer area as well as for environmental restoration and waste management activities. There are limited forested areas within the Y-12 boundary. There are no wetlands located within the Y-12 fenced boundaries. Land outside the SWEIS area includes buffer for the Walker Branch watershed long-term research area and other environmental research sites.

There are a number of active waste management facilities within the Y-12 SWEIS area of analysis. These include the following:

- Disposal Area Remedial Action (liquid storage) facility. Collection of contaminated groundwater as a result of cleanup efforts in Bear Creek Valley

- Above-Ground Low-Level Waste Storage Facility

- Industrial Landfill V. Nonhazardous, nonradioactive industrial solid waste

- Construction/Demolition Landfill VI. Construction and demolition debris

- Construction/Demolition Landfill VII. Additional storage of construction and demolition debris (SPAS 1988)

These areas are discussed in detail in Appendix A.5, Waste Management Activities.

Source: LMER 1999a.

FIGURE 4.1.2–2.—*Watershed Areas on Oak Ridge Reservation.*

The environmental restoration Y-12 Project includes two areas that are located within the Y-12 SWEIS physical study area of analysis: the Bear Creek and UEFPC watersheds. The boundaries of the Bear Creek watershed extend west from a topographic high near the west end of the plant to the point where Bear Creek exits the valley near Highway 95. Release points within the Y-12 SWEIS area of analysis include the (former) S-3 Pond Site, Sanitary Landfill I, Boneyard/Burnyard, the Oil Landfarm, the Bear Creek Burial Grounds, and the Rust Spoil Area. These units were used in the past as the primary area for disposal of various types of hazardous and nonhazardous wastes generated at Y-12. The UEFPC watershed is bounded by the base of Pine Ridge to the north and by Chestnut Ridge to the south and extends westward, abutting the Bear Creek watershed, and eastward to the DOE property line (LMER 1999a). These watersheds are shown in Figure 4.1.2–2.

Some sludge land farming activity is conducted to the south of the Y-12 Plant. Figures 4.1.2–3 and 4.1.2–4 present the locations of the sludge land farming sites and environmental restoration activities, respectively.

The ORR End Use Working Group has recommended the following land use for Y-12: “the western area of the Y-12 Plant is expected to remain controlled industrial property. As opportunity arises, national security activities should be concentrated in the western area to allow for the broadest possible use of the rest of the plant (PEC 1998).”

Source: Tetra Tech, Inc./SPAS 1998.

FIGURE 4.1.2–3.—*Sludge Land Application Sites.*

Source: Tetra Tech Inc./SPAS 1998.

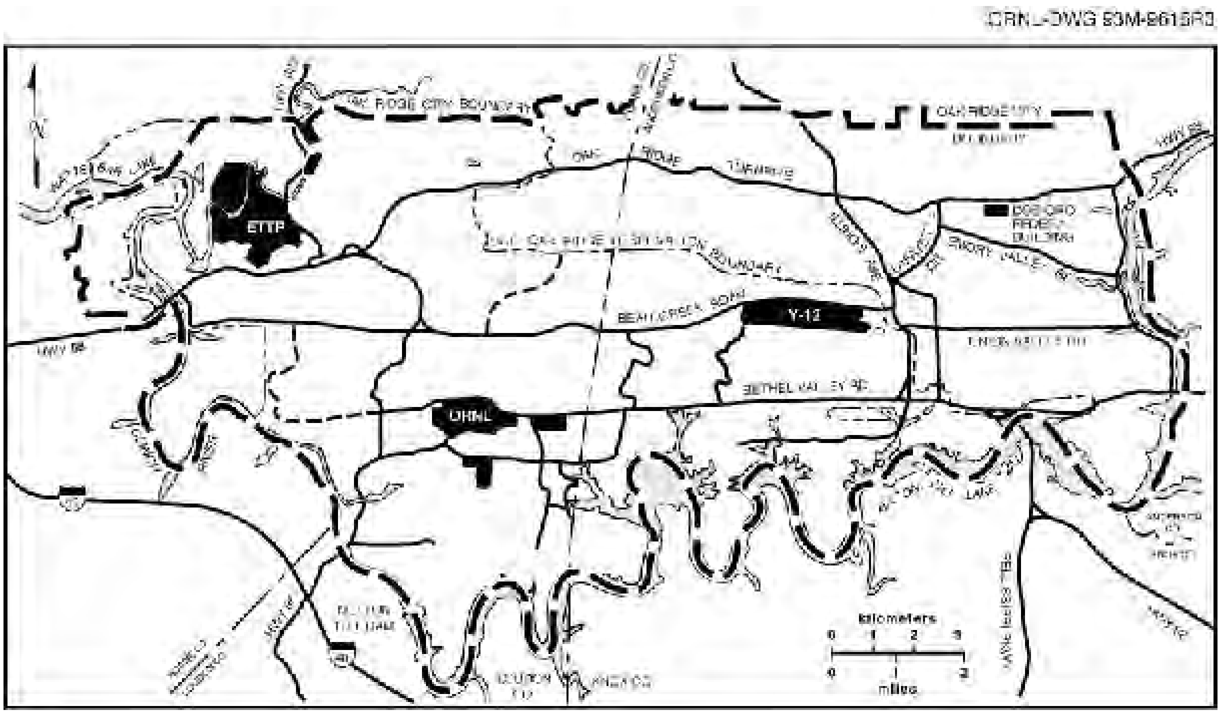
FIGURE 4.1.2–4.—*Active Waste Management Facilities and Environmental Restoration Projects.*

4.2 TRANSPORTATION

4.2.1 On-site Traffic

Primary roads on the ORR serving Y-12 include Tennessee State Routes (TSRs) 95, 58, 62, and 170 (Bethel Valley Road), and Bear Creek Road. Except for Bear Creek Road, all are public roads. Figure 4.2.1–1 schematically presents the on-site routes on the ORR serving the Y-12 Site.

Existing traffic on these on-site roads is presented in Table 4.2.1–1 along with designation of Level of Service (LOS).



Source: DOE 1999k.

FIGURE 4.2.1–1.—*Road Network at Y-12 Site.*

4.2.2 Off-site Traffic

Y-12 is located within 80 km (50 mi) of three interstate highways: I-40, I-75, and I-81. Interstate 40, an east-west highway, extends from North Carolina to California. Interstate 75 is a north-south highway extending from Michigan to Florida. Interstate 81 is a north-south interstate extending from New York to Tennessee. Interstate 81 connects with I-40 east of Knoxville while I-40 and I-75 connect west of Knoxville near the city of Oak Ridge. In addition, TSR 61, TSR 162, and U.S. 25W at Clinton also serve Y-12 transportation needs off-site.

4.2.3 Transportation of Materials and Waste

Various chemicals and other materials being used for Y-12 operations are transported by truck using the above-addressed roads (TSRs 58, 62, 95, and 170; I-40, I-75, and I-81). LLW, hazardous waste, and municipal and solid wastes are being generated by Y-12 operations. LLW is being stored on-site in temporary storage facilities and would eventually be disposed off-site at a DOE Site. A detailed description of Y-12 waste treatment and storage capabilities can be reviewed in Appendix A.5.

4.2.4 Other Transportation

Rail transport is available to Y-12 but is not currently being used.

TABLE 4.2.1–1.—*Existing Average Daily Traffic Flows (Vehicles per Day) on Oak Ridge Reservation Serving Y-12*

Road	To	From	Average Daily Traffic Vehicles/Day	Level of Service[a]
TSR 58	TSR 95	I-40	11,600	B
TSR 95	TSR 62	TSR 58	16,440	D
TSR 95	TSR 58	I-40	8,058	A
TSR 62	TSR 95	TSR	28,320	E
East Bear Creek Rd.	Eastbound	-	12,490	C
West Bear Creek Rd.	Westbound	-	3,200	A
East Bethel Valley Rd.	Eastbound	-	10,000	C
West Bethel Valley Rd.	Westbound	-	6,440	A

[a] LOS designations: A(Free Flow); B (Free Flow with maneuverability slightly impeded); C (Stable Flow maneuverability noticeably restricted); D (Stable Flow, reduced speed, maneuverability limited); E (Near capacity, speeds are low but relatively uniform).
Source: TDOT 1998.

4.3 SOCIOECONOMICS

This section describes current socioeconomic conditions within a region of influence (ROI) where more than 90 percent of the ORR workforce resides. The ROI is a four-county area in Tennessee comprised of Anderson, Knox, Loudon, and Roane Counties. Figure 4.3–1 shows the surrounding counties influenced by ORR. In 1997, almost 40 percent of the ORR workforce resided in Knox County, 29 percent in Anderson County, 16 percent in Roane County, and 6 percent in Loudon County. The remaining 9 percent of the workforce resides in other counties across Tennessee, none of which are home to more than 3 percent of the workforce (DOE 1999f).

TABLE 4.3.1–1.—*Employment by Sector (%)*

Sector	1980	1990	1998
Services	19.1	27.5[a]	30.2[a]
Wholesale and Retail	21.1	25.3[a]	24.7[a]
Government (including Federal, State, local, and military)	20.3	15.6	13.7
Manufacturing	21.9	15.9	13.0
Farm	2.0	1.6	1.2
Construction	4.9	5.4	6.1
Finance, Insurance, and Real Estate	6.0	5.2	6.5
Transportation and Public Utilities	3.7	4.0	4.5
Agricultural Service, Forestry, and Other	0.3	0.6	0.9
Mining	0.7	0.4	0.2

[a] Percentage only includes Knox and Loudon Counties. Data for Roane and Anderson Counties not available.
Source: BEA 1999.

4.3.1 Employment and Income

The ORR ROI has historically been dependent on manufacturing and government employment. More recent trends show growth in the service and wholesale and retail trade sectors and a decline in manufacturing and government employment. Table 4.3.1–1 presents current and historical employment for the major sectors of the ROI economy.

The ROI labor force grew by almost 15 percent in the first half of this decade from 243,209 in 1990 to 279,275 in 1995. There was a slight decline in the labor force between 1995 and 1998 when it totaled 278,866. ROI employment grew from 231,822 in 1990 to 268,748 in 1995 and continued to grow despite the decline in the labor force and totaled 269,466 in 1998 (BLS 1999).

The ROI unemployment rate was 3.4 percent in 1998, the lowest level in over a decade, as shown in Table 4.3.1–2. Unemployment rates within the ROI ranged from a low of 3.1 percent in Knox County to a high of 5 percent in Roane County. The unemployment rate in Tennessee was 4.2 percent in 1998 (BLS 1999).

Source: LMER 1999a.

FIGURE 4.3–1.—*Location of Oak Ridge Reservation and Surrounding Counties.*

Per capita income in the ROI was $23,520 in 1997, a 35 percent increase from the 1990 level of $17,407. Per capita income in 1997 in the ROI ranged from a low of $19,564 in Roane County to a high of $24,688 in Knox County. The per capita income in Tennessee was $22,699 in 1997 (BEA 1999).

TABLE 4.3.1–2.—*Region of Influence Unemployment Rates (%)*

County	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anderson	4.8	5.1	5.4	4.9	3.9	3.9	4.8	5.5	3.6
Knox	4.1	4.5	4.5	3.9	3.3	3.4	3.4	3.6	3.1
Loudon	5.7	7.0	5.6	4.6	3.9	4.0	3.9	4.6	3.2
Roane	8.3	8.2	8.5	5.7	4.4	5.8	5.3	7.3	5.0
ROI Total	4.7	5.0	5.0	4.3	3.6	3.6	3.6	4.3	3.4
Tennessee	5.3	6.7	6.4	5.7	4.8	5.2	5.2	5.4	4.2

Source: BLS 1999.

Y-12 employs approximately 8,900 workers, including DOE employees and contractors. DOE has a significant impact on the economy of the ROI and Tennessee. As a whole, DOE employees and contractors number more than 13,700 individuals in Tennessee, primarily in the ROI. These jobs have a higher average salary than the statewide average, $40,000 compared to $25,695 (BEA 1999). DOE employment and spending generate additional benefits to the ROI and state economies through the creation of additional jobs in sectors providing support to DOE and its workers.

4.3.2 Population and Housing

Between 1960 and 1990, population growth in the ROI was slower than population growth in Tennessee as a whole. The ROI population increased at an average annual rate of 1 percent while the state population increased 1.2 percent annually. Between 1990 and 1998, ROI population growth increased 1.1 percent annually while the state population increased 1.4 percent annually. Loudon County experienced the fastest rate of population growth, averaging 3.1 percent annually between 1990 and 1998, while Anderson County population has increased an average of 0.5 percent annually (Census 1995, Census 1999). Population in all counties in the ROI is projected to continue to grow at a somewhat slower rate between 1998 and 2020, as shown in Table 4.3.2–1.

Knox County is the largest county in the ROI with a 1998 population of 366,846. Knox County includes the city of Knoxville, the largest city in the ROI. Loudon County is the smallest county in the ROI with a total population of 39,052. The city of Oak Ridge and the ORR are located in both Anderson and Roane Counties with 1998 populations of 71,116 and 50,026, respectively (Census 1999).

TABLE 4.3.2–1.—*Historic and Projected Population in the Region of Influence*

County	1960	1970	1980	1990	1998	2000	2010	2020
Anderson	60,032	60,300	67,346	68,250	71,116	72,502	76,000	79,275
Knox	250,523	276,293	319,694	335,749	366,846	374,616	404,666	432,866
Loudon	23,757	24,266	28,553	31,255	39,052	39,761	44,941	50,238
Roane	39,133	38,881	48,425	47,227	50,026	50,829	54,433	58,113
ROI	373,445	399,740	464,018	482,481	527,040	537,708	580,040	620,492
Tennessee	3,567,089	3,923,687	4,591,120	4,877,203	5,430,621	5,533,762	6,062,695	6,593,194

Source: Census 1995, Census 1999, BEA 1999.

TABLE 4.3.2–2.—*Region of Influence Housing Characteristics (1990)*

County	Total Number of Housing Units	Number of Owner-Occupied Units	Owner-Occupied Vacancy Rates (percent)	Median Value	Number of Occupied Rental Units	Rental Vacancy Rates (percent)	Median Monthly Contract Rent
Anderson	29,323	19,401	1.1	$55,100	7,983	9.3	$262
Knox	143,582	85,369	1.9	$63,900	48,270	8.4	$272
Loudon	12,995	9,428	1.7	$51,000	2,727	7.2	$190
Roane	20,334	14,102	1.4	$48,700	4,351	9.9	$194
ROI	206,234	128,300	NA	NA	63,331	NA	NA

Note: NA - Not applicable.
Source: Census 1992.

There were a total of 206,234 housing units in the ROI in 1990. A summary of ROI housing characteristics is shown in Table 4.3.2–2. Approximately 67 percent of these units were single family homes, 24 percent were multifamily units, and 8 percent were mobile homes. Approximately 7 percent of the housing units were vacant, although some vacant units were used for seasonal, recreational, or other occasional purposes. Rental vacancy rates ranged from 7.2 percent in Loudon County to 9.9 percent in Roane County while homeowner vacancy rates ranged from 1.1 percent in Anderson County to 1.9 percent in Knox County.

Owner-occupied housing units accounted for 62 percent of the total housing units while renter-occupied units accounted for approximately 31 percent (Census 1992).

In 1990, the median value of owner-occupied housing units ranged from $48,700 in Roane County to $63,900 in Knox County, while the median contract rent ranged from $190 in Loudon County to $272 in Knox County.

4.3.3 Community Services

Community services in the ROI include public schools, law enforcement, and medical services.

Eight public school districts with a total of 144 schools provide educational services for the approximately 78,000 students in the ROI. Higher education opportunities in the ROI include the University of Tennessee as well as several private colleges and two community colleges (HPI 1999a).

Law enforcement is provided by 20 municipal, county, and local police departments that employ over 1,500 officers and civilians. Security at Y-12 was provided by LMES employees until January 10, 2000, when the protective force and selected security work was contracted to Wackenhut Services, Inc. (HPI 199b).

There are 13 hospitals in the ROI with a total of 2,833 beds. These hospitals operate at an average of 67 percent occupancy (AHA 1995). There are 1,525 doctors in the ROI with the majority (1,279) in Knox County (AMA 1996).

4.4 GEOLOGY AND SOILS

4.4.1 Physiography

ORR lies in the Valley and Ridge Physiographic Province of eastern Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys. In general, the ridges consist of resistant siltstone, sandstone, and dolomite units, and the valleys, which resulted from stream erosion, consist of the less-resistant shales and shale-rich carbonates (DOE 1991b).

The topography within the ORR ranges from a low of 229 m (750 ft) above mean sea level (MSL) along the Clinch River to a high of 384 m (1,260 ft above) MSL along Pine Ridge. Within the ORR, the topographic relief between the valley floors and ridge crests is generally about 91 to 107 m (300 to 350 ft) (LMER 1999a).

4.4.2 Geology

ORR Geology. Several geologic formations are present in the ORR area. A geologic map and stratigraphic column of the area are shown in Figures 4.4.2–1 and 4.4.2–2, respectively. The Rome Formation, which is present north of Y-12 and forms Pine Ridge, consists of massive to thinly bedded sandstones interbedded with minor amounts of thinly bedded, silty mudstones, shales, and dolomites. In the ORR area, the stratigraphic thickness of the Rome Formation is uncertain because of the displacement caused by the White Oak Mountain Thrust Fault. The Conasauga Group, which underlies Bear Creek Valley, consists primarily of calcareous shales, siltstone, and limestone. The Knox Group, which is present immediately south of Y-12, can be divided into five formations of dolomite and limestone. All five formations have been identified at the ORR. The Knox Group, which underlies Chestnut Ridge, is estimated to be approximately 732 m (2,400 ft) thick. The Knox Group weathers to a thick, orange-red, clay residuum that consists of abundant chert and contains karst features (DOE 1991b).

Carbonate bedrock displaying karst features are dissolutional features occurring in carbonate bedrock. Karst features represent a spectrum ranging from minor solutional enlargement of fractures to conduit flowpaths to caves large enough for a person to walk into. Numerous surface indications of karst development have been identified at ORR (Figure 4.4.2–3). Surface evidence of karst development includes sinking streams (swallets) and overflow swallets, karst springs and overflow springs, accessible caves, and numerous sinkholes of varying size. In general, karst appears most developed in association with the Knox Group carbonate bedrock, as the highest density of sinkholes occurs in this group (LMER 1999a).

ORR Seismology. The Oak Ridge area lies at the boundary between seismic Zones 1 and 2 of the Uniform Building Code, indicating that minor to moderate damage could typically be expected from an earthquake (Table 4.4.2–1). Since the New Madrid earthquakes of 1811 to 1812, at least 26 other earthquakes with a Modified Mercalli intensity, herein referred to as intensity, of III to VI have been felt in the Oak Ridge area, the majority of these having occurred in the Valley and Ridge Province. The Charleston, South Carolina, earthquake of 1886 had an intensity of VI at Oak Ridge, and an earthquake centered in Giles County, Virginia, in 1886 produced an intensity of IV to V at Oak Ridge. One of the closest seismic events to ORR occurred in 1930; its epicenter was 8 km (5 mi) from ORR (DOE 1996e). This earthquake had an estimated intensity of VII at the epicenter and an approximate intensity of V to VI in the Oak Ridge area. Maximum horizontal ground surface accelerations of 0.06 to 0.30 of acceleration due to gravity at ORR are estimated to result from an earthquake that could occur once every 500 to 2,000 years.

Source: Sutton and Field (1995).

FIGURE 4.4.2–1.—*Generalized Geological Map of the Oak Ridge Reservation.*

Source: DOE 1998b.

FIGURE 4.4.2–2.—*Stratigraphic Section in the Vicinity of the Upper East Fork Poplar Creek Characterization Area.*

An earthquake occurred in 1973 in Maryville, TN, 34 km (21 mi) southeast of ORR, and had an estimated intensity of V to VI in the Oak Ridge area (DOE 1996b). In 1987, a significant earthquake occurred approximately 48 km (30 mi) from ORR with an intensity of VI. In addition, since 1995, two earthquakes with an intensity of III and two earthquakes with an intensity of V occurred within 160 km (100 mi) of the ORR (NEIC 1999). In 1998, one earthquake that had an intensity of III occurred approximately 3 km (1.9 mi) from the ORR. There have been 13 earthquakes in the last 155 years that at their epicenter produced an intensity of VI and one of intensity VII within 166 km (100 mi) of ORR (NEIC 1999).

There is no volcanic hazard at ORR. The area has not experienced volcanism within the last 230 million years. Therefore, no present or future volcanic activity is expected (DOE 1996e).

Y-12 Seismology. Y-12 is cut by many inactive faults formed during the late Paleozoic Era (DOE 1996e). There is no evidence of capable faults in the immediate area of Oak Ridge, as defined by 10 CFR 100 (surface movement within the past 35,000 years or movement of a recurring nature within the past 500,000 years). The nearest capable faults are approximately 480 km (300 mi) west of ORR in the New Madrid Fault zone.

Y-12 Geology. Y-12 is located within Bear Creek Valley, which is underlain by Middle to Late Cambrian strata of the Conasauga Group (see Figure 4.4.2–1). The Conasauga Group consists primarily of highly fractured and jointed shale, siltstone, calcareous siltstone, and limestone in the site area. The upper part of the group is mainly limestone, while the lower part consists of mostly shale (LMER 1999a). This group can be divided into six discrete formations, which are, in ascending order, the Pumpkin Valley Shale, the Rutledge Limestone, the Rogersville Shale, the Maryville Limestone, the Nolichucky Shale, and the Maynardville Limestone. The thickness of each of these formations varies throughout the Conasauga Group. The bedrock at the Y-12 Site is adequate to support structures using standard construction techniques.

Bedrock in the Y-12 area is overlain by alluvium, colluvium, man-made fill, fine-grained residuum from the weathering of the bedrock, saprolite, and weathered bedrock. The overall thickness of these materials in the Y-12 area is typically less than 12 m (40 ft). In undeveloped areas of the Y-12, the saprolite (a transitional mixture of fine-grained residuum and bedrock remains) retains primary textural features of the unweathered bedrock, including fractures (HSW 1994).

Numerous dissolution and karst features are the primary geological features influencing Y-12 (see Figure 4.4.2–3). Y-12 is situated on carbonate bedrock such that groundwater flow and contaminant transport are controlled by solution conduits in the bedrock. These karst features, including large fractures, cavities, and conduits, are most widespread in the Maynardville Limestone, a formation underlying Y-12, and the Knox Group. These cavities and conduits are often connected and typically found at depths greater than approximately 33 m (100 ft) (DOE 1998b).

FIGURE 4.4.2–3.—*Geology and Karst Features.*

TABLE 4.4.2–1.—*The Modified Mercalli Intensity Scale of 1931, With Approximate Correlations to Richter Scale and Maximum Ground Acceleration*[a]

Modified Mercalli Intensity[b]	Observed Effects of Earthquake	Approximate Richter Magnitude[c]	Maximum Ground Acceleration[d]
I	Usually not felt	<2	negligible
II	Felt by persons at rest, on upper floors or favorably placed	2-3	<0.003 g
III	Felt indoors; hanging objects swing; vibration like passing of light truck occurs; might not be recognized as earthquake	3	0.003 to 0.007 g
IV	Felt noticeably by persons indoors, especially in upper floors; vibration occurs like passing of heavy truck; jolting sensation; standing automobiles rock; windows, dishes, and doors rattle; wooden walls and frames may creak	4	0.007 to 0.015 g
V	Felt by nearly everyone; sleepers awaken; liquids disturbed and may spill; some dishes break; small unstable objects are displaced or upset; doors swing; shutters and pictures move; pendulum clocks stop or start	4	0.015 to 0.03 g
VI	Felt by all; many are frightened; persons walk unsteadily; windows and dishes break; objects fall off shelves and pictures fall off walls; furniture moves or overturns; weak masonry cracks; small bells ring; trees and bushes shake	5	0.03 to 0.09 g
VII	Difficult to stand; noticed by car drivers; furniture breaks; damage moderate in well built ordinary structures; poor quality masonry cracks and breaks; chimneys break at roof line; loose bricks, stones, and tiles fall; waves appear on ponds and water is turbid with mud; small earthslides; large bells ring	6	0.07 to 0.22 g
VIII	Automobile steering affected; some walls fall; twisting and falling of chimneys, stacks, and towers; frame houses shift if on unsecured foundations; damage slight in specially designed structures, considerable in ordinary substantial buildings; changes in flow of wells or springs; cracks appear in wet ground and steep slopes	6	0.15 to 0.3 g
IX	General panic; masonry heavily damaged or destroyed; foundations damaged; serious damage to frame structures, dams and reservoirs; underground pipes break; conspicuous ground cracks	7	0.3 to 0.7g
X	Most masonry and frame structures destroyed; some well built wooden structures and bridges destroyed; serious damage to dams and dikes; large landslides; rails bent	8	0.45 to 1.5 g
XI	Rails bent greatly; underground pipelines completely out of service	9	0.5 to 3 g
XII	Damage nearly total; large rock masses displaced; objects thrown into air; lines of sight distorted	9	0.5 to 7 g

[a] This table illustrates the approximate correlation between the Modified Mercalli intensity scale, the Richter scale, and maximum ground acceleration.
[b] Intensity is a unitless expression of observed effects.
[c] Magnitude is an exponential function of seismic wave amplitude, related to the energy released.
[d] Acceleration is expressed in relation to the earth's acceleration due to earth’s gravity (g).
Source: NEIC 1999.

4.4.3 Soils

ORR Soils. Bear Creek Valley lies on well to moderately well-drained soils underlain by shale, siltstone, and silty limestone. Developed portions of the valley are designated as urban land. Soil erosion from past land uses has ranged from slight to severe. Erosion potential is very high in those areas that have been eroded in the past with slopes greater than 25 percent. Erosion potential is lowest in the nearly flat-lying permeable soils that have a loamy texture. Additionally, wind erosion is slight, shrink-swell potential is low to moderate, and the soils are acceptable for standard construction techniques (DOE 1996e).

Y-12 Soils. Y-12 lies on soils of the Armuchee-Montevallo-Hamblen, the Fullerton-Claiborne-Bodine, and the Lewhew-Armuchee-Muskinghum associations. Soil erosion due to past land use has ranged from slight to severe. Wind erosion is slight and shrink-swell potential is low to moderate. Finer textured soils of the Armuchee-Montevallo-Hamblen association have been designated as prime farmland when drained (DOE 1993). The soils at the Y-12 Site are generally stable and acceptable for standard construction techniques

4.5 HYDROLOGY

This section describes the surface and groundwater resources on the ORR in general and Y-12 specifically. Much of the information for the Y-12 water resources, particularly surface water and groundwater quality, are based on the results of recent CERCLA Remedial Investigations conducted in Bear Creek Valley (DOE 1997a) and UEFPC (DOE 1998b).

4.5.1 Surface Hydrology

ORR Surface Drainage Systems. The major surface water body in the immediate vicinity of the ORR is the Clinch River, which borders the site to the south and west. There are four major subdrainage basins on the ORR that flow into the Clinch River and are affected by site operations: Poplar Creek, East Fork Poplar Creek, Bear Creek, and White Oak Creek. Drainage from Y-12 enters both Bear Creek and EFPC; ETTP drains predominantly into Poplar Creek and Mitchell Branch; and ORNL drains into the White Oak Creek drainage basin (DOE 1992). Several smaller drainage basins, including Ish Creek, Grassy Creek, Bearden Creek, McCoy Branch, Kerr Hollow Branch, and Raccoon Creek, drain directly in to the Clinch River. Each drainage basin takes the name of the major stream flowing through the area. Within each basin are a number of small tributaries. The natural surface water bodies in the vicinity of ORR are shown in Figure 4.5.1–1.

Y-12 Surface Drainage Systems. Within the Y-12 area the two major surface water drainage basins are those of Bear Creek and EFPC. The upper reaches of EFPC drain the majority of the industrial facilities of Y-12. The in-plant portion of EFPC has been designated as UEFPC.

The natural drainage pattern of UEFPC has been radically altered by the construction of Y-12. The western portion of the creek flows underground through pipes and the remaining portion flows in a modified and straightened channel lined with riprap and concrete. Flow in UEFPC is derived partially from groundwater captured by the buried channels and funneled to the creek. In addition, outfalls into UEFPC add a combination of groundwater, storm water, and water generated by plant operations (e.g., basement sumps, treatment plant discharges). As a result of reduced operations and elimination of inadvertent direct discharges of contaminated water to UEFPC, flow in UEFPC decreased from 38 - 57 MLD (10-15 MGD) in the mid-1980s to about 9 MLD (2.5 MGD) in the mid-1990s. To improve downstream water quality (e.g., toxicity requirements, temperature), Y-12's 1995 National Pollutant Discharge Elimination System (NPDES) permit required supplementing flow in UEFPC by the addition of raw water from the Clinch River. Since mid-1996, water has been added to the western portion of the open channel in order to maintain flow of 26 MLD (7 MGD) at Station 17.

Bear Creek Valley west of Y-12 is drained by Bear Creek. Bear Creek begins near the westernmost portion of Y-12 and flows west for approximately 8.3 km (5 mi). When Bear Creek reaches U.S. Highway 95, it turns north and flows through a water gap in Pine Ridge to its confluence with Lower EFPC just above its confluence with Poplar Creek. Bear Creek flow is maintained by inputs from tributary streams flowing in from the north (mostly) from Pine Ridge. Flow in Bear Creek is further supplemented by discharges from several springs at the base of Chestnut Ridge (entering Bear Creek from the south). The channel of Bear Creek is less modified than that of UEFPC but several short reaches have been relocated to accommodate construction (e.g., Bear Creek Road) at the west end of Y-12.

The Clinch River and connected waterways supply all raw water for ORR and provide potable water for Y-12, ORNL, and the city of Oak Ridge. The Clinch River has an average flow of 132 m^3/s (4,647 ft^3/s) as measured at the downstream side of Melton Hill Dam at mile 23.1. The average flow of Bear Creek near Y-12 is 0.11 m^3/s (3.9 ft^3/s). Prior to flow augmentation in UEFPC, the average flow in EFPC measured downstream of Y-12 was 1.3 m^3/s (45 ft^3/s). The average flow in EFPC has increased as flow augmentation raised the minimum flow rate to 0.3 m^3/s (11 ft^3/s) in the headwaters of UEFPC. Y-12 uses approximately 7,530 MLY (1,989 MGY) of water while ORR uses approximately twice as much (14,760 MLY [3,900 MGY]). The ORR water supply system, which includes the city of Oak Ridge treatment facility and the ETTP treatment facility, has a capacity of 44,347 MLY (11,716 MGY).

Clinch River water levels in the vicinity of ORR are regulated by a system of dams operated by TVA. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of ORR. Watts Bar Dam, located on the Tennessee River downstream of the lower end of the Clinch River, controls the flow of the Clinch River along the southeast side of ORR.

Source: Tetra Tech, Inc.

FIGURE 4.5.1–1.—*Y-12 Plant Area Surface Water Features.*

TVA has conducted floodplain studies along Clinch River, Bear Creek, and EFPC (TVA 1991). Portions of Y-12 lie within the 100- and 500-year floodplains of EFPC; however, proposed SWEIS facilities are located outside the 500-year floodplain (Figure 4.5.1–2).

Surface Water Quality. The streams and creeks of Tennessee are classified by TDEC and defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. The Clinch River is the only surface water body on ORR classified for domestic water supply. Most of the streams at ORR are classified for fish and aquatic life, livestock watering, wildlife, and recreation. White Oak Creek and Melton Branch are the only streams not classified for irrigation. Portions of Poplar Creek and Melton Branch are not classified for recreation.

At Y-12, there are six treatment facilities with NPDES-permitted discharge points to UEFPC. Y-12 is also permitted to discharge wastewater to the city of Oak Ridge Wastewater Treatment Facility. The water quality of surface streams in the vicinity of Y-12 is affected by current and past operations. Despite efforts to reroute discharge pipes and to treat all wastewater from the plant processes, wastewater discharges from Y-12 are a major influence on water quality and flow in UEFPC. Storm water discharges, groundwater discharges (either directly to the stream channel or collected in building sumps and discharged to UEFPC) and wastewater discharges contribute specific contaminants to UEFPC. Surface water contaminants in UEFPC are summarized in Table 4.5.1–1 and include metals (particularly mercury and uranium), chlorinated solvents, and radionuclides (especially isotopes of uranium) (DOE 1998b). Water quality in Bear Creek is influenced significantly by a groundwater hydraulic connection either directly to Bear Creek or to tributaries to Bear Creek. Contaminants in Bear Creek, from multiple formerly used waste burial trenches and pits, include nitrate, metals (e.g., uranium), radionuclides (e.g., uranium isotopes, ^{99}Tc), and chlorinated organics and are summarized in Table 4.5.1–1 (DOE 1997a and LMES 1997b).

FIGURE 4.5.1–2.—*100- and 500-year Floodplains for Y-12.*

Surface Water Rights and Permits. In Tennessee, the state's water rights laws are codified in the *Water Quality Control Act*. In effect, the water rights are similar to riparian rights in that the designated usages of a water body cannot be impaired. The only requirement to withdraw water from available supplies would be a U.S. Army Corps of Engineers (USACE) permit to construct intake structures.

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)*

			Tennessee Water Quality Criteria			
					Recreation	
Parameter	UEFPC (mean concentration)	Bear Creek	Domestic Use	Fish and Aquatic Life	Organisms	Water and Organisms
Metals (mg/L)						
Mercury	0.00091	!	0.002	0.00169	0.00005	0.00005[b]
Uranium	0.015	0.031	!	!	!	!
Lithium	0.041	!	!	!	!	!
Copper	0.007	!	!	0.0177[c]	!	!
Zinc	0.045	0.003	!	0.117[c]	!	!
Nickel	0.021	!	0.1	1.418[c]	4.6	0.61
Organics (Fg/L)						
Chloroform	2.8	!	!	!	4700	57
Tetrachloroethene	3.9	!	5	!	88.5	8
Carbon Tetrachloride	4[a]	!	5	!	44	2.5
Radionuclides (pCi/L)						
Gross Alpha	6.8	12.5	!	!	!	!
Gross Beta	3.7	8.62	!	!	!	!
Gamma	28	!	!	!	!	!

[a] One sample.
[b] Based on consumption of water and organisms. Applied to waters designated for domestic and recreational uses.
[c] Based on total hardness of 100 mg/L.
Note: BCK - Bear Creek kilometer.
Source: DOE 1997a, DOE 1998b, LMES 1997b, TDEC 1999b.

4.5.2 Groundwater

ORR Hydrogeology. ORR is located in an area of sedimentary rocks of widely varying hydrological characteristics. Two geologic units on the ORR, designated as the Knox Group and the Maynardville Limestone of the Conasauga Group, both consisting of dolostone and limestone, constitute the Knox Aquifer. A combination of fractures and solution conduits in this aquifer control flow over substantial areas and relatively large quantities of water may move rapidly over relatively long distances. Active groundwater flow can occur at substantial depths in the Knox Aquifer (92 to 122 m [300 to 400 ft] deep). The Knox Aquifer is the primary source of groundwater to many streams (base-flow), and most large springs on the ORR receive discharge from the Knox Aquifer. Yields of some wells penetrating larger solution conduits are reported to exceed 3,784 LPM (1,000 GPM).

The remaining geologic units on the ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) are aquitards, which consist mainly of siltstone, shale, sandstone, and interbedded limestone and dolostone of low to very low permeability. Nearly all groundwater flow in the aquitards occurs through fractures similar to the flow mechanism dominant in the aquifers. However, the absence of solution-enlarged fractures in the aquitards limits flow to a system of smaller and less connected fractures. The typical yield of a well in the aquitards is less than 4 LPM (1 GPM) and the base flows of streams draining areas underlain by the aquitards are poorly sustained because of such low flow rates. In areas underlain by aquitards, the combination of topographic relief and a decrease in bedrock fracture density with depth, restrict groundwater flow to shallow depths of the saturated zone and groundwater discharges primarily to nearby surface waters within the ORR (DOE 1999k).

The Knox Aquifer and ORR Aquitards can each be divided into a shallow soil and regolith unit and a deeper bedrock unit. The shallow unit consists of manmade fill, alluvium, colluvium, residuum, and weathered bedrock. In undisturbed areas an active storm flow zone, roughly equivalent to the zone of plant roots, carries a large percentage of infiltrating precipitation toward surface water streams. The influence of manmade fill on groundwater flow within the shallow unit is particularly important in Y-12 where pre-existing UEFPC stream channels have been filled and act as preferential groundwater flow paths (DOE 1998b). The bedrock unit consists of sandstones, siltstones, shales, and carbonates where groundwater flow occurs in fracture and/or conduit systems.

Y-12 Hydrogeology. Y-12, bound on the north by Pine Ridge and on the south by Chestnut Ridge, is located near the boundary between the Knox Aquifer and the ORR Aquitards. ORR Aquitards underlie Pine Ridge and Bear Creek Valley, which contains the main plant area of Y-12 and the disposal facilities of western Bear Creek Valley. The Knox Aquifer underlies Chestnut Ridge and the stream channels of Bear Creek and UEFPC. Bedrock formations comprising the Aquitards are hydraulically upgradient of the Aquifer, which functions as a hydrologic drain in Bear Creek Valley. Fractures provide the principal groundwater flowpaths in both the Aquifer and Aquitards. Dissolution of carbonates in the Aquifer has enlarged fractures and produced solution cavities and conduits that greatly enhance its hydraulic conductivity relative to the Aquitards.

Groundwater at Y-12 has been divided into three hydrogeologic regimes: UEFPC, Bear Creek, and Chestnut Ridge. A surface water divide at the west end of Y-12 effectively separates the UEFPC and Bear Creek hydrogeologic regimes with groundwater flow directions generally to the west in the Bear Creek regime and toward the east in the UEFPC regime. Bedrock beneath these two regimes is predominantly the ORR Aquitards. The Chestnut Ridge hydrogeologic regime, although hydraulically connected to the other two regimes, is distinctive in being developed on the underlying Knox Aquifer. In Bear Creek Valley, depth to groundwater is generally 6 to 9 m (20 to 30 ft) but is as little as 2 m (7 ft) in the area of Bear Creek near Highway 95. On Chestnut Ridge, the depth to the water table is greatest (>30 m [100 ft] below ground surface) along the crest of the ridge, which is a groundwater flow divide and recharge area. Groundwater in the Chestnut Ridge hydrogeologic regime tends to flow from west to east with elements of radial flow from the ridge crest north into Bear Creek Valley and south toward the headwaters of tributaries draining into Bethel Valley.

Recharge occurs over most of the area but is most effective where overburden soils are thin or permeable. Groundwater flow in the Aquitard and the Aquifer is primarily parallel to bedding, which in the Aquitard may or may not coincide with the direction of maximum hydraulic gradient calculated from field measurements.

Cross bedding flows occur along permeable zones formed by fractures. The northern tributaries to Bear Creek (those exposed in western Bear Creek Valley and buried beneath Y-12) are possibly surficial expressions of the cross-cutting features.

In the Aquitard, most groundwater flow occurs in a highly conductive interval near the bedrock/residuum interface (water table interval). Flow occurs above the water table in response to precipitation when flowpaths in the residual soils become saturated and rapidly transmit water laterally (stormflow) down slope toward springs and seeps in drainage features, and vertically (recharge) to the water table interval. Recharge to the water table interval promotes bedding-parallel groundwater flow toward discharge areas in nearby cross-cutting streams. Although most active groundwater flow occurs at depth less than 30 m (100 ft) below ground surface, contaminants in groundwater more than 61 m (200 ft) below ground surface in the Aquitard indicate permeable flowpaths at depth.

In the Aquifer, most groundwater flow occurs at shallow depths (i.e., <30 m [100 ft] below ground surface) in an extensively interconnected maze of solution conduits and cavities. Below the shallow karst network, fractures provide the primary flowpaths. Flow in the shallow karst network in the Aquifer is relatively rapid and during rainfall results in rapid discharge to surface streams. Groundwater from the deeper flow system (>30 m [100 ft] below ground surface) discharges along major gaining reaches of Bear Creek. In the main plant area of Y-12, the surface water drainage system has been drastically altered by construction. Despite the alterations, groundwater discharges continue to the buried tributaries and to pre-existing spring locations. Actively pumping basement sumps in several buildings within Y-12 locally influence groundwater flow directions by drawing water toward the pump and lowering the water table. Basement sumps also contribute discharge to UEFPC.

There are no Class I sole-source aquifers that lie beneath ORR. All aquifers are considered Class II aquifers (current potential sources of drinking water). Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORR. Only one water supply well exists on ORR; it provides a supplemental water supply to an aquatics laboratory during extended droughts.

Groundwater Quality. Groundwater samples are collected semiannually or annually from a representative number of the monitoring wells throughout ORR. Groundwater samples collected from the monitoring wells are analyzed for a standard suite of parameters and constituents, including trace metals, VOCs, radionuclides, inorganics, and field parameters. Background groundwater quality at ORR is generally good in the near surface aquifer zones and poor in the bedrock aquifer at depths greater than 300 m (984 ft) due to high total dissolved solids.

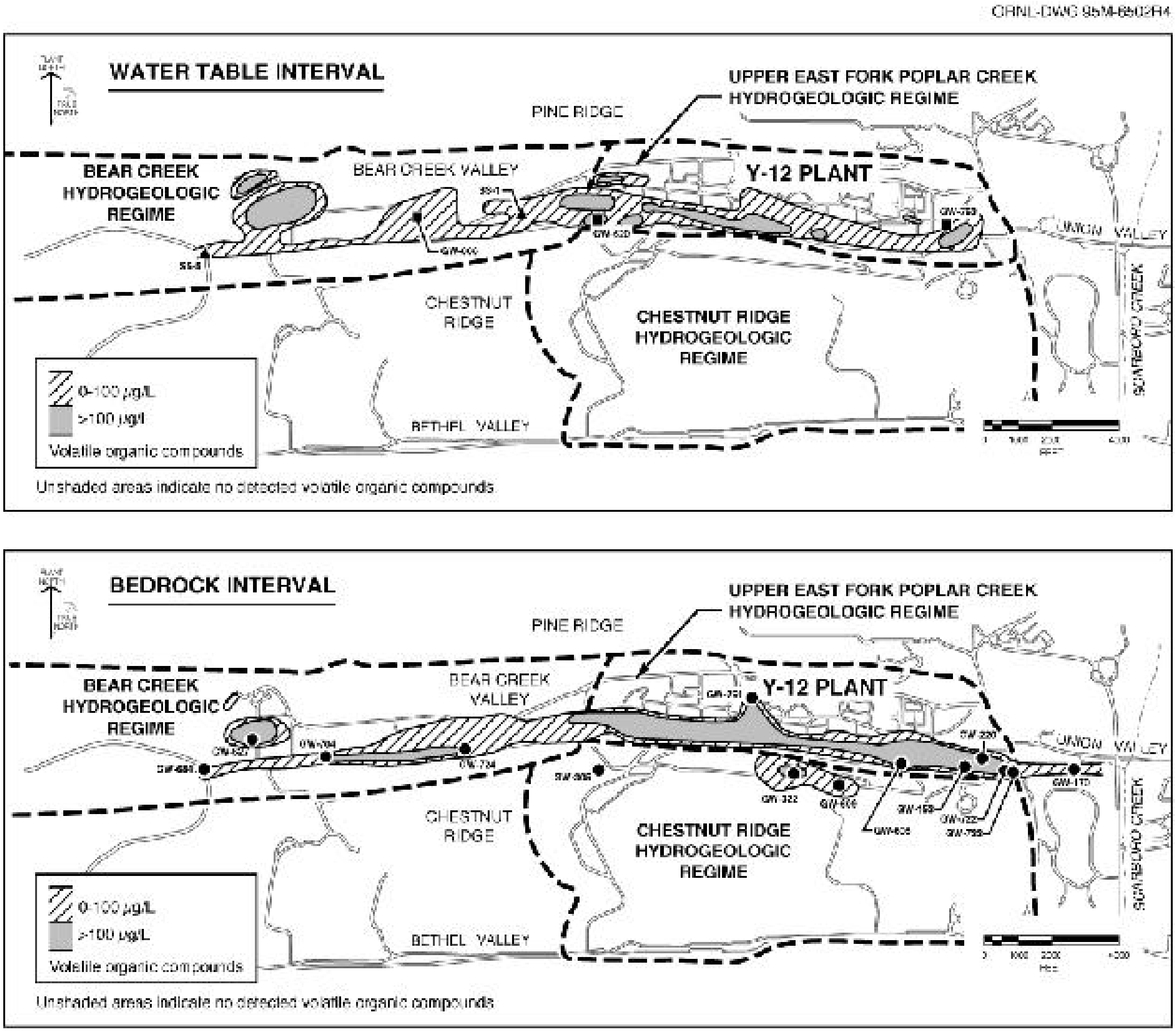
Groundwater in Bear Creek Valley west of Y-12 has been contaminated by hazardous chemicals and radionuclides (mostly uranium) from past weapons production waste disposal activities (DOE 1997a). The contaminant sources include past waste disposal facilities sited on Aquitard bedrock north of Bear Creek. Former disposal facilities include the S-3 Ponds, the Oil Landfarm, the Boneyard/Burnyard site, and the Bear Creek Burial Grounds, all closed since 1988. Each site was used for the disposal of waste chemicals including acids, solvents, oils, radioactive material (e.g., uranium), and wastewater containing dissolved metals and radionuclides. As a result, the aquifers below disposal sites often contain accumulations of the organic solvents (dense nonaqueous phase liquids) and the groundwater beneath and downgradient of the disposal facilities is contaminated with nitrate, solvents (e.g., PCE, TCE, DCE), radionuclides (e.g., uranium isotopes and ^{99}Tc), and metals (e.g., uranium, cadmium, strontium). The distribution of groundwater contamination in the Bear Creek hydrogeologic regime is illustrated in Figures 4.5.2–1 through 4.5.2–3.

Historical monitoring of groundwater in the UEFPC Y-12 area has been used to define an area of contamination that extends throughout Y-12 and off-site to the east into Union Valley. The groundwater contamination is the result of a comingling of releases from multiple sources within Y-12. The most widespread contaminant types are VOCs such as the solvents PCE, TCE, DCE, carbon tetrachloride, and chloroform; and fuel components such as benzene, toluene, ethylbenzene, and xylenes (BTEX). Other groundwater contaminants include nitrate, gross alpha activity (primarily uranium isotopes), gross beta activity (primarily uranium isotopes and ^{99}Tc). The most frequently detected metals are boron, beryllium, cobalt, copper, chromium, lead, lithium, mercury, manganese, nickel, and total uranium (DOE 1998b). The distribution of groundwater contamination in the UEFPC hydrogeologic regime is illustrated in Figures 4.5.2–1 through 4.5.2–3.

The Chestnut Ridge hydrogeologic area is dominated by several closed and operating disposal facilities including the closed Chestnut Ridge Security Pits, Chestnut Ridge Sediment Disposal Basin, United Nuclear Corporation Site, and five nonhazardous waste landfills. Groundwater monitoring data collected since the mid-1980s indicate limited groundwater contamination. Contaminants consist primarily of VOCs detected in scattered monitoring wells. The only definable VOC contaminant plume in groundwater is associated with the Chestnut Ridge Security Pits and extends approximately 792 m (2,600 ft) east of that facility. The distribution of groundwater contamination in the Chestnut Ridge hydrogeologic regime is illustrated in Figures 4.5.2–1 through 4.5.2–3.

Groundwater Availability, Use, and Rights. Industrial and drinking water supplies in the area are primarily taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by the public water supply system. Most of the residential supply wells in the immediate area of ORR are south of the Clinch River. Most wells used for potable water are located in the deeper principal carbonate aquifer (305 m [1,000 ft]), while the groundwater contamination at Y-12 is primarily found above a depth of approximately 84 m (276 ft), with the exception of VOC contamination at the east end of Y-12 which has been found to extend to 171 m (560 ft) below ground surface.

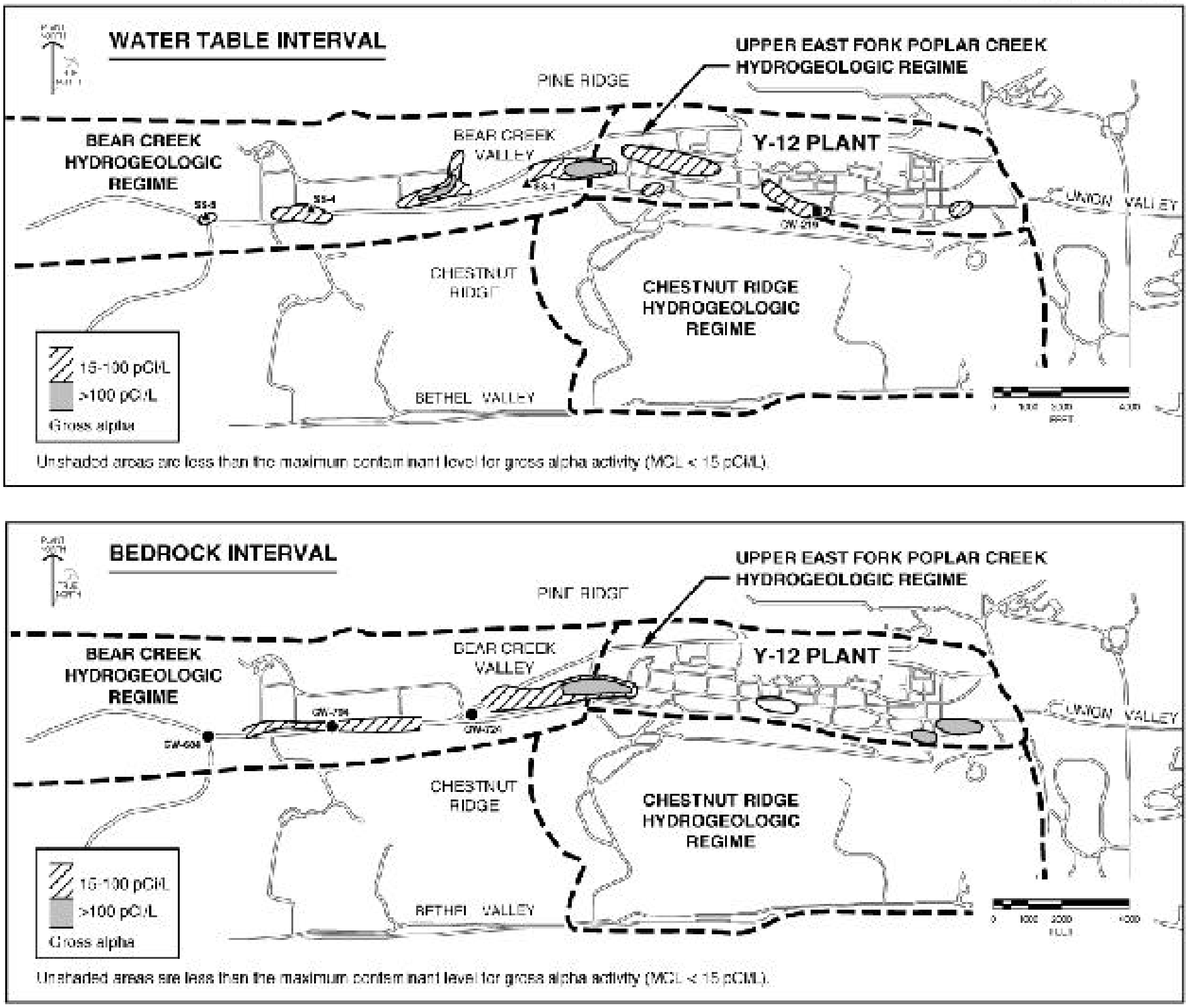
Groundwater rights in the State of Tennessee are traditionally associated with the Reasonable Use Doctrine (Van der Leeden 1990). Under this doctrine, landowners can withdraw groundwater to the extent that they must exercise their rights reasonably in relation to the similar rights of others.



Source: DOE 1999k.

FIGURE 4.5.2–1.—*Summed Volatile Organic Compounds in Groundwater*.

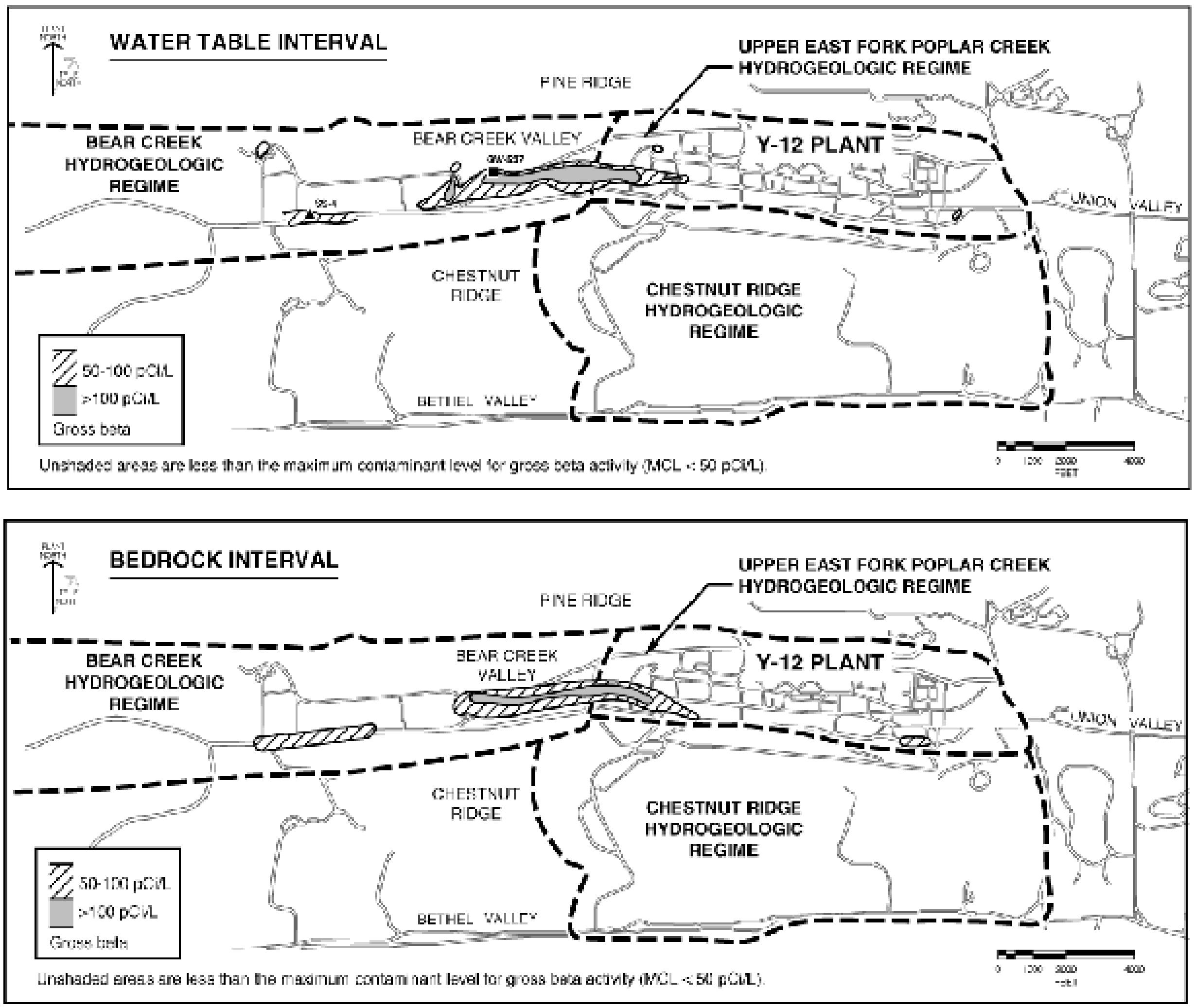
ORNL-DWG 95M-6905R5



Source: DOE 1999k.

FIGURE 4.5.2–2.—*Gross Alpha Activity in Groundwater at Y-12.*

ORNL-DWG 95M-5504R4



Source: DOE 1999k.

FIGURE 4.5.2–3.—*Gross Beta Activity in Groundwater at Y-12.*

4.5.3 Y-12 Liquid Release

Nonradiological Liquid Discharges. The *Clean Water Act* requires that EPA establish limits on the amounts of specific pollutants that may be discharged to surface waters. The standards, called effluent limitations, are written into NPDES permits issued to all municipal and industrial dischargers. The Y-12 Plant, ORNL, and the ETTP are each required to monitor discharges at frequencies specified in their permits to ensure compliance with the NPDES effluent limitations.

The current Y-12 Plant NPDES permit, issued on April 28, 1995, and effective on July 1, 1995, requires sampling, analysis and reporting at approximately 100 outfalls. Discharges to surface water allowed under the permit include storm drainage, cooling water, cooling tower blowdown, andtreated process wastewaters, including effluents from wastewater treatment facilities. The effluent limitations contained in the permit are based on the protection of water quality in the receiving streams.

The permit emphasizes monitoring storm water runoff as well as biological, toxicological, and radiological monitoring. Currently, the Y-12 Plant has outfalls and monitoring points in the following water drainage areas: EFPC, Bear Creek, and several unnamed tributatries on the south side of Chestnut Ridge. These creeks and tributatries eventually drain to the Clinch River (DOE 1999k). At Y-12, there are six treatment facilities with NPDES-permitted discharge points to UEFPC. Y-12 is also permitted to discharge wastewater to the city of Oak Ridge Wastewater Treatment Facility.

Radiological Liquid Discharges. At the Y-12 Plant, a Radiological Monitoring Plan is in place to address compliance with DOE Orders and the NPDES permit. No discharge limits for radionuclides are set by the NPDES permit; however, the permit does require monitoring and reporting of results. Under the monitoring program, effluent monitoring is performed at three types of locations: (1) treatment facilities, (2) other point and area source discharges, and (3) instream locations. Radiological parameters monitored at the Y-12 Plant in 1998 include the following:

- Uranium isotopes (^{238}U, ^{235}U, and ^{234}U, total uranium, and weight % of uranium ^{235}U)
- Fission and activation products (^{90}Sr, tritium, ^{99}Tc, and ^{137}Cs)
- Transuranic isotopes (^{241}Am, ^{237}Np, ^{238}Pu, and $^{239/240}$Pu)
- Other isotopes of interest (^{232}Th, ^{230}Th, ^{288}Th, ^{226}Ra and ^{228}Ra)

In 1998, the highest summed percentage of Derived Concentration Guidelines (DCGs) was from the total 8.6 percent. The total mass of uranium and associated curies released from the Y-12 Plant at the easternmost monitoring station, Station 17 on UEFPC, and the westernmost monitoring station, at Bear Creek Kilometer 4.55, was 375 kg or 0.167 Ci.

The Radiological Monitoring Plan also addresses monitoring of the sanitary sewer. The Y-12 Plant is permitted to discharge domestic wastewater to the city of Oak Ridge publicly owned treatment works. Studies of the potential sources of radionuclides discharging to the sanitary sewer have shown that levels of radionuclides are orders of magnitude below levels established in DOE Orders and are not thought to pose a safety or health risk. No single radionuclide in the Y-12 Plant contribution to the sanitary sewer exceeded 1 percent of the DCG listed in DOE Order 5400.5. Summed percentages of DCGs calculated from the Y-12 Plant contribution to the sewer are essentially zero.

Radiological monitoring of storm water also is required by the NPDES permit. Uranium is the dominant constituent and increases during storm flow, probably due to surface sources and increase groundwater flow (DOE 1999k).

4.6 BIOLOGICAL RESOURCES

This section describes the biological resources at ORR including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Information for Y-12 is also provided.

4.6.1 Terrestrial Resources

Plant communities on the ORR are characteristic of the intermountain regions of central and southern Appalachia. Approximately 35 percent of the ORR has been developed since it was withdrawn from public access; the remainder of the site has reverted to or been planted with natural vegetation (LMER 1999a). Over 1,100 vascular plant species have been found on ORR (LMER 1999a). The vegetation of ORR has been categorized into seven plant communities (Figure 4.6.1–1). Pine and pine-hardwood forest and oak-hickory forest are the most extensive plant communities on ORR, while northern hardwood forest and hemlock-white pine-hardwood forest are the least common forest community types. Important conifers on the ORR include loblolly pine (*Pinus taeda*), shortleaf pine (*Pinus echinata*), Virginia pine (*Pinus virginiana*), and white pine (*Pinus strobus*). Important deciduous trees include white oak (*Quercus alba*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), shagbark hickory (*Carya ovata*), pignut hickory (*Carya glabra*), sweetgum (*Liquidambar styraciflua*), tulip poplar (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). Some additional representative plants are provided in Table 4.6.1–1.

Animal species found on the ORR include about 63 species of fish; 59 species of amphibians and reptiles; up to 260 species of migratory, transient, and resident birds; and 38 species of mammals (LMER 1999a). Representative amphibians and reptiles include American toad (*Bufo americanus),* eastern tiger salamander (*Ambystoma tigrinum)*, five-lined skink (*Eumeces fasciatus),* eastern garter snake (*Thamnophis sirtalis),* rat snake (*Elaphe obsoleta),* and eastern box turtle (*Terrapene carolina).*

Some representative mammals on the ORR, particularly in less developed areas, include deer mouse (*Peromyscus maniculatus*), eastern chipmunk (*Tamias striatus*), eastern cottontail (*Sylvilagus floridanus),* eastern gray squirrel (*Sciurus carolinensis*), southern flying squirrel (*Glaucomys volans),* gray fox (*Urocyon cinereoargenteus*), hispid cotton rat (*Sigmodon hispidus),* Meadow vole (*Microtus pennsylvanicus),* opposum (*Didelphis virginiana),* raccoon (*Procyon lotor),* striped skunk (*Mephitis mephitis),* and white-tailed deer (*Odocoileus virginianus)* (Mitchell 1996). The white-tailed deer is a game species hunted on the ORR.

Some of the more common birds on the ORR, particularly in less developed areas, include mourning dove (*Zenaida macroura*), chimney swift (*Chaetura pelagica*), barn swallow (*Hirundo rustica*), blue jay (*Polioptila caerulea*), Carolina chickadee (*Parus carolinesis*), American crow (*Corvus brachyrhunchos*), Carolina wren (*Thryothus Iudovicianus*), American robin (*Turdus migratorius*), northern mockingbird (*Mimus polyglottos*), European starling (*Sturnis vulgaris*), red-eyed vireo (*Vireo olivaceus*), northern cardinal (*Cardinalis cardinalis*), indigo bunting (*Passerina cyanea*), eastern meadowlark (*Sturnella magna*), common grackle (*Quiscalus quiscula*), and house sparrow (*Passer domesticus*) (Mitchell, 1996; Sauer, 1997). The wild turkey (*Meleagris gallopavo)* is a game species hunted on the ORR. A variety of migratory birds has been found at ORR. Migrating birds present on site, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act.* The ORR has more species of breeding birds documented than any other single tract of land in Tennessee (Mitchell 1998). Table 4.6.1-2 contains a partial list of some of the potential breeding birds and their relative abundance on the ORR. A more detailed list is provided by Sauer et al. (1997).

Source: DOE 1996e

FIGURE 4.6.1–1 ***Distribution of Plant Communities on the Oak Ridge Reservation.***

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* [Page 1 of 2]

Common name	Scientific name	Common name	Scientific name
PLANTS		**FISH (continued)**	
American beech	*Fagus grandifolia*	Largemouth bass	*Micropterus salmonides*
Black oak	*Quercus velutina*	Sauger	*Stizostedion canadense*
Black willow	*Salix nigra*	Sunfish	*Lepomis spa*
Blueberry	*Vaccinium* sp.		
Box elder	*Acer negundo*	**AMPHIBIANS & REPTILES**	
Juneberry	*Aelanchier* sp.	American toad	*Bufo americanus*
Fescue	*Festuca* sp.	Bull frog	*Bufo catesbeiana*
Green ash	*Fraxinus pennsylvanica*	Eastern tiger salamander	*Amblystoma tigrinum*
Hazelnut	*Corylus americana*	Spring peeper	*Pseudacris triseriata*
Hop hornbeam	*Ostrya virginiana*	Five-lined skink	*Eumeces fasciatus*
Japanese honeysuckle	*Lonicera japonica*	Corn snake	*Elaphe guttata*
Jewelweed	*Impatiens capensis*	Eastern garter snake	*Thamnophis sirtalis*
Juneberry	*Amelanchier* sp.	Northern water snake	*Nerodia spiedon*
Loblolly pine	*Pinus taeda*	Rat snake	*Elaphe obsoleta*
Northern red oak	*Quercus rubra*	Eastern box turtle	*Terrapene carolina*
Pignut hickory	*Carya glabra*	Painted turtle	*Chrysemys picta*
Red bud	*Cercis canadensis*	**BIRDS**	
Reed canary grass	*Phalaris arundianaceae*	Wood duck	*Aix sponsa*
Rice cutgrass	*Leersia oryzoides*	Canada goose	*Branta canadensis*
Rusty viburnum	*Viburnum rudifulum*	Mourning dove	*Zenaida macroura*
Sedges	Carex sp.	Yellow-billed cuckoo	*Coccyzus americanus*
Shagbark hickory	*Carya ovata*	Chimney swift	*Chaetura pelagica*
Shortleaf pine	*Pinus echinata*	Barn swallow	*Hirundo rustica*
Silky dogwood	*Cornus amomum*	Blue jay	*Cyanocitta cristata*
Soft rush	*Juncus effusus*	American crow	*Corvus brachyrhynchos*
Sugar maple	*Acer sccharum*	Carolina chickadee	*Parus carolinesis*
Sweetgum	*Liquidambar styraciflua*	Tufted titmouse	*Parus bicolor*
Sycamore	*Platanus occidentalis*	Carolina wren	*Thryothus Iudovicianus*
Tulip poplar	*Liriodendron tulipifera*	Blue-gray gnatcatcher	*Polioptila caerulea*
Turnflower rush	*Juncuc biflorus*	Eastern bluebird	*Sialia sialis*
Virginia pine	*Pinus virginiana*	Wood thrush	*Hylocichla mustelina*
White oak	*Quercus alba*	American robin	*Turdus migratorius*
White pine	*Pinus strobus*	Northern mockingbird	*Mimus polyglottos*
FISH		Brown thrasher	*Toxostoma rufum*
Shad	Clupeidae	European starling	*Sturnus vulgaris*
Herring	*Clupeidae*	Red-eyed vireo	*Vireo olivaceus*
Common carp	*Cyprinus carpio*	Ovenbird	*Seiurus aurocapillus*
Catfish	Ictaluridae	Common yellowthroat	*Geothylpis trichas*
Bluegill	*Lepomis macrochirus*	Yellow-breasted chat	*Icteria virens*
Crappie	Pomoxis spp	Scarlet tanager	*Piranga olivacea*
Drum	*Aplodinotus grunniens*	Northern cardinal	*Cardinalis cardinalis*

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* [Page 2 of 2]

Common name	Scientific name	Common name	Scientific name
BIRDS (Continued)		**MAMMALS**	
Indigo Bunting	*Passerina cyanea*	Deer mouse	*Peromyscus maniculatus*
Eastern Towhee	*Pipilo erthrophthalmus*	Eastern chipmunk	*Tamias striatus*
Field Sparrow	*Spizella pusilla*	Eastern cottontail	*Sylvilagus floridanus*
Song Sparrow	*Melospiza melodia*	Eastern gray squirrel	*Sciurus carolinensis*
Red-winged Blackbird	*Agelaius phoeniceus*	Eastern harvest mouse	*Reithrodontomys humulis*
Eastern Meadowlark	*Sturnella magna*	Gray fox	*Urocyon cinereoargenteus*
Common Grackle	*Quiscalus quiscula*	Hispid cotton rat	*Sigmodon hspidus*
Brown-headed Cowbird	*Molothrus ater*	Meadow vole	*Microtus pennsylvanicus*
American Goldfinch	*Carduelis tristis*	Mink	*Mustela vison*
House Sparrow	*Passer domesticus*	Norway rat	*Rattus norvegicus*
Wild turkey	*Meleagris gallopavo*	Opposum	*Didelphis virginiana*
Turkey Vulture	*Cathartes aura*	Raccoon	*Procyon lotor*
Red-shouldered hawk	*Buteo lineatus*	Shorttailed shrew	*Blarina brevicauda*
Broad-winged hawk	*Buteo platypterus*	Southern flying squirrel	*Glaucomys volans*
		Striped skunk	*Mephitis mephitis*
		White-footed mouse	*Peromyscus leucopus*
		White-tailed deer	*Odocoileus virginianus*

Sources: Mitchell et al. 1996; ORNL 1994; DOE 2000.

Table 4.6.1–2.—*List of Potential Breeding Birds and Relative Abundance on the Oak Ridge Reservation* [Page 1 of 4]

Common Name	Scientific Name	Relative Abundance
Great Blue Heron	*Ardea herodias*	0.18
Green Heron	*Butorides virescens*	0.46
Black-crowned Night Heron	*Nycticorax nycticorax*	0.11
Yellow-crowed Night Heron	*Nycticorax violacus*	0.01
Canada Goose	*Branta canadensis*	0.94
Wood Duck	*Aix sponsa*	0.28
Mallard	*Anas platyrhynchos*	0.09
Black Vulture	*Coragyps atratus*	0.01
Turkey Vulture	*Cathartes aura*	0.48
Sharp-shinned Hawk	*Accipiter striatus*	0.03
Cooper's Hawk	*Accipiter cooperii*	0.02
Red-shouldered Hawk	*Buteo lineatus*	0.49
Broad-winged Hawk	*Buteo platypterus*	0.19
Red-tailed Hawk	*Buteo jamaicensis*	0.07
American Kestrel	*Falco sparverius*	0.08
Ruffed Grouse	*Bonasa umbellus*	0.00
Northern Bobwhite	*Colinus virginianus*	8.05
Killdeer	*Charadrius vociferus*	3.02
American Woodcock	*Scolopax minor*	0.00
Rock Dove	*Columba livia*	4.78
Mourning Dove	*Zenaida macroura*	26.40
Black-billed Cuckoo	*Coccyzus erythropthalmus*	0.03
Yellow-billed Cuckoo	*Coccyzus americanus*	6.15
Eastern Screech-owl	*Otus asio*	0.04
Great Horned Owl	*Bubo virginianus*	0.07
Barred Owl	*Strix varia*	0.11
Common Nighthawk	*Chordeiles minor*	0.00
Chuck-will's-widow	*Caprimulgus carolinensis*	0.24
Whip-poor-will	*Caprimulgus vociferus*	0.16
Chimney Swift	*Chaetura pelagica*	21.14
Ruby-throated Hummingbird	*Archilochus colubris*	0.51
Belted Kingfisher	*Ceryle alcyon*	0.58

Table 4.6.1–2.—*List of Potential Breeding Birds and Relative Abundance on the Oak Ridge Reservation* [Page 2 of 4]

Common Name	Scientific Name	Relative Abundance
Red-headed Woodpecker	*Melanerpes erythrocephalus*	0.00
Red-bellied Woodpecker	*Melanerpes carolinus*	4.41
Downy Woodpecker	*Picoides pubescens*	3.70
Hairy Woodpecker	*Picoides villosus*	0.40
Yellow-shafted Flicker	*Colaptes auratus*	2.96
Pileated Woodpecker	*Dryocopus pileatus*	3.44
Easter Wood-pewee	*Contopus virens*	4.62
Acadian Flycatcher	*Empidonax virescens*	3.90
Willow Flycatcher	*Empidonax traillii*	0.12
Least Flycatcher	*Empidonax minimus*	0.06
Easter Phoebe	*Sayornis phoebe*	5.41
Great Crested Flycatcher	*Myiarchus crinitus*	2.10
Easter Kingbird	*Tyrannus tyrannus*	2.33
Horned Lark	*Ermophila alpestris*	0.00
Purple Martin	*Progne subis*	4.06
Tree Swallow	*Tachycineta bicolor*	0.01
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	1.42
Bank Swallow	*Riparia riparia*	0.01
Cliff Swallow	*Hirundo pyrrhonota*	0.05
Barn Swallow	*Hirundo rustica*	18.33
Blue Jay	*Cyanocitta cristata*	15.09
American Crow	*Corvus brachyrhynchos*	37.45
Carolina Chickadee	*Parus carolinensis*	17.97
Tufted Titmouse	*Parus bicolor*	12.45
White breasted Nuthatch	*Sitta carolinensis*	2.93
Carolina Wren	*Thryothorus ludovicianus*	1628
Bewick's Wren	*Thryomanes bewickii*	0.00
House Wren	*Troglodytes aedon*	0.14
Winter Wren	*Troglodytes troglodytes*	0.08
Blue-gray Gnatcatcher	*Polioptila caerulea*	6.32
Eastern Bluebird	*Sialia sialis*	6.09
Veery	*Catharus fuscescens*	0.77

Table 4.6.1–2.—*List of Potential Breeding Birds and Relative Abundance on the Oak Ridge Reservation* [Page 3 of 4]

Common Name	Scientific Name	Relative Abundance
Wood Thrush	*Hylocichla mustelina*	14.84
American Robin	*Turdus migratorius*	32.81
Gray Catbird	*Dumetella carolinensis*	2.46
Northern Mockingbird	*Mimus polyglottos*	14.79
Brown Thrasher	*Toxostoma rufum*	3.34
Cedar Waxwing	*Bombycilla cedrorum*	4.48
Loggerhead Shrike	*Lanius ludovicianus*	0.17
European Starling	*Sturnus vulgaris*	69.36
White-eyed Vireo	*Vireo griseus*	3.85
Solitary Vireo	*Vireo solitarius*	0.65
Yellow-throated Vireo	*Vireo flavifrons*	4.25
Red-eyed Vireo	*Vireo olivaceus*	24.68
Blue-winged Warbler	*Vermivora pinus*	0.14
Golden-winged Warbler	*Vermivora chrysoptera*	0.28
Norther Parula	*Parula americana*	1.37
Yellow Warbler	*Dendroica petechia*	1.61
Chestnut-sided Warbler	*Dendroica pensylvanica*	0.20
Black-throated Blue Warbler	*Dendroica caerulescens*	1.46
Black-throated Green Warbler	*Dendroica virens*	3.64
Blackburnian Warbler	*Dendroica fusca*	0.00
Yellow-throated Warbler	*Dendroica dominica*	5.24
Pine Warbler	*Dendroica pinus*	1.51
Prairie Warbler	*Dendrocia discolor*	0.79
Cerulean Warbler	*Dendroica cerulea*	1.29
Black & white Warbler	*Mniotilta varia*	3.37
American Redstart	*Setophaga ruticilla*	1.36
Prothonotary Warbler	*Protonotaria citrea*	0.00
Worm-eating Warbler	*Helmitheros vermivorus*	1.59
Swainson's Warbler	*Limnothlypis swainsonii*	0.09
Ovenbird	*Seiurus aurocapillus*	9.26
Louisiana Waterthrush	*Seiurus motacilla*	1.67
Kentucky Warbler	*Oporornis formosus*	2.86

Table 4.6.1–2.—*List of Potential Breeding Birds and Relative Abundance on the Oak Ridge Reservation* [Page 4 of 4]

Common Name	Scientific Name	Relative Abundance
Common Yellowthroat	*Geothlypis trichas*	8.88
Hooded Warbler	*Wilsonia citrina*	5.87
Yellow-breasted Chat	*Icteria virens*	7.95
Summer Tanager	*Piranga rubra*	1.28
Scarlet Tanager	*Piranga olivacea*	7.41
Northern Cardinal	*Cardinalis cardinalis*	27.19
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	0.10
Blue Grosbeak	*Guiraca caerulea*	2.03
Indigo Bunting	*Passerina cyanea*	35.31
Dickcissel	*Spiza americana*	0.01
Eastern Towhee	*Pipilo erythrophthalmus*	8.50
Chipping Sparrow	*Spizella passerina*	5.78
Field Sparrow	*Spizella pusilla*	7.42
Grasshopper Sparrow	*Ammodramus savannarum*	0.16
Song Sparrow	*Melospiza melodia*	31.21
Slate-colored Junco	*Junco hyemalis*	0.92
Red-winged Blackbird	*Agelaius phoeniceus*	19.57
Eastern Meadowlark	*Sturnella magna*	23.28
Common Grackle	*Quiscalus quiscula*	48.73
Brown-headed Cowbird	*Molothrus ater*	7.72
Orchard Oriole	*Icterus spurius*	2.28
Baltimore Oriole	*Icterus galbula*	0.08
House Finch	*Carpodacus mexicanus*	3.95
American Goldfinch	*Carduelis tristis*	8.25
House Sparrow	*Passer domesticus*	14.68

Source: Mitchell 1996; Sauer 1997.

The Oak Ridge Research Park covers approximately 8,094 ha (20,000 acres) at ORR for the protection of flora and fauna. As an ORNL User Facility, the Research Park is available for environmental research and education by DOE, other Federal agencies, industries, state, and other organizations, individuals, and academic institutions (LMER 1999a). The Walker Branch Watershed located partially within the Y-12 area has been used for long-term studies on hydrology, forest and stream ecology, and watershed biogeochemical studies since 1968 (SPAS 1998).

Within the fenced, developed portion of Y-12, grassy and devegetated areas surround the entire facility (see Figure 4.6.1–1). Buildings and parking lots dominate the landscape in Y-12, with limited vegetation present (ORNL 1992a). Fauna within the Y-12 area is limited by the lack of large areas of natural habitat. The two sites being considered for the proposed HEU Materials Facility are in previously disturbed areas containing a parking lot (Site A) or existing facilities (Site B). Adjacent land has also been previously disturbed to allow the construction of roads, structures, and utilities. As such, neither site is conducive to sustaining plant or animal populations, although birds and more mobile mammals may traverse the sites on a transient basis. Three sites are being considered for the proposed new Special Materials Complex. Site 1 is just north of the perimeter fence in a grassy and wooded area. The lower 50 percent of Site 1 is cleared and contains grass and non-native herbaceous plants (ORNL 1994). Site 2 and Site 3 are in previously disturbed areas of Y-12 containing structures, roads, and parking lots. Site 3 for the Special Materials Complex is the same location as Site B for the HEU Materials Facility. Neither Site 2 nor Site 3 is conducive to sustaining plant or animal populations, although birds and more mobile mammals may traverse the sites on a transient basis.

ORNL scientists monitor trace levels of radionuclides in hay, milk, eggs, and fish. The purpose of the monitoring is to evaluate potential radiation doses and to track trends in long-term accumulation of radionuclides (DOE 1999k). ORR conducts annual deer and turkey hunts, with the carcasses scanned at monitoring stations for radioactivity. Since hunts began in 1985, 2.3 percent of 7,123 deer taken (through 1998) have been retained due to radiological contamination (LMER 1999a).

A Biological Monitoring and Abatement Program was established in conjunction with the NPDES permit issued to Y-12 in 1992. The program includes toxicity monitoring, bioaccumulation studies, biological indicator studies, and ecological surveys. Toxicity testing and bioaccumulation studies indicate that the exposure of aquatic organisms in UEFPC to toxicants has been steadily decreasing as a result of remedial activities such as implementation of flow management and continuing mercury reductions at Y-12 (LMER 1999a).

4.6.2 Wetlands

Approximately 235 ha (580 acres) of wetlands have been identified on ORR, with most classified as forested palustrine, scrub/shrub, and emergent wetlands. Known wetlands range in size from several square yards at small seeps to approximately 10 ha (25 acres) at the White Oak Lake. Only a small percentage of the wetlands on the ORR are greater than 0.4 ha (1 acre) in size, with larger ones typically associated with river embayments, other areas affected by fluctuating levels of the Clinch River reservoirs, or beaver ponds (LMER 1999a). A wetland survey for the Y-12 area has been performed using the USACE methodology (DOE 1987), and wetlands have been classified as palustrine, scrub/shrub, or emergent according to the U.S. Fish and Wildlife Service system (USFWS 1979, ORNL 1994, ORNL 1992a).

An emergent wetland was found at the eastern end of Y-12 at a seep by a small tributary of the EFPC, between New Hope Cemetery and Bear Creek Road. The wetland receives effluent from an NPDES outfall. Cardinal flower (*Lobelia cardinalis*), an obligate species, and jewelweed (*Impatiens capensis*), a facultative species, were observed there (ORNL 1994).

Eleven small wetlands were found north of Bear Creek Road in remnants of the UEFPC. Obligate species observed included black willow (*Salix nigra*) and cattail (*Typha latifolia*); facultative species included elderberry (*Sambuccus canadensis*) and dotted smartweed (*Polygonum punctatum*) (ORNL 1994).

A relatively undisturbed, forested, wetland was identified in the stream bottomland of Bear Creek North Tributary 1 between Bear Creek Road and the powerline right-of-way in the Bear Creek Operable Unit. Common species noted included sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), and hazelnut (*Corylus americana*) (ORNL 1994).

Emergent and scrub/shrub wetlands were identified in the riparian area and in old pastures in the McCoy Branch bottomland in Chestnut Ridge Operable Unit 2 between Bethel Valley Road and the McCoy Embayment west of Y-12. Common species included reed canary grass (*Phalaris arundinaceae*), soft rush (*Juncus effusus*); some green ash, black willow, and sycamore (*Plantanus occidentalis*) were observed along McCoy Branch and in depressions (ORNL 1994).

4.6.3 Aquatic Resources

Aquatic habitat on or adjacent to the ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas within the ORR also include seasonal and intermittent streams (DOE 1996e).

Sixty-four fish species have been collected on or adjacent to the ORR. The minnow family has the largest number of species and is numerically dominant in most streams (ORNL 1988). Fish species representative of the Clinch River in the vicinity of the ORR include shad and herring (Clupeidae), common carp (*Cyprinus carpio*), catfish and bullheads (Ictaluridae), bluegill (*Lepomis macrochirus*), crappie (*Pomoxis* spp.), and freshwater drum (*Aplodinotus grunniens*) (ORNL 1981b). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from Melton Hill Dam (TWRA 1995). Recreational species consist of crappie, largemouth bass (*Micropterus salmonides*), sauger (*Stizostedion canadense*), sunfish (*Lepomis* spp.), and catfish. Sport fishing is not permitted within the ORR.

4.6.4 Threatened and Endangered Species

Forty-five Federal- and state-listed threatened, endangered, and other special status species have been identified on the ORR (Table 4.6.4–1) (ORNL 1999). Fifteen of these species are Federal- and/or state-listed as threatened or endangered (DOE 1996; Mitchell 1996; ORNL 1999). A rare plant survey has been performed for the Y-12 area (ORNL 1992a). There are no federally listed threatened or endangered plant species at ORR. Only two Federal-listed animal species have been observed on the ORR. The bald eagle (*Haliaeetus leucocephalus*) forages on Melton Hill and Watts Bar Lakes. On July 6, 1999, the U.S. Fish and Wildlife Service (USFWS) requested public comments concerning a proposal to remove the bald eagle (*Haliaeetus leucocephalus)* from that agency's list of endangered and threatened wildlife (64 FR 36454, July 1999). However, that proposal does not change the current threatened designation provided the bald eagle by the USFWS and the State of Tennessee, nor protection afforded under the *Bald and Golden Eagle Protection Act* and the *Migratory Bird Treaty Act.* The final rule on this proposal has not been issued (64 FR 36454, July 1999). On August 25, 1999, the USFWS removed the American peregrine falcon (*Falco peregrinus anatum*) from that agency's list of endangered and threatened wildlife (64 FR 46542, August 1999). However, that decision does not affect the endangered designation provided by the State of Tennessee. The USFWS is still tracking this raptor as a species of concern.

The only federally threatened or endangered species that has been reported from Y-12 is a single dead federally endangered gray bat (*Myotis grisescens*). The specimen was turned over to USFWS. The USFWS is currently conducting analyses to determine the cause of death and any potential exposure to Y-12 site-related contaminants (USFWS 1999). Two surveys have been conducted, in part, to determine if gray bats are present on ORR. Neither survey detected gray bats, although several species of unprotected bats were collected (Webb 1990, ORNL 1997). USFWS records indicate that the federally endangered Indiana Bat (*Myotis sodalis*) may also be present in the vicinity of Y-12 SWEIS impact area (USFWS 1999c). However, this bat has not been observed at Y-12 or other parts of ORR, during previous surveys for protected and sensitive species (Mitchell 1996). No critical habitat for threatened or endangered species, as defined in the *Endangered Species Act* (50 CFR 17.11 and 17.12), exists on ORR.

The ORR also has four plant and two animal species that are designated as Federal species of concern: Appalachian bugbane (*Cimicifuga rubifolia*), butternut (*Juglans cinerea*), spreading false foxglove (*Aureolaria patula*), tall larkspur (*Delphinium exaltatum*), paddlefish (*Polyodon spathula*), and loggerhead shrike (*Lanius ludovicianus*). These former C2 species (i.e., species possibly appropriate for listing as protected) no longer receive protection under the *Endangered Species Act*. However, Federal agencies are encouraged to include them in NEPA environmental impact analyses.

State threatened and endangered species observed on the ORR include 11 plant, 1 mammal, and 3 raptor species (ORNL 1999). A number of rare or state-listed animals and plants are present in the vicinity of Y-12. A population of the Tennessee dace (*Phoxinus tennesseensis*) is found in Bear Creek which flows out of Y-12 into the EFPC. This species is classified as "deemed in need of management" by the State of Tennessee.

The only ORR population of mountain witch alder (*Fothergilla major*), a species with Tennessee-threatened status, is on a west-facing slope of the Walker Branch Watershed. Canada lily *(Lilium canadense*) and the tuberculed rein-orchid (*Platanthera flava* var. *herbiola*), two species with Tennessee-threatened status, are found in the Pine Ridge Wetlands. Ginseng (*Panax quinquifolius*), a Tennessee species of special concern, and whorled horsebalm (*Collinsonia verticillata*) considered rare by the Nature Conservancy are found in the Chestnut Ridge area. The tuberculed rein-orchid, ginseng, and whorled horsebalm are found in the Bear Creek Spring area. A recently described quillwort species (*Isoetes carolinia*) is present at the Quillwort Temporary Pond and may be rare enough to be Tennessee listed (LMES 1998).

TABLE 4.6.4–1.—*Federal- or State-Listed Threatened, Endangered, and Other Special Status Species Reported on the Oak Ridge Reservation*

	Common Name	Scientific Name	Status[a] Federal	Status[a] State
Mammals				
	Gray bat[b]	*Myotis grisescens*	E	E
	Indiana bat[c]	*Myotis sodalis*	E	E
	Southeastern shrew	*Sorex longirostris*	NL	NM
Birds				
	American peregrine falcon[d]	*Falco peregrinus anatum*	NL	E
	Anhinga[d]	*Anhinga anhinga*	NL	NM
	Bald eagle[d]	*Haliaeetus leucocephalus*	T (DL)	T
	Cerulean warbler[e]	*Dendroica cerulea*	C	NL
	Cooper's hawk[e]	*Accipter cooperii*	NL	NM
	Double-crested cormorant[d]	*Phalacrocorax auritus*	NL	NM
	Grasshopper sparrow[e]	*Ammodramus savannarum*	NL	NM
	Great egret[d]	*Casmerodius alba*	NL	NM
	Little blue heron[e]	*Egretta caerulea*	NL	NM
	Loggerhead shrike	*Lanius ludovicianus*	NL	NM
	Northern harrier[d]	*Circus cyaneus*	NL	NM
	Olive-sided flycatcher[d]	*Contopus borealis*	NL	NM
	Osprey	*Pandion haliaetus*	NL	T
	Sandhill crane[d]	*Grus canadensis*	NL	NM
	Sharp-shinned hawk[e]	*Accipiter striatus*	NL	NM
	Snowy egret	*Leucophoyx thula*	NL	NM
	Yellow-bellied sapsucker	*Sphyrapicus varius*	NL	NM
Amphibians				
	Four-toed salamander	*Hemidactylium scutatum*	NL	NM
Fish				
	Paddlefish	*Polyodon spathula*	SC	NL
	Tennessee dace[f]	*Phoxinus tennesseensis*	NL	NM
Plants				
	American ginseng[f]	*Panax quinquefolius*	NL	S-CE
	Appalachian bugbane[d]	*Cimicifuga rubifolia*	SC	T
	Branching whitlow-grass	*Draba ramosissima*	NL	S
	Butternut[f]	*Juglans cinerea*	SC	T
	Canada (wild-yellow) lily[f]	*Lilium canadense*	NL	T
	Carey's saxifrage[f]	*Saxifraga careyana*	NL	S
	Fen orchid[f]	*Liparis loeselii*	NL	E
	Golden seal[f]	*Hydrastis canadensis*	NL	S-CE
	Hairy sharp-scaled sedge	*Carex oxylepis var. pubescense*	NL	S
	Heavy sedge[f]	*Carex gravida*	NL	S
	Howe's sedge	*Carex howei*	NL	E
	Lesser lady's tresses	*Spiranthes ovalis*	NL	S
	Michigan lily[f]	*Lilium michiganense*	NL	T
	Mountain witch alder[f]	*Fothergilla major*	NL	T
	Northern bush honeysuckle[f]	*Diervilla lonicera*	NL	T
	Northern white cedar	*Thuja occidentalis*	NL	S
	Nuttall waterweed[f]	*Elodea nuttallii*	NL	S
	Pink lady's-slipper[f]	*Cypripedium acaule*	NL	E-CE
	Purple fringeless orchid[f]	*Platanthera peramoena*	NL	T
	Pursh's wild-petunia	*Ruellia purshiana*	NL	S
	River bulrush	*Scirpus fluviatilis*	NL	S
	Shining ladies-tresses	*Spiranthes lucida*	NL	T
	Small-headed sedge	*Juncus brachycephalus*	NL	S
	Spreading false foxglove[f]	*Aureolaria patula*	SC	T
	Tall larkspur[f]	*Delphinium exaltatum*	SC	E
	Three-parted violet	*Viola triparta* var. *triparta*	NL	S
	Tubercled rein-orchid[f]	*Platanthera flava var. herbiola*	NL	S
	White-topped sedge	*Rhynchospora colorata*	NL	S
	Whorled mountainmint	*Pycnanthemum verticillatum*	NL	E-P

[a] Status codes: C-Candidate; DL-proposed for delisting; E-endangered; NL-not listed; NM-in need of management; P-possibly extirpated; S-special concern in Tennessee; SC-Federal Species of Concern; T-threatened.

[b] Only one dead gray bat has been reported from the ORR. Not currently known to nest on the ORR.

[c] The Indiana bat has not been reported from the ORR although USFWS records suggest it may be present.

[d] Uncommon visitor or migrant. Not currently known to nest on the ORR.

[e] Summer

[f] Recent record of species occurrence on ORR.

Sources: 50 CFR 17.11; 50 CFR 17.12; DOE 1995a; 64 FR36454; 64 FR 46542; DOE 1990; ORNL 1993b; ORNL 1981b; ORNL 1984a; ORNL 1988; DOE 1999k; LMER 1999a; TDEC 1997; TDEC 1998; TWRC 1991a; TWRC 1991b.

4.7 AIR QUALITY AND CLIMATE/NOISE

The following sections describe the affected environment at Y-12 and the surrounding region with respect to meteorology and climatology, nonradiological air quality, and radiological air quality.

4.7.1 Meteorology and Climatology

The city of Oak Ridge lies in a valley between the Cumberland and Blue Ridge mountain ranges and is bordered on two sides by the Clinch River. The Cumberland Mountains are 16 km (10 mi) to the northwest while the Blue Ridge Mountains, which include the Great Smoky Mountains National Park, are 51 km (32 mi) to the southeast (DOE 1999k). The ROI specific to air quality is primarily the Bear Creek Valley for Y-12. This valley is bordered by ridges that generally confine facility emissions to the valley between the ridges.

The climate of the region may be broadly classified as humid continental. The Cumberland Mountains to the northwest help to shield the region from cold air masses that frequently penetrate far south over the plains and prairies in the Central United States during the winter months. During the summer, tropical air masses from the south provide warm and humid conditions that often produce thunderstorms. Anti-cyclonic circulation around high-pressure systems centered in the western Gulf of Mexico can bring dry air from the southwestern United States into the region, leading to occasional periods of drought.

The mean annual temperature for the Oak Ridge area is 14.0 EC (57.2 EF). The coldest month is usually January, with temperatures averaging about 2.2 EC (36 EF), occasionally dipping as low as –31 EC (–24 EF). July is typically the hottest month of the year, with temperatures averaging 24.9 EC (76.8 EF), occasionally reaching over 37.8 EC (100 EF). In the course of a year, the difference between the maximum and minimum daily temperatures averages 12.5 EC (22.5 EF). The 1998 average temperature was 15.8 EC (60.4 EF) (DOE 1999k).

Winds in the Oak Ridge area are controlled in large part by the valley-and-ridge topography. Prevailing winds are either up-valley (northeasterly) daytime winds or down-valley (southwesterly) nighttime winds. Wind speeds are less than 11.9 km/hr (7.4 mph) 75 percent of the time (Figure 4.7.1–1). Tornadoes and winds exceeding 30 km/hr (18.5 mph) are rare in the Oak Ridge area, although on February 21, 1993, a tornado did strike the east end of Y-12, uprooting trees but causing minimal damage to buildings and equipment. Air stagnation is relatively common in eastern Tennessee (about twice as common as in western Tennessee). An average of about two multiple-day air stagnation episodes occur annually in eastern Tennessee, to cover an average of about 8 days per year. August, September, and October are the most likely months for air stagnation episodes (DOE 1999k).

Source: Computer Modeling Results.

FIGURE 4.7.1–1.—*Wind Rose Data for Y-12.*

The 30-year annual average precipitation is 138.5 cm (54.5 in), including about 24 cm (9.3 in) of snowfall. Precipitation in 1998 was 128.4 cm (50.6 in). Precipitation in the region is greatest in the winter months (December through February). Precipitation in the spring exceeds the summer rainfall, but the summer rainfall may be locally heavy because of thunderstorm activity. The driest periods generally occur during the fall months, when high-pressure systems are most frequent (DOE 1999k).

4.7.2 Air Quality

Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA, the TDEC Division of Air Pollution Control, and DOE Orders. Each ORR facility has a comprehensive air regulation compliance assurance and monitoring program to ensure that airborne discharges meet all regulatory requirements and therefore do not adversely affect ambient air quality. Common air pollution control devices employed at the three Oak Ridge facilities include exhaust gas scrubbers, baghouses, and other exhaust filtration systems designed to remove contaminants from exhaust gases before release to the atmosphere. Process modifications and material substitutions are also made to minimize air emissions. In addition, administrative control plays a role in regulating emissions (DOE 1999k).

4.7.2.1 *Nonradiological Air Quality*

Regional Air Quality

As directed by the *Clean Air Act* of 1970 (42 U.S.C. §7401), the EPA has set the National Ambient Air Quality Standards (NAAQS) for several criteria pollutants to protect human health and welfare (40 CFR 50). These pollutants include particulate matter less than 10 microns in diameter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), lead (Pb), and ozone (O_3). The nearest area not in attainment with the NAAQS is Atlanta, GA.

Nonradiological air quality is defined by the concentration of various pollutants in the atmosphere expressed in units of parts per million (ppm) or in micrograms per cubic meter. The standards and limits set by Federal and state regulations are provided in concentrations averaged over incremental time limits (e.g., 30 minutes, 1 hour, 3 hours). The averaging times shown in the tables in this section correspond to the regulatory averaging times for the individual pollutants.

TDEC implements and enforces the NAAQS and regulations on additional pollutants. In addition to the NAAQS, the TDEC has set standards for gaseous fluorides expressed as HF. Table 4.7.2–1 presents the NAAQS and Tennessee State ambient air quality standards. The EPA approved more restrictive ambient standards for ground-level ozone and particulate matter that became effective on September 16, 1997 (62 FR 38855). However, on May 14, 1999, in response to challenges filed by industry and others, a three-judge panel of the U.S. Court of Appeals for the District of Columbia Circuit issued a split opinion (2 to 1) on the these new clean air standards. The Court vacated the new particulate standard and directed EPA to develop a new standard, meanwhile reverting back to the previous PM_{10} standard. The revised ozone standard was not nullified; however, the judges ruled that the standard “cannot be enforced” (EPA 1999b). On October 29, 1999, the full U.S. Court of Appeals for the District of Columbia supported the lower court’s decision with a split ruling. EPA intends to have the Justice Department take the case to the U.S. Supreme Court in 2001. Therefore, it is uncertain at this time when new ozone and particulate matter standards will become enforceable.

An area is designated by the EPA as being in attainment for a pollutant if ambient concentrations of that pollutant are below the NAAQS, or, in nonattainment if violations of the NAAQS occur. In areas where insufficient data are available to determine attainment status, designations are listed as unclassified. Unclassified areas are treated as attainment areas for regulatory purposes. ORR is located in Anderson and Roane Counties in the Eastern Tennessee-Southwestern Virginia Interstate Air Quality Control Region (AQCR) 207. AQCR 207 is designated by EPA (40 CFR 81.343) as:

- "Better than national standards" for SO_2
- "Unclassifiable/attainment" for CO and O_3
- "Cannot be classified or better than national standards" for NO_2
- "Not designated" for lead

The ORR is designated a Class II area with respect to the *Clean Air Act's* (CAA) Prevention of Significant Deterioration (PSD) regulations (40 CFR 51.166). The PSD regulations provide a framework for managing the existing clean air resources in areas that meet the NAAQS. Areas designated PSD Class II have sufficient air resources available to support moderate industrial growth. A Class I PSD designation is assigned to areas that are to remain pristine, such as national parks and wildlife refuges. Little additional impact to the existing air quality is allowed with a Class I PSD designation. Industries locating within 100 km (62 mi) of Class I Areas are subject to very strict Federal air pollution control standards. The nearest Class I PSD Area is the Great Smoky Mountains National Park, approximately 56 km (35 mi) southeast of the ORR.

Air Quality Monitoring Data

The TDEC performs ambient air monitoring throughout the State of Tennessee and within the vicinity of the ORR. Concentration of regulated pollutants observed during 1999 at locations near the ORR are presented in Table 4.7.2–2. As the data indicate, the first highest 1-hr carbon monoxide concentration and the first, second, and third highest 1-hr ozone concentration exceed the standards.

During 1997, ambient concentrations of mercury vapor were measured at four on-site monitoring stations at Y-12 (Figure 4.7.2–1). Outdoor airborne mercury vapor at Y-12 is primarily the result of vaporization from mercury-contaminated soils, fugitive (non-stack) emissions from former mercury-use area buildings, and releases from coal burning at the Y-12 Steam Plant. Table 4.7.2–3 presents the results of the mercury monitoring program at Y-12 (DOE 1999k). The observed concentrations of mercury vapor are well below the ACGIH threshold limit value of 50 $\mu g/m^3$.

TABLE 4.7.2–1.—*National Ambient Air Quality Standards and Tennessee Ambient Air Standards*

Pollutant	Averaging Time	NAAQS Standard	Tennessee Standard
Ozone (O_3)	1-hr	235 µg/m^3 / 0.12 ppm	235 µg/m^3 / 0.12 ppm
Carbon monoxide (CO)	8-hr	10,000 µg/m^3 / 9 ppm	10,000 µg/m^3 / 9 ppm
	1-hr	40,000 µg/m^3 / 35 ppm	40,000 µg/m^3 / 35 ppm
Nitrogen dioxide (NO_2)	Annual	100 µg/m^3 / 0.053 ppm	100 µg/m^3 / 0.053 ppm
Sulfur dioxide (SO_2)	Annual	80 µg/m^3 / 0.03 ppm	80 µg/m^3 / 0.03 ppm
	24-hr	365 µg/m^3 / 0.14 ppm	365 µg/m^3 / 0.14 ppm
	30-minute	--	1,021 µg/m^3 / 0.4 ppm
Particulate matter (PM_{10})	Annual	50 µg/m^3	50 µg/m^3
	24-hr	150 µg/m^3	150 µg/m^3
Lead	Calendar Quarter	1.5 µg/m^3	1.5 µg/m^3
Gaseous fluorides (as HF)	30-day	--	1.2 µg/m^3 / 1.5 ppb
	7-day	--	1.6 µg/m^3 / 2.0 ppb
	24-hr	--	2.9 µg/m^3 / 3.5 ppb
	12-hr	--	3.7 µg/m^3 / 4.5 ppb
Total Suspended Particulates (TSP)	24-hr	–	150 µg/m^3

Source: TDEC 1997.

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*

Pollutant	Averaging Time	TN standard (Fg/m^3)	Maximum concentration (Fg/m^3) 1st	2nd	3rd	4th	Nearest monitoring location
Sulfur dioxide (as SO_x)	3-hr	1,300	241	220	--	--	Anderson Co.
	24-hr	365	49.7	47.1	--	--	
	Annual	80	7.9	--	--	--	
Total suspended particulates[a]	Annual geometric mean	260	107	87	77	77	Knox Co.
Particulate matter (≤10 Fm)[b]	24-hr	150	71	58	54	50	Knox Co.
	Annual	50	30.6	--	--	--	
Carbon monoxide	1-hr	40,000	12,712	7,329	--	--	Knox Co.
	8-hr	10,000	4,466	4,352	--	--	
Ozone[b]	1-hr	235	240	240	240	226	Anderson Co.
Nitrogen dioxide (as NO_x)	Annual	100	11.3	--	--	--	Roane Co.
Lead[c]	Calendar quarterly mean	1.5	0.33	0.15	0.14	--	Roane Co.

[a] TDEC secondary standard. 1997 monitoring data.

[b] New standards may be applicable in the future; see discussion in section 4.7.2.1.

[c] 1998 monitoring data.

Source:TDEC 1998, TDEC 2000.

Source: DOE 1999k.

FIGURE 4.7.2–1.—*Locations of Ambient Air Monitoring Stations for Mercury Vapor and Uranium.*

TABLE 4.7.2–3.—*Results of Y-12 Ambient Air Mercury Monitoring Program*

Ambient Air Monitoring Site	Mercury Vapor Concentration (μg/m^3)				
	1998 Average	1997 Average[a]	1996 Average[a]	1995 Average[a]	1986-88 Average[a]
Station No. 2 (east end of Y-12 Plant)	0.0048	0.0048	0.004	0.005	0.010
Station No. 8 (west end of Y-12 Plant)	0.0074	0.0065	0.006	0.007	0.033
Bldg. 9422-13 (SW of Bldg. 9201-4)	0.044	0.032[b]	0.030	N/A[c]	N/A[c]
Bldg. 9805-1 (SE of Bldg. 9201-4)	0.057	0.064[b]	0.058	0.066	0.099
Reference site (1988[d])	N/A	N/A	N/A	N/A	0.006
Reference site (1989[e])	N/A	N/A	N/A	N/A	0.005

[a] The American Conference of Governmental Industrial Hygienists 8-hour day, 40-hour work week standard equals 50 μg/m^3.
[b] Data for period from January 1 through September 30, 1997.
[c] Site established in late 1995.
[d] Data for February 9 through December 31, 1988 at Rain Gage No. 2 on Chestnut Ridge in the Walker Branch Watershed.
[e] Data for January 1 through October 31, 1989 at Rain Gage No. 2 on Chestnut Ridge in the Walker Branch Watershed.
Source: DOE 1999k.

As the data indicate, annual average mercury vapor concentrations have declined in recent years when compared with concentrations measured from 1986 through 1988. Of the three sites operating since 1986, all three recorded significantly lower annual averages for mercury vapor concentration when compared with the 1986 through 1988 average. The decrease in ambient mercury recorded at Y-12 since 1989 is thought to be related to the reduction in coal burned at the Y-12 Steam Plant beginning in 1989 and to the completion prior to 1989 of several major engineering projects (e.g., New Hope Pond closure, the PIDAS, Reduction of Mercury in Plant Effluent, and Utility Systems Restoration).

In addition to the mercury vapor sampling stations, three low-volume uranium particulate monitoring stations were operated during 1997 by Y-12 (see Figure 4.7.2–1). Table 4.7.2–4 presents the uranium concentrations measured at monitoring stations during 1998 For 1998 the average 7-day concentration of uranium at the three monitored locations ranged from a low of 0.00001μg/m^3 at Stations 5 and 8 to a high of 0.00044 μg/m^3 at Station 4.

TABLE 4.7.2–4.—*Uranium Mass in Ambient Air at Y-12, 1998*

Station	Number of Samples	7-day concentration (μg/m^3)		
		Maximum	Minimum	Average
4	51	0.00044	0.00002	0.000011
5	34	0.00026	0.00001	0.00008
8	52	0.00036	0.00001	0.000011

Source: DOE 1999k.

TABLE 4.7.2–5.—*Actual vs. Allowable Air Emissions from the Oak Ridge Y-12 Steam Plant, 1998*

Pollutant	Emissions tons/yr (kg/yr)		Percentage of Allowable
	Actual	Allowable	
Particulate matter	31 (28,123)	1,118 (1,014,250)	2.8
Sulfur dioxide	2,545 (2,308,824)	20,803 (18,872,481)	12.2
Carbon monoxide	22 (19,958)	311 (282,139)	7.1
Nitrogen oxides	1,386 (1,257,379)	9,741 (8,837,035)	14.2
Volatile organic compounds	2.1 (1,905)	17 (15,422)	12.4

Source: DOE 1999k.

TABLE 4.7.2–6.—*Chemical Pollutant Emissions from Y-12 During 1998*

Pollutant	Emissions tons/yr (kg/yr)
Hydrochloric acid[a]	48.05 (43,591)
Lead[a,b]	0.0055 (5)
Methanol[a]	21.86 (19,831)
Nitric acid[a]	0.147 (133)

[a] *Superfund Amendments and Reauthorization Act* (SARA), Title III, Section 313 chemical.
[b] Lead is regulated as an ambient air pollutant.
Source: DOE 1999k.

Emissions

The release of nonradiological contaminants into the atmosphere at Y-12 occurs as a result of plant production, maintenance, and waste management operations and steam generation. Most process operations are served by ventilation systems that remove air contaminants from the workplace. TDEC has issued over 50 air permits that cover Y-12 emission sources. The allowable level of air pollutant emissions from emission sources in 1997 was approximately 10,033 tons per year of regulated pollutants. The actual emissions are much lower than the allowable amount (DOE 1999k).

The level of pollutant emissions is expected to decline in the future because of the changing mission of Y-12 and downsizing of production areas. More than 90 percent of the pollutants are attributed to the operation of the Y-12 Steam Plant. Nonradiological airborne emissions of materials have been estimated and are provided in Tables 4.7.2–5 and 4.7.2–6.

Practices have successfully been implemented to minimize releases of ozone-depleting refrigerants to the atmosphere. Requirements for refrigeration-system and motor vehicle air-conditioner maintenance compliance are being met. The use of chlorofluorocarbon (CFC) refrigerants in chillers, direct expansion air conditioners, and process coolers will be eliminated, either by direct replacement with new equipment that operates with "ozone-friendly" refrigerants or by retrofit of existing equipment with new components to operate on "ozone-friendly" refrigerants (DOE 1999k).

4.7.2.2 *Radiological Air Quality*

Atmospheric emissions of radionuclides from DOE facilities are limited by EPA regulations found under National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR 61, Subpart H. The EPA effective dose equivalent (EDE) limit of 10 mrem per year to members of the public for the atmospheric pathway is also incorporated in DOE Order 5400.5, "Radiation Protection of the Public and the Environment." To demonstrate compliance with the NESHAP regulations, DOE annually calculates maximally exposed individual (MEI) and collective doses and a percentage of dose contribution from each radionuclide emitted using the CAP88 computer code. For 1998 all ORR facilities were in compliance with the Radiological NESHAP dose limit. Results of Y-12 compliance modeling are discussed under the radiological emissions section below. Details on the annual compliance modeling are also reported in the ORR Annual Site Environmental Report.

Air Quality Monitoring Data

The ORR maintains a perimeter air monitoring network of eight stations at the reservation perimeter and one at an off-site reference location. Surveillance of airborne radionuclides includes measurement of ambient levels of alpha-, beta-, and gamma-emitting radionuclides and tritium. Monitoring locations were selected based on atmospheric dispersion modeling which determined the locations most likely to be affected by routine releases from the Oak Ridge facilities.

Four of the eight stations are located in the vicinity of Y-12; these monitoring locations are shown in Figure 4.7.2–2. Station 40 monitors the east end of Y-12, and Station 37 monitors the overlap of Y-12, ORNL, and ETTP emissions. On-site Station 48 is located approximately 3 km (2 mi) to the southeast of Y-12. Station 46, which measures off-site impacts of emissions from Y-12, is located in the Scarboro Community of Oak Ridge. To provide an estimate of background radionuclide concentrations, an additional station is located at a site not affected by releases from the ORR. Reference samples are collected from Station 52 (Fort Loudon Dam) located approximately 24 km (15 mi) southwest of ORNL (not shown on Figure 4.7.2–2). Results of monitoring data collected at the various stations during 1998 are shown in Table 4.7.2–7.

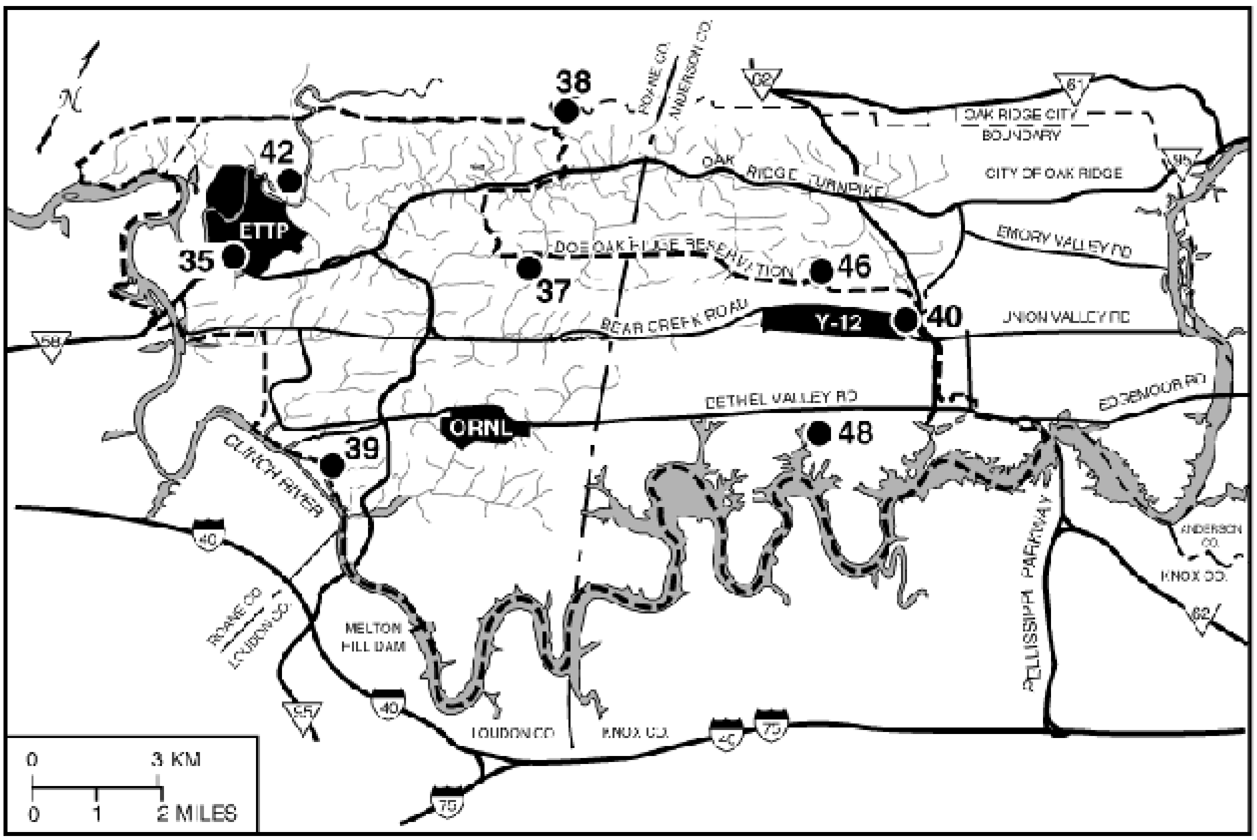
Radiological Emissions

NESHAP regulations for radiological emissions require continuous emission sampling of major sources (a "major source" is considered to be any emission point that potentially can contribute greater than 0.1 mrem/year EDE to an off-site individual). Of the 57 stacks at Y-12, 51 were active stacks and 6 were temporarily shut down during 1998. Forty-five of those stacks were considered to be major sources. Thus, at the end of 1998, 51 active stacks were being monitored at Y-12 (DOE 1999k).

The release of radiological contaminants, primarily uranium, into the atmosphere at Y-12 occurs almost exclusively as a result of plant production, maintenance, and waste management activities. An estimated 0.017 Ci (9.97 kg) of uranium was released into the atmosphere in 1998 as a result of Y-12 activities.

For 1998, six emissions points at Y-12 were modeled; each of these points includes one or more individual sources of emissions. The total effective dose equivalent (TEDE) to the hypothetical MEI from Y-12 emissions was estimated at 0.53 mrem, which is 5.3 percent of the 10 mrem per year EPA standard. This dose is also significantly less than the 300 mrem per year dose that the average individual receives from natural sources of radiation. The MEI for Y-12 is located about 1,080 m (0.7 mi) north-northeast of the Y-12 release point. The collective (population) EDE due to Y-12 emissions was estimated at 4.3 person-rem, which is approximately 35 percent of the collective EDE for the entire ORR (DOE 1999k).

ORNL-DWG 92M-5318R2



Source: 1999k.

FIGURE 4.7.2–2.—*Locations of Oak Ridge Reservation Perimeter Air Monitoring Stations in the Vicinity of Y-12.*

TABLE 4.7.2–7.—*Radionuclide Concentrations at Oak Ridge Reservation Perimeter Air Monitoring Stations During 1998*[a, b]

Radionuclide	Station 35	Station 37	Station 38	Station 39	Station 40	Station 42	Station 46	Station 48	Station 52[c]
Beryllium-7	1.8×10^{-14}	1.8×10^{-14}	2.2×10^{-14}	1.8×10^{-14}	2.6×10^{-14}	2.8×10^{-14}	3.7×10^{-14}	2.7×10^{-14}	3.1×10^{-14}
Cobalt-60	d	d	6.8×10^{-17}	d	d	d	d	4.2×10^{-17}	d
Cesium-137	d	2.5×10^{-17}	d	d	2.3×10^{-17}	d	d	3.9×10^{-17}	3.6×10^{-17}
Potassium-40	d	d	d	d	*d*	d	d	d	4.7×10^{-16}
Tritium-3	d	2.6×10^{-12}	6.9×10^{-13}	d	3.5×10^{-12}	d	d	8.1×10^{-13}	3.3×10^{-12}
Uranium-234	1.1×10^{-17}	1.0×10^{-17}	8.5×10^{-18}	5.5×10^{-18}	1.8×10^{-17}	1.0×10^{-17}	1.5×10^{-17}	7.0×10^{-18}	5.0×10^{-18}
Uranium-235	4.5×10^{-19}	5.9×10^{-19}	8.5×10^{-19}	d	1.0×10^{-18}	d	d	4.6×10^{-19}	7.5×10^{-19}
Uranium-238	1.4×10^{-17}	1.5×10^{-17}	1.2×10^{-17}	8.6×10^{-18}	1.3×10^{-17}	1.3×10^{-17}	1.5×10^{-17}	7.1×10^{-18}	4.6×10^{-18}
Gross alpha	2.0×10^{-15}	1.5×10^{-15}	d	d	1.9×10^{-15}	3.0×10^{-15}	d	2.2×10^{-15}	2.4×10^{-15}
Gross beta	4.6×10^{-15}	3.7×10^{-15}	4.0×10^{-15}	3.7×10^{-15}	4.7×10^{-15}	d	d	6.4×10^{-15}	d

[a] All values are mean concentration.
[b] Units are FCi/mL.
[c] Reference location.
[d] Not detected at 95 percent confidence level.
Source: DOE 1999k.

4.7.3 Noise

Major noise emission sources within Y-12 include various industrial facilities, equipment and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most Y-12 industrial facilities are at a sufficient distance from the site boundary so noise levels at the boundary from these sources would not be distinguishable from background noise levels.

EPA guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (14 CFR 150).

Sound-level measurements have been recorded at various locations within and near ORR in the process of testing sirens and preparing support documentation for the Atomic Vapor Laser Isotope Separation site. The acoustic environment along the Y-12 Site boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with the day-night average sound level in the range of 35 to 50 dBA. Areas near the site within Oak Ridge are typical of a suburban area, with the average day-night sound level in the range of 53 to 62 dBA. The primary source of noise at the site boundary and at residences located near roads is traffic. During peak hours, the Y-12 Plant worker traffic is a major contributor to traffic noise levels in the area.

The State of Tennessee has not established specific community noise standards applicable to Y-12. The city of Oak Ridge has specific acceptable sound levels at property lines. Maximum allowable noise limits for the city of Oak Ridge are presented in Table 4.7.3–1 (Oak Ridge 2000).

TABLE 4.7.3–1.—*City of Oak Ridge Maximum Allowable Noise Limits Applicable to Oak Ridge Reservation*

	Decibel Level dBA					
Adjacent Use			**7 a.m. - 10 p.m.**			**10 p.m. - 7 a.m.**
	L_{50}	L_{10}	**Maximum Limit**	L_{50}	L_{10}	**Maximum Limit**
Residential	65	70	80	55	50	75
			7 a.m. - 12 Midnight			**12 Midnight - 7 a.m.**
	L_{50}	L_{10}	**Maximum Limit**	L_{50}	L_{10}	**Maximum Limit**
Business	70	75	80	70	75	80
Residential	75	NA	80	75	NA	80

Notes: “L_{10} - sound level, expressed in dBA, which is exceeded ten percent (%) of the time for a one-hour survey.
“L_{50} - sound level, expressed in dBA, which is exceeded fifty percent (%) of the time for a one-hour survey.
Source: Oak Ridge 2000.

4.8 SITE FACILITIES AND SUPPORT ACTIVITIES

The main area of Y-12 is largely developed. It encompasses 328 ha (811 acres), with 255 ha (630 acres) fenced (4 by 2 km [3 by 1 mi]). Approximately 580 buildings house about 714,317 m^2 (7.6 million ft^2) of laboratory, machining, dismantlement, and R&D areas. Because of the site’s defense support manufacturing and storage facilities, the land in the Y-12 area is classified in DOE’s industrial category.

Many of the buildings used for Y-12 production processes were built during the 1940s for the plant’s original mission of eletromagnetically separated isotopes of uranium. These buildings have been modified over the years to accommodate changing missions. The separation of lithium isotopes using column exchange technology was performed at one time in some of the buildings, but that process was discontinued in the 1960s.

Generally speaking, the Y-12 Plant can be divided into three areas: the East End mission support area; the West End manufacturing areas; and the West End environmental area. East End shops are generally technical, administrative, and plant support function. The West End manufacturing area is generally considered an area inside the PIDAS fence. The area inside the PIDAS boundaries contains manufacturing and nuclear material storage facilities as well as technical and plant support operations and program management, product certification, quality control, product engineering and scheduling, maintenance, and utilities. The West End environmental area is managed by EM and contains tank farms, waste management treatment facilities, and storage areas; included are such facilities or areas as the Bear Creek Road Debris Burial Area, Rust Spoil Area, Liquid Organic Waste Storage Facility, Hazardous Chemical Disposal Area, Oil Landfarm, Oil Landfarm Contaminant Area, and Sanitary Landfill I.

In the following, a description of major DP and EM facilities located at the Y-12 Plant is provided. This is followed by a summary of site infrastructure. Appendix A provides detailed information concerning site facilities and utilities as well as the Y-12 Site facility planning and transition process, and major production processes.

4.8.1 Defense Programs Facilities

DP occupies around 427,350 m^2 (4.6 million ft^2) of facilities at the Y-12 Plant. Of this total, approximately 223,000 m^2 (2.4 million ft^2) are in major manufacturing facilities while approximately 195,100 m^2 (2.1 million ft^2) are in support facilities. Forty-nine DP buildings are in surplus; most of these are small support structures that are not process contaminated. The long-term objective is to plan for the removal of these facilities when it becomes cost-effective or a compliance requirement mandates action. Another 11 facilities are planned to be surplus by 2008, assuming the availability of funding for downsizing. The remainder of the DP buildings are anticipated to have a continuing mission.

All Y-12 facilities used in processing and storage of HEU are located in the protected area of Y-12 surrounded by the PIDAS. Appendix Figure A.4.1–1 shows the locations of major DP facilities. Appendix Table A.4–1 provides an overview of the DP facilities. The following summarizes information on the major DP facilities located at the Y-12 Plant.

4.8.1.1 *Building 9212 Complex*

The Building 9212 Complex includes Buildings 9212, 9818, 9815, 9980, and 9981. The largest, Building 9212, was constructed in the early 1940s. Over 100 operations or processes have been or are capable of being performed within the Building 9212 Complex. The primary missions performed in this Complex include the following:

- Casting of HEU metal (for weapons, reactor fuels, storage, and other purposes)
- Accountability of HEU from plant activities (quality evaluations, casting, storage)
- Recovery and processing of HEU to a form suitable for storage and/or future reuse and/or disposition (from plant activities, other DOE programs, and commercial scrap)
- IAEA sampling of surplus enriched uranium
- Packaging HEU for off-site shipment
- Preparation of special uranium compounds and metal for research reactor fuel

The Building 9212 Complex houses two major process areas: the Building 9212 Uranium Recovery Operations (also called Chemical Recovery operations) and the Metallurgical Operations. The Building 9212 Complex is currently not operating except for limited special operations. It is expected that all operations will resume after stand-down.

4.8.1.2 *Building 9206 Complex*

The Building 9206 Complex includes the primary Building 9206 and an immediately adjacent Building 9720-17. It is centrally located in Y-12 near the east end of the protected area. Building 9206 is a multistory facility constructed in the early 1940s. Contained in Building 9206 is an incinerator, which is currently permitted for burning combustible waste containing uranium. Building 9720-17, adjacent to the south side of Building 9206, was constructed in the 1950s.

Building 9206 has generally been reserved for intermediate enrichments (20 to 85 percent) of HEU. Its original design mission was to recover HEU from the electromagnetic separation process. In the mid 1950s, a UF_6 to UF_4 conversion facility using fluorine and hydrogen gas was installed to perform the same function. In the late 1960s Building 9206 underwent modifications to install denitration and fluid bed systems for the conversion of uranyl nitrate to UF_4. The mission of converting recovered uranyl nitrate from Savannah River back into metal was transferred to Building 9206 in 1973. The machining-turning- cleaning process was installed in the mid-1980s for recycling intermediate enrichments of uranium turnings. In 1988 shipments of uranyl nitrate from Savannah River were stopped. A year later the weapon production rate was severely decreased. In 1993 decommissioning of Building 9206 began. Since that time, most of the processes have been shut down, some processes have been removed from the facility, and there are no current plans to resume operations in Building 9206.

4.8.1.3 *Building 9215*

The 9215 Complex consists of Buildings 9215 and 9998. Building 9998 is physically attached to the northeast corner of Building 9215. Building 9215 was constructed in the early 1940s, and Building 9998 was added shortly thereafter. Both buildings have been expanded and modified over the years. Included in Building 9215 is a Blister Area where HEU parts and scraps are packaged and shipped. The Blister Area was constructed in the 1970s and is configured as an "L"-shaped steel frame structure with cement block shear walls.

The mission of the 9215 Complex is to provide for storage and handling of HEU inventories, to aid in the dismantlement of nuclear weapons, to provide fabricated metal shapes as needed for the nuclear weapons stockpile maintenance, and to support nuclear programs at other U.S. and foreign facilities. Materials stored in Building 9215 are considered to be part of the backlog awaiting processing. Not all of the materials will be processed in Building 9215. Except for the limited special operations noted above, the Building 9215 Complex is currently not operating, although it is expected that all operations will resume after stand-down.

4.8.1.4 *Buildings 9204-2 and 9204-2E*

Building 9204-2 was built in 1943 and has been used to support nuclear weapons production since then. As a result of a major upgrade program, Lithium Process Replacement, some of the major processes and equipment were upgraded in the early 1990s. In addition, a portion of Building 9204-2 is being modified for storage of HEU materials.

Building 9204-2E, which comprises the major portion of the building partition, was built in 1971 to house weapon assemblies. Four current HEU activities at Building 9204-2E are as follows: (1) Assembly of new or replacement weapons; (2) quality certification of components and assemblies; (3) disassembly of retired weapons assemblies; and (4) storage of retired assemblies, subassemblies, and components. Assembly and disassembly operations areas, five vault-type rooms, and one vault are located in the Building 9204-2E. Most of the HEU is either metal pieces or weapons components.

4.8.1.5 *Building 9204-4*

Building 9204-4 press operations include the forming of depleted uranium, depleted uranium alloys, and nonradiological material. Building 9204-4 is a three-story structure that was built in 1943. Areas within Building 9204-4 can be functionally classified as follows: (1) quality evaluation of current weapons production programs and disassembly of obsolete weapons; (2) metalworking operations (forging, forming, heat treating) and grit blast cleaning of depleted uranium, depleted uranium alloys, and metals such as steel and aluminum: (3) a Bonded Storage Area (occupying approximately 929 m^2 [10,000 ft^2]) and vault-type room for storage of SNM (occupying approximately 557 m^2 [6,000 ft^2]); (4) radiography, ultrasonic, and other nondestructive testing; and (5) a plating area. The only active operational areas involving HEU within Building 9204-4 are quality evaluation, assembly, and storage in the vault-type room and the Bonded Storage Area. The plating area, while shut down, contains residual materials. The Bonded Storage Area and the vault-type room are set aside for the storage of HEU in drums.

4.8.1.6 *Building 9720-12*

Building 9720-12 is a warehouse facility located in the western portion of Y-12. The mission of Building 9720-12 is to provide storage for items and materials that have been removed from the Material Access Areas. The western portion of the facility is used for storage of combustibles that contain recoverable amounts of enriched uranium. The storage area is also used for other hazardous materials including RCRA waste, and drums of beryllium.

4.8.1.7 *Building 9201-5*

Building 9201-5 is a multi-story structure that was constructed in the early 1940s. The building is a large production/processing facility previously used for depleted uranium and nonuranium processing. Three small storage areas for enriched uranium combustibles have been established on the third floor of the building. The building has several collocated operations, including lithium hydride storage and arc melt operations. The third floor storage area also includes miscellaneous parts, combustibles, and depleted uranium.

4.8.1.8 *Building 9720-5*

Building 9720-5 historically has been used as a warehouse for weapons-related materials and reactor fuel. The facility was built in 1944 and has since been renovated. The current mission is as an operating warehouse used for short- and long-term storage of materials, including high-equity uranium, weapons assemblies, reactor fuel, and low-equity materials awaiting recycling.

4.8.1.9 *Building 9995*

Building 9995, the Analytical Chemistry Laboratory was constructed in 1952 and is located within the Y-12 PIDAS area. The facility was designed for, and is currently used as, an analytical chemistry laboratory, providing analytical support for DP, Work-for-Others, and operation and maintenance contractor regulatory compliance programs. Building 9995 has had two major expansions since it was originally constructed. A south addition was added in 1969 that is currently used for analytical development, and an annex office area was added in 1981. Building 9995 is equipped with approximately 150 chemical fuming hoods with supporting HVAC systems that form the primary engineered safety feature. Most chemical fume hoods in the building are original equipment; limited hood upgrades have been performed and approximately 20 hoods were replaced in the mid-1980s with additional units having been added or replaced at various times during laboratory alteration projects.

4.8.1.10 *Buildings 9119, 9983, and 9710-3*

Building 9119 is an office building located in the western end of Y-12. The current mission of the building supports a variety of DP related organizations.

Building 9983 is a small wood frame storage building located next to Building 9711-1 in the eastern half of Y-12. Radiological control instrument calibrations are performed in Building 9983. Y-12 personnel use HEU calibration sources for calibration purposes and to store sources awaiting disposal.

Building 9710-3 is an office building constructed of noncombustible materials and is located in the eastern section of Y-12. This building houses the Protective Services Force which uses HEU calibration sources to test the portal monitors at the Y-12 Plant.

4.8.1.11 *Building 9201-5W*

Building 9201-5W is used as a machine shop and performs machining, plating and support operations (including nondestructive testing and dimensional inspections) of depleted uranium, depleted uranium alloys, and nonradiological materials. Offices for shop supervision are provided on a mezzanine. Currently, the facility is on standby awaiting refurbishment.

4.8.1.12 *Building 9201-5N*

Activities conducted in Building 9201-5N include eletroplating parts, machining of beryllium, depleted uranium, and stainless steel parts, and dimensional inspection of parts. Barriers to exposure of workers or the public to radiation or chemical hazards or to releases of radioactive or toxic materials to the environment include gloveboxes, hoods, and ventilation systems with HEPA filters. Ventilation exhaust stacks are monitored for radiological and hazardous materials as appropriate.

4.8.1.13 *Buildings 9202 and 9203*

Building 9202 is a two-story R&D structure built in 1954. An addition, which houses a welding laboratory, was built in 1972. A small beryllium blank forming area is operated in the building. Building 9203 which was built in 1944. Activities conducted in Building 9203 include development of processes for material characterization and for measurements, and instrumentation and controls.

4.8.1.14 *Building 9996*

Building 9996 is used as a tooling and material storage facility to support operations in immediately adjacent portions of Building 9212.

4.8.1.15 *Building 9201-1*

Building 9201-1, built in 1955, is a large, general machine shop with several areas containing machining equipment and controls. Nominal storage for in-process parts and materials and offices for supervision are also provided. The building is used as a general machine shop for nonuranium metal and graphite parts.

4.8.2 Waste Management Facilities

The majority of waste management facilities at Y-12 are operated under the EM Program, but some are managed by DP. Waste management facilities are located in buildings, or on sites, dedicated to their individual functions, or are collocated with other waste management facilities or operations. Active facilities for the storage and treatment of LLW, mixed-LLW, RCRA-hazardous and TSCA-regulated waste as well as disposal facilities for non-hazardous waste are summarized in this section and in Appendix A.5. Many of the facilities are used for more than one waste stream.

The TDEC Division of Solid Waste Management (DSWM) regulates management of both hazardous and non-hazardous waste streams under RCRA. Facilities used to store or treat RCRA-hazardous waste at Y-12 are regulated by the DSWM as authorized by the EPA. These facilities may also be used to manage mixed waste (waste that are both RCRA-hazardous and radioactive). There are no facilities for the disposal of hazardous waste currently in operation at Y-12. Storage and physical treatment (e.g., shredding, compaction) of non-hazardous waste does not generally require a permit under RCRA. There are three landfills in operation for disposal of non-hazardous waste at Y-12. These disposal facilities are regulated by the TDEC DSWM as well.

TSCA-regulated waste that contains PCBs is managed at Y-12 in accordance with EPA regulations (40 CFR 761) and with a Federal Facilities Compliance Agreement (FFCA) for managing PCBs on the ORR (EPA 1997). Many requirements for the safe storage and handling of PCB-waste are similar to requirements for RCRA-hazardous waste. Therefore, PCB wastes and TSCA mixed waste (waste containing both PCBs and radioactivity) are often stored in facilities approved for RCRA-hazardous and mixed waste storage. Some Y-12 databases and reports group TSCA-regulated and RCRA-hazardous wastes together and refer to this grouping as hazardous waste.

DOE is authorized to manage radioactive waste that it generates under the *Atomic Energy Act of 1954*. Low-level radioactive waste (LLW) are generated during machining and other operations at Y-12. DOE stores, treats, and repackages, but does not dispose of LLW at Y-12. The majority of the LLW generated at Y-12 is otherwise uncontaminated scrap metal and machine turnings and fines. LLW at Y-12 is managed in accordance with DOE Orders (e.g., DOE Order 435.1), policy, and guidance related to management of radioactive waste. Management of this waste is not directly regulated by EPA or TDEC.

The following description of waste management facilities at Y-12 focuses on the facilities currently available for managing waste at Y-12 and not on facilities that are closed or inactive. The facilities are grouped by functional program area: storage, treatment, or disposal.

4.8.2.1 *Waste Storage at Y-12*

Information on these storage facilities is based on the following references: Bechtel Jacobs 2000, LMES 2000d, PAI 1996.

Storage for Mixed Waste Residues/Ash. Buildings 9212 and 9206 provide container storage areas for mixed waste residues or ash. A RCRA operating permit was issued on September 28, 1995 for these units.

The ash resulted from the burning of solvent- and uranium-contaminated solid wastes. The ash does not contain free liquids. Uranium-bearing solutions generated during the uranium recovery process (Building 9818) and laboratory analyses are also stored in these areas. These solutions, as well as the residues, are mixed (hazardous and radioactive) wastes and are being stored prior to further uranium recovery. Occasionally, uranium-bearing materials generated off-site may be stored in Buildings 9212 and 9206, prior to uranium recovery at Building 9212. Although a Phaseout/Deactivation Program Management Plan has been approved by DOE for Building 9206 and the recovery operations within this facility will no longer be operated, this building will continue to store hazardous and mixed waste for several years into the future.

Building 9212 Tank Farm. Building 9212 Tank Farm, a RCRA permit-by-rule facility, has never been placed in operation, but there are future plans to do so when Enriched Uranium Operations are restarted. The facility consists of three dikes containing four 37,854-L (10,000-gal) stainless-steel tanks that will eventually be used to collect nitrate waste from Building 9818 operations before being transferred to the West End Treatment Facility (WETF).

Liquid Storage Facility. The Liquid Storage Facility (Building 9416-35) of the Disposal Area Remedial Actions (DARA) Liquid Storage Treatment Unit is a hazardous and mixed waste storage and pretreatment facility built during the Bear Creek Burial Ground closure activities. It is located in Bear Creek Valley approximately 3 km (2 mi) west of Y-12, and operates under RCRA permit-by-rule. It collects, stores, and pre-treats groundwater and other wastewater received from the seep collection lift station, the DARA Solid Storage Facility, tankers, polytanks, and the diked area rainfall accumulation. Feed streams may contain oil contaminated with PCBs, VOCs, non-VOCs, and heavy metals. Most equipment is in an outdoor, containment area and includes: two 284,000-L (75,000-gal) bulk water storage tanks; a 22,700-L (6,000-gal) oil storage tank; gravity separator; two filtering units; composite monitoring station; and a tanker transfer station. Collected liquids are pe-treated by traveling through the gravity separator, filters, and composite monitoring station prior to entering bulk storage tanks. The wastewater is then transferred by tanker to the Groundwater Treatment Facility for further treatment.

Containerized Waste Storage Area. The Containerized Waste Storage Area (Buildings 9500-120, 9500-121, and 9500-149) consists of three concrete pads covering approximately 2,320 m^2 (24,800 ft^2). An impermeable dike for spill containment surrounds each pad. The area was previously RCRA-permitted and closed. It is currently being used for LLW storage.

PCB and RCRA Hazardous Drum Storage Facility. Building 9720-9 is a 1161 m^2 (12,500 ft^2), single-story, prefabricated metal building with slab on grade built in 1955. The facility provides a drum storage area for mixed and PCB waste, including an area for flammable waste. The building is used to store both RCRA and PCB mixed waste.

Container Storage Facility. Building 9720-12, a Container Storage Facility, also called the LLW Storage Areas, provides storage for mixed (hazardous and radioactive) waste residues, ash, and combustibles. It also contains some classified waste. A RCRA operating permit was issued on September 28, 1995. The ash is a product from burning solvent- and uranium-contaminated wastes. Unburned solvent- and uranium-contaminated solid wastes are also stored in Building 9720-12. The waste at Building 9720-12 contains no free liquids and is typically generated during the uranium recovery process. Some of this waste is also stored in Buildings 9212 and 9206, as described above.

Classified Waste Storage Facility. The Classified Waste Storage Facility (Building 9720-25) is a 1635-m^2 (17,600-ft^2), single-story building with masonry-bearing walls and a precast concrete roof system built in 1962. It provides storage for PCB-waste, LLW and mixed LLW, which is classified for national security purposes under provisions of the *Atomic Energy Act*. A RCRA operating permit was issued on September 28, 1995. The facility meets Y-12 Plant security requirements for classified waste management and guidelines for the management of LLW and mixed LLW.

PCB Storage Facility. The PCB Storage Facility (Building 9720-28) provides storage capability for PCB waste, primarily PCB-containing ballasts. Building 9720-28 is a 335 m^2 (3,600 ft^2), single-story building with masonry-bearing walls and a structural steel roof built in 1984.

RCRA and Mixed Waste Staging and Storage Facility. The RCRA Staging and Storage Facility (Building 9720-31) is a 610-m^2 (6,571-ft^2), single-story building with masonry-bearing walls and a precast concrete roof system built in 1986. A RCRA permit was issued on September 28, 1995. Solid, liquid, and sludge wastes are prepared for off-site shipment at this facility. The facility consists of seven storage rooms and seven staging rooms, each with a separate ventilation system. The staging rooms house small containers that are packed with compatible materials and shipped. The storage rooms hold larger containers, such as 208-L (55-gal) drums.

Production Waste Storage Facility . The Production Waste Storage Facility (also a Container Storage Area, Building 9720-32) has not yet been used for storage, but future use is planned. The building is separated into two areas, a smaller one for ignitable RCRA waste, and a larger area for non-ignitable waste. Both areas have curbing and may be used for containerized liquids if stored on self-containing pallets. A RCRA operating permit for the facility was issued September 3, 1996 for storage of reactive and ignitable hazardous and mixed waste. The facility houses the non-destructive assay equipment for Y-12 and has a design capacity for storage of 616,968 gal (2,335 m^3).

Low-Level Waste Storage Pad. The Low-Level Waste Storage Pad, is located in the Sludge Handling Facility (Building 9720-44) that originally provided water filtration and sludge dewatering to support a storm sewer cleaning and relining project. The facility is currently being used to store containers of LLW sludge.

Liquid Organic Solvent Storage Facility. The Liquid Organic Waste Storage Facility (Building 9720-45, OD-10) is a 209-m^2 (2,250-ft^2) single-story pavilion with metal posts and roof panels, built in 1987. A RCRA permit was issued on September 30, 1994. It contains four 24,600 L (6,500 gal) and two 11,400 L (3,000 gal) stainless-steel tanks for storage of ignitable nonreactive liquids, including those contaminated with PCBs and uranium. In addition, a diked and covered storage area provides space for 40,000 L (10,600 gal) of containerized waste. The facility is set up to segregate various spent solvents for collection and storage. Major solvent waste streams are transferred to tanks until final disposition.

RCRA and PCB Container Storage Area. The RCRA and PCB Container Storage Area (Building 9720-58) is a 390 m^2 (4,200 ft^2), single-story, prefabricated metal building with metal wall panels built in 1987. It holds a RCRA permit issued on September 28, 1995. It is a warehouse facility used for staging prior to treatment or disposal of PCB- and RCRA- contaminated equipment (e.g., transformers, capacitors, and electrical switchgear) and non-reactive, non-ignitable RCRA, mixed and PCB waste.

Classified Container Storage Facility . The Classified Container Storage Facility (Building 9720-59, also a Production Waste Storage Facility) is a 1403 m^2 (15,105 ft^2), single-story, prefabricated metal building with metal wall panels. Building 9720-59 was issued a RCRA permit on September 3, 1995 and stores both RCRA and PCB wastes.

DARA Solid Storage Facility. The DARA Solid Storage Facility (Building 9720-60) provides 1,625 m^2 (17,500 ft^2) of storage space for PCB-, RCRA-, and uranium-contaminated soil. The facility has a synthetic liner for leachate collection and a leak detection system. Collected leachate is transferred to the Liquid Storage Facility for pretreatment. The DARA Solid Storage Facility is an interim status facility under RCRA, but is now being managed through the CERCLA process. No additional wastes are being added to the facility.

OD7 Waste Oil Storage Tank Area. Building 9811-1, houses three areas for storage of RCRA liquids (OD7, OD8, and OD9), and is an 81-m^2 (874-ft^2) single-story prefabricated metal building with metal wall panels, built in 1986. OD7 contains a diked storage area for tanks (permitted September 30, 1994). The OD7 contains four 114,000-L (30,000-gal) tanks, two 37,900-L (10,000-gal) tanks, and associated piping and pumps. The OD7 facility is now inactive, and there are no plans to use it in the future.

OD8 Waste Oil Solvent Drum Storage Facility. The Waste Oil Solvent Drum Storage Facility (Building 9811-1, OD8) was issued a RCRA permit on September 28, 1995. It has a capacity for 750, 2,080 L (55 gal) drums and a smaller number of Tuff tanks. RCRA waste oil/solvent mixtures containing various concentrations of chlorinated and nonchlorinated hydrocarbon solvents, uranium, trace PCBs, and water for specific chemical constituents are stored at OD8 in 208 L (55 gal) drums and 1,140 L (300 gal) Tuff tanks.

OD9 Waste Oil/Solvent Storage Facility. The Waste Oil/Solvent Storage Facility (Building 9811-1, OD9) is a RCRA-permitted (September 30, 1994) storage facility that houses LLW, mixed-LLW, and hazardous waste, including PCBs. It consists of a diked area supporting five 151,000 L (40,000 gal) tanks, a tanker transfer station with five centrifugal transfer pumps, and a drum storage area. Four tanks house PCB and RCRA wastes contaminated with uranium. A fifth tank is empty. A diked and covered pad furnishes space for 33 m^3 (1,165 ft^3) of containerized waste. The diked area contains additional space for a sixth 151,000-L (40,000-gal) tank.

Depleted Uranium Oxide Storage Vaults I and II. The Depleted Uranium Oxide Storage Vaults I and II (Buildings 9825-1 and -2 oxide vaults) are located on Chestnut Ridge northeast of Building 9213. The vaults are constructed of reinforced concrete and provide a retrievable storage repository for uranium oxide, uranium metal, and a blended mixture of uranium sawfines and oxide. The vaults contain a negative pressure exhaust system that operates during material entry. The exhaust is filtered and monitored prior to its release to the atmosphere. The facility uses forklift trucks, electric hoists, and a motorized drum dumper. Waste is no longer accepted in the vaults. Building 9809-1 is also being used as storage for drummed, depleted uranium oxide materials; it is a 111 m^2 (1,200 ft^2), single-story building with masonry bearing walls and a structural steel roof system built in 1990.

West Tank Farm. The West Tank Farm provides storage for mixed and LLW sludge and is associated with the WETF. It operates under RCRA permit-by-rule and has five, 1.89 million L (500,000 gal) tanks that provide storage for mixed waste and three, 378,541 L (100,000 gal) tanks that provide storage for radioactively contaminated calcium carbonate sludge generated in the WETF treatment processes.

Oil Landfarm Soil Storage Facility. The Oil Landfarm Soil Storage Facility is a RCRA-interim status facility containing approximately 1377 m^3 (14,832 ft^3) of soil contaminated with PCBs and volatile organics (DOE 1993). The soil was excavated from the Oil Landfarm and Tributary 7 in 1989. The soil is contained in a covered, double-lined concrete dike with a leak-detection system. The leak-detection system will soon be modified to enhance detection capabilities.

Old Salvage Yard. The Old Salvage Yard, located at the west end of Y-12, contains both low-level uranium-contaminated and non-radioactive scrap metal. Most scrap currently sent to this area is contaminated. The Contaminated Scrap Metal Storage is an area within the Old Salvage Yard that is used to store uranium-contaminated scrap metal. Contaminated scrap is placed in approved containers and eventually will be transferred to the aboveground storage pads or shipped off-site for disposal. Non-contaminated scrap is sold when allowed.

Salvage Yard. The Salvage Yard is used for the staging and public sale of nonhazardous, non-radioactive scrap metal that has been approved by DOE for release. It consists of 3.2 enclosed ha (8 acre); 0.4 ha (1 acre) is paved. The New Salvage Yard provides accumulation and sorting space for the scrap metal. This facility is located on the north side of Bear Creek Road, near the Bear Creek Burial Grounds.

4.8.2.2 *Treatment of Waste at Y-12*

Information on these treatment facilities is based on the following references: Bechtel Jacobs 2000, LMES 2000d, PAI 1996.

Central Pollution Control Facility. The Central Pollution Control Facility (Building 9623), a 1858 m^2 (20,000 ft^2) multistory structural steel building with masonry walls, was built in 1985. The Central Pollution Control Facility operates under RCRA permit-by-rule and an NPDES permit issued in April 28, 1995. It is the primary facility for treatment of non-nitrated waste. It receives wastes that are acidic or caustic, oily mop waster containing beryllium, thorium, uranium, emulsifiers, and cleansers. It also receives waste already treated at other Y-12 facilities. The Central Pollution Control Facility provides both physical and chemical processing, including oil/water separation, neutralization, precipitation, coagulation, flocculation, carbon adsorption, decanting, and filtration. Treated water is discharged to EFPC through an NPDES monitoring station. Sludge from the treatment processes is transferred to the West End Tank Farm. Spent carbon cartridges and filters are sent to ETTP for storage.

Plating Rinsewater Treatment Facility. The Plating Rinsewater Treatment Facility treats dilute, non-nitrate bearing, plating rinsewater contaminated primarily with chromium, copper, nickel, and zinc. In addition, the facility can treat cyanide-bearing wastes and remove chlorinated hydrocarbons. It is currently used relatively little because the Plating Shop (Building 9401-2) that formerly produced most of Y-12's rinsewater has been deactivated. The facility's neutralization, equalization, and cyanide destruction equipment are located outdoors in a diked basin. The remainder of the facility process is located in Building 9623 with the Central Pollution Control Facility.

Waste Coolant Processing Facility. The Waste Coolant Process Facility (Building 9983-78) treats machine coolant waste and mop water from machining operations containing heavy metals, including uranium compounds and uranium metallic fines. The equipment and controls are located outside. Gravity feed is used to separate oils and water. The waste oil is then transferred to OD9 (Building 9811-1) or containerized and stored, and the wastewater goes into an extended aerator reactor. Sludge and sediment from the oils are drummed and stored at. Sludge from the wastewater treated in the reactor is dried, drummed and sent to ETTP mixed waste storage. The treated wastewater is transferred to the Central Pollution Control Facility for further treatment and then discharged into EFPC.

Central Mercury Treatment System. The Central Mercury Treatment System (CMTS) is designed to treat mercury-contaminated sump water from former mercury use building. The CMTS was installed as part of the Y-12 Plant's Integrated Mercury Strategy Program to achieve compliance with regulations and guidance addressing mercury contamination in EFPC. Sump water from Buildings 9201-5, 9201-4, and 9204-4 is treated at the CMTS. The CMTS is located at the Central Pollution Control Facility. A new outfall (Outfall 551) is the discharge point where treated wastewater is discharged in conformance to NPDES monitoring guidelines.

West End Treatment Facility. The WETF (Building 9616-7) treats mixed-LLW- and LLW-contaminated wastewater generated by Y-12 production operations and other DOE- ORO meeting the facility waste acceptance criteria under a RCRA permit-by-rule. Treatment methods include hydroxide precipitation of metals, sludge settling and decanting, bio-denitrification, bio-oxidation, pH adjustment, degasification, coagulation, flocculation, clarification, filtration, and carbon adsorption. Wastewaters are primarily nitrate bearing and include the following: nitric acid wastes, mixed acid wastes, waste coolant solutions, mop water, and caustic wastes. Wastes are received at the WETF in 8,927 L (5,000 gal) tankers, 1136 L (300 gal) polytanks, drums, carboys, and small bottles. Detailed waste characterization documentation and jar tests are used to determine the treatment scheme for wastewater shipments. Treatment at WETF is performed in three processes: Head End Treatment, West Tank Farm biological treatment, and Effluent Polishing. The Head End Treatment System consists of waste receiving, hydroxide precipitation of heavy metals, sludge settling, and decanting. Biological treatment in the West Tank Farm consists of bio-denitrification, then bio-oxidation. The Effluent Polishing System consists of pH adjustment, degasification, coagulation, flocculation, clarification, filtration, carbon adsorption, and effluent discharge to the EFPC through an NPDES monitoring station.

Legacy mixed-LLW treatment sludges are presently being removed from sludge storage tanks at the West Tank Farm for off-site disposal. Currently generated mixed-LLW and LLW treatment sludges are being accumulated and concentrated for final characterization and disposal. Other treatment residuals, such as spent carbon and personal protective equipment, are being sent for immediate off-site disposal where feasible or otherwise characterized for on-site treatment or disposal.

Organic Handling Unit for Mixed Waste. The Organic Handling Unit (Building 9815) provides storage and treatment of organic solutions containing enriched uranium. The uranium level in the waste material arriving at the Organic Handling Unit is typically less than 400 ppm. These wastes are characterized as mixed hazardous and radioactive wastes. Occasionally, enriched uranium-contaminated wastes generated off-site may be treated at the Organic Handling Unit. An assay reduction process is used to dilute the ^{235}U isotope with ^{238}U isotope in such a manner that they cannot be easily separated chemically or physically. This is accomplished by first mixing depleted uranyl nitrate with the organic solution and then neutralizing the organic solution by adding sodium hydroxide or other acceptable material. Since uranyl nitrate solution is not readily soluble in most organic solutions, “extractant” may be added to the organic solution.

Cyanide Treatment Unit. The Y-12 Cyanide Treatment Unit (located in Building 9201-5N) provides storage and treatment of LLW and mixed-LLW solutions containing metallic cyanide compounds from spent plating baths and precious metal recovery operations or other areas; the unit’s RCRA permit was issued on September 28, 1995. Treatment is by chemical oxidation and pH adjustment. The cyanide reduction process performed within the unit is currently performed in 208 L (55 gal) containers. After waste is treated at the Cyanide Treatment Unit, it is transferred to the WETF for further treatment, then discharged to the EFPC. Biodenitrification Unit. The Biodenitrification Unit (Building 9818) has been in stand-down, but restart is anticipated. It is capable of treating nitrate-bearing, liquid mixed-LLW generated by enriched uranium recovery operations in Building 9212. The denitrification unit removes nitrates from the waste and also separates liquids and solids. The wastewater is then transferred to the WETF for further treatment, and the sludge is transferred to the West Tank Farm.

Biodenitrification Unit. The Biodenitrification Unit (Building 9818) has been in stand-down, but restart is anticipated. It is capable of treating nitrate-bearing, liquid mixed-LLW generated by enriched uranium recovery operations in Building 9212. The denitrification unit removes nitrates from the waste and also separates liquids and solids. The wastewater is then transferred to the WETF for further treatment, and the sludge is transferred to the West Tank Farm.

Uranium Recovery Operations. Uranium Recovery Operations (Building 9212) is a recovery process to increase production efficiency at Y-12. Liquid waste from the operation is transferred to the Biodenitrification Unit. The system is exempt from permitting requirements under RCRA.

Groundwater Treatment Facility. The Groundwater Treatment Facility (Building 9616-7) treats wastewater from the Liquid Storage Facility at Y-12 and seepwater collected at ETTP and East Chestnut

Ridge waste piles to remove volatile organic compounds (VOCs), non-VOCs, and iron. It is part of the DARA program to treat groundwater contaminated with LLW and mixed-LLW that is collected from the Bear Creek Burial Grounds. The Groundwater Treatment Facility is located at the far west end of Y-12, in the same building as the WETF. This facility uses an air stripping operation to remove VOCs. In addition, carbon adsorption eliminates nonvolatile organics and PCBs. Precipitation and filtration are used to remove iron. After treatment, wastewater is sampled and recycled if additional processing is required. Wastewater that meets discharge specifications is pumped into the EFPC through a NPDES monitoring station.

East End Mercury Treatment System. The East End Mercury Treatment System (EEMTS) is designed to treat mercury-contaminated sump water from Building 9201-2, a former mercury use building constructed in the late 1940s and located in the eastern part of the Y-12 Plant on Second Street directly south of the North Portal parking lot. The EEMTS was installed as part of the Y-12 Plant's Integrated Mercury Strategy Program to achieve compliance with regulations and guidance addressing mercury contamination in EFPC. Sump water from Building 9201-2 is treated at the EEMTS. A new outfall (Outfall 550) is the discharge point where treated water is discharged in conformance to NPDES monitoring guidelines. Mercury-contaminated wastewater is pumped from building sumps located in the basement of Building 9201-2 to the treatment unit installed on the first floor. The water is treated there and released to EFPC through the NPDES Outfall 550. The EEMTS process consists of influent filtration, granular-activated carbon adsorption, and associated water transfer equipment.

Steam Plant Wastewater Treatment Facility. The Steam Plant Wastewater Treatment Facility treats wastewater from Steam Plant operations, demineralizers, and coal pile runoff. Treatment processes include wastewater collection/sedimentation, neutralization, clarification, pH adjustment, and dewatering. The treatment facility uses automated processes for continuous operation. All solids generated during treatment are nonhazardous and are disposed of in the sanitary landfill. The treated effluent is monitored prior to discharge to the Oak Ridge public sewage system.

Uranium Chip Oxidation Facility. The Uranium Chip Oxidation Facility (Building 9401-5) is a 348 m^2 (3,750 ft^2), single-story, prefabricated building with metal wall panels built in 1987. The facility thermally oxidizes depleted and natural uranium machine chips under controlled conditions to a stable uranium oxide. Upon arrival, chips are weighed, drained of machine coolant, placed into an oxidation chamber, and ignited. The oxide is transferred into drums and transported to the uranium oxide storage vaults. The Uranium Chip Oxidation Facility is not designed to treat uranium sawfines. Hence, sawfines are currently blended with uranium oxide and placed in the oxide vaults as a short-term treatment method.

Waste Feed Preparation Facility. The Waste Feed Preparation Facility is a 335 m^2 (3,600 ft^2), single-story, prefabricated building with metal wall panels built in 1984 (Building 9401-4). This facility is no longer in operation. It was previously used to process and prepare solid LLW for volume reduction (compaction and repackaging) by an outside contractor or storage facility.

Steam Plant Ash Disposal Facility. The Steam Plant Ash Disposal Facility is used to collect, dewater, and dispose of sluiced bottom ash generated during operation of the coal-fired Y-12 Steam Plant. To comply with environmental regulations for landfill operations, it includes a leachate collection system and a transfer system to discharge the collected leachate into the Oak Ridge public sewage system. The dewatered ash is disposed of in Landfill VI.

4.8.2.3 *Disposal of Waste at Y-12*

On-site waste disposal facilities in operation at Y-12 are limited to industrial and construction/ demolition landfills. None of the landfills accept, or plan to accept, RCRA-hazardous, TSCA-regulated, or radioactive waste. Waste that contains residual radioactive materials at levels below authorized limits established in accordance with DOE Order 5400.5 may be accepted for disposal. All DOE facilities may receive materials containing residual radioactivity of any radionuclide on material surfaces provided that they are below limits specified in DOE Order 5400.5. Current waste acceptance criteria (WAC) for the landfills include a ceiling for residual radioactivity of 35 pCi/gm for total uranium on a volumetric basis. Materials containing uranium and other radioisotopes with residual levels of radioactivity below DOE authorized limits on a volumeric basis are accepted for disposal on a case-by-case basis. DOE is now reevaluating existing WAC of 35 pCi/gm for total uranium for the on-site disposal facilities, as well as future acceptance of materials containing residual levels of other isotopes, in accordance with guidance for the release and control of property containing residual radioactive material under DOE Order 5400.5 (DOE 1995 and 1997). Review of the WAC should not alter the type or classification of wastes accepted at these landfills. An overview of previously used landfills is included in Appendix Table A.5.3-1 for background information. Information on the disposal facilities is based on the following references: Burns 1993, FWC 1995, MMES 1992, MMES 1995b, PAI 1996, and Schaefer 2000.

Industrial Landfill IV. Industrial Landfill IV is used for disposal of classified, non-hazardous industrial waste, for construction/demolition waste, and for approved special waste. This landfill is intended for the disposal of classified waste. Approximately 12 percent of the landfill's design capacity has been filled. It has a footprint of about 1.6 ha (4 acres).

Industrial Landfill V. Industrial Landfill V is used for disposal of unclassified, non-hazardous sanitary/industrial waste and for approved special waste. Approved special wastes have included asbestos materials, empty aerosol cans, materials contaminated with beryllium, glass, fly ash, coal pile runoff sludge, empty pesticide containers, and Steam Plant Wastewater Treatment Facility sludge. The landfill area is located on Chestnut Ridge near the eastern end of the Y-12 Plant and serves Y-12, ORNL, ETTP, and other DOE prime contractors at Oak Ridge. The landfill is equipped with a liner and leachate collection system. Disposal of special waste is approved on a case-by-case basis by the State of Tennessee. Requests are filed with the state to provide disposal for additional materials as needed. The landfill is approximately 15 percent filled. The landfill has a footprint of almost 10.5 ha (26 acres) and is being constructed in phases as disposal capacity is needed.

Construction/Demolition Landfill VI. Construction/Demolition Landfill VI accepts unclassified, non-hazardous construction/demolition debris and approved special waste. Dewatered ash from the Y-12 Steam Plant is currently disposed of in Landfill VI. The facility has been constructed to 100% design capacity and has been in operation since 1993. It is approximately 93 percent filled and has a footprint of about 1.6 ha (4 acres).

Construction/Demolition Landfill VII. Construction/Demolition Landfill VII has been constructed and is on standby status. It will not be placed in service until Landfill VI has been filled to capacity. It has a footprint of slightly more than 12 ha (30 acres).

On-site Low-Level Waste Disposal Capability. Y-12 has no active disposal facility on-site for LLW or hazardous waste. All disposal activities at the Bear Creek Burial Grounds were terminated on June 30, 1991. These burial grounds were used to dispose of radiologically contaminated waste. Similar waste streams generated today are containerized and stored at Y-12 or are shipped off-site for disposal.

However, the Environmental Management Waste Management Facility that is currently under construction will provide a new disposal capability at ORR for various types of hazardous and radioactively-contaminated waste under certain conditions. This facility has only been approved to accept waste generated as a result of response actions to expedite cleanup of contamination that resulted from previous DOE and Atomic Energy Act operations on the ORR and that are conducted under CERCLA authorization (or in a few cases, under the Inactive Hazardous Substances Site Remedial Action Program [State Superfund] of the State of Tennessee).

The Environmental Management Waste Management Facility will use state-of-the-art disposal technologies, including lined cells with leachate collection capabilities. The WAC for the Environmental Management Waste Management Facility are still being developed and are subject to approval by DOE, EPA, and TDEC. It has a design capacity of 993,921 m^3 (1,300,000 yd^3). Section 3.2.2.2 describes the Environmental Management Waste Management Facility.

4.8.3 Site Infrastructure

An extensive network of existing infrastructure provides services to Y-12 activities and facilities. These are summarized in the following sections while more detailed information is provided in Appendix A.

4.8.3.1 *Roads and Railroads*

The Y-12 Site area contains 104 km (65 mi) of roads ranging from well-maintained paved roads to remote, seldom-used roads that provide occasional access. A 7-km (4-mi) spur from the CSX main line east of the city of Oak Ridge serves Y-12; DOE maintains an additional 5 km (3 mi) of rail at the Y-12 Site to serve on-site operations.

4.8.3.2 *Electrical Power*

Electric power is supplied by TVA and is distributed throughout the Y-12 Site via three 161-kV overhead radial feeders; these, in turn, feed eleven 13.8-kV distribution systems consisting of high-voltage transformers, switch gear, and 15-kV feeder cables; and the 13.8-kV feeders distribute power to approximately 400 distribution transformers located throughout the Y-12 Site. In addition, there is one 161-kV interconnecting overhead header. Some sections of the three lines are supported from suspension insulators on self-supporting steel towers; most sections, however, are supported on wooden-pole H-frame structures. Thirteen 13.8-kV distribution systems ranging in size from 20 MVA to 50 MVA are located within such buildings as 9201-1, 9201-2, 9201-3, 9204-4, 9201-4, 9201-5, 9204-1, and 9204-3. Each system consists of a high-voltage outdoor transformer with indoor switchgear, 15-kV feeder cables, power distribution transformers, and auxiliary substation equipment.

4.8.3.3 *Natural Gas*

Natural gas is used for furnaces, the Y-12 Steam Plant, and laboratories and is supplied via a pipeline from the East Tennessee Natural Gas Company at “C” Station located south of Bethel Valley Road near the eastern end of the Y-12 Plant. A 36-cm (14-in), 125-psig line is routed from “C” Station to the southwest corner of the Y-12 Plant perimeter fence. From this point, a 20-cm (8-in) line feeds the steam plant and a 15-cm (6-in) branch line serve the process buildings and laboratories in the east end of the Y-12 Plant. The western end of the Y-12 Plant, other than the Y-12 Steam Plant, is served by 10-cm (4-in) and 5-cm (2-in) headers that are fed from the steam plant line. In turn, two other pressure reducing stations, one at the steam plant and the other at Building 9202, reduce the gas pressure from 125 psig to 25 psig and 35 psig, respectively. The gas pressure is further reduced and the flow metered at each use point.

4.8.3.4 *Steam*

Heating and process steam is supplied from a Y-12 Steam Plant which was originally built in 1955 and upgraded and modernized several times since then. The Plant operates 24 hours/day, 365 days/year. It includes four coal-fired boilers, each of which is rated at 200,000 lb/hr at 500EF and 235 psig. Steam is distributed throughout the plant at 235 psig through main headers ranging in size from 5 cm (2 in) to 46 cm (18 in) in diameter. Condensate is collected and returned to the steam plant using a similar network of pipes; a majority of the returned condensate is used as feed to the demineralized water system.
Each boiler is capable of firing on either pulverized coal or natural gas and includes two coal pulverizes and four burners. Coal for the steam plant is purchased regionally, delivered by truck, and stored in a bermed area near the steam plant. Runoff from the coal pile is collected and treated in the Steam Plant Wastewater Treatment Facility prior to discharge to the sanitary sewer system. Natural gas is supplied from the Y-12 Plant system through an 8-in-diameter, 125-psig underground main; a pressure reducing station reduces the pressure to 25 psig for use in the burners.

4.8.3.5 *Raw Water*

The source of raw water for the Y-12 Plant and the city of Oak Ridge Filtration Plant is the Melton Hill Reservoir. Raw water is pumped approximately 2,743 m (9000 ft) from the reservoir to a 5.7 million L (1.5 million gal) storage tank and pumping station east of the plant. From the pumping station, raw water is pumped to a 91-MLD (24-MGD) filtration plant water system that also serves ORNL and the city of Oak Ridge. Separate underground piping systems provide distribution of raw and treated water within the Y-12 Plant. Raw water is routed to the Y-12 Plant by two lines: a 41-cm (16-in) main from the booster station, installed in 1943, and a 46-cm (18-in) main from the 61-cm (24-in) filtration plant feed line. The raw water system has approximately 8 km (5 mi) of pipes with diameters ranging from 10 cm (4 in) to 46 cm (18 in). The primary use of the raw water is to maintain a minimum flow of 26 million L/day (7 MGD) in the EFPC.

4.8.3.6 *Treated Water*

Treated water is routed from the city of Oak Ridge Filtration Plant to Y-12 facilities by three lines: one 61-cm (24-in) main and two 41-cm (16-in) mains. The total treated water system contains approximately 31 km (19 mi) of pipe ranging in size from 3 cm (1 in) to 61 cm (24 in) in diameter. The treated water system supplies water for fire protection, process operations, sanitary sewerage requirements, and boiler feed at the steam plant. Treated water usage at the Y-12 Plant averages 19 to 23 MLD (5 to 6 MGD) or 6,908 to 8,290 MLY (1,825 to 2,190 MGY). Ownership and operation of the treated water system was transferred from DOE to the city of Oak Ridge in May 2000.

4.8.3.7 *Demineralized Water*

Demineralized water is used to support various processes at the Y-12 Plant that require high-purity water. A central system located in and adjacent to Building 9404-18 serves the entire plant through a distribution piping system. This system consists of feedwater storage, carbon filters, demineralizers, a deaerator, and demineralized water storage tanks. The primary source of feedwater is condensate return, which is cooled and stored in two storage tanks of 49,210 L and 113,562 L (13,000 gal and 30,000 gal) capacity. The secondary source of feedwater is softened water from the steam plant; feedwater from the storage tanks is filtered, demineralized, deaerated, and stored until needed.

4.8.3.8 *Sanitary Sewer*

The Y-12 Site's sanitary sewer system was first installed in 1943 and expanded as the plant grew. Sanitary sewage from the Y-12 Plant flows by gravity to the West End Treatment Plant. Sewage from most buildings flows to a 46-cm (18-in) sewer main that leaves the east end of the plant near Lake Realty and connects to the city main near the intersection of Bear Creek and Scarboro roads. The current system capacity is approximately 1.5 MGD.

4.8.3.9 *Chilled Water*

The chilled water systems were renovated and upgraded during the mid-1990s. Most chillers that were more than 20 years old were replaced, and the new chillers were inspected and renovated to eliminate the use of chlorofluorocarbons and to restore the chillers to optimal mechanical condition.

4.8.3.10 *Industrial Gases*

Industrial gases include compressed air, liquid nitrogen, liquid oxygen, liquid argon, helium, and hydrogen.

Compressed air is supplied by three different systems that use compressors and associated air-drying equipment located throughout the Y-12 Plant. The high-pressure (110 psig) instrument air system serves specific production buildings in the west end of the Y-12 Plant. The low-pressure (100 psig) system also serves the production facilities in addition to serving the production support buildings and ORNL facilities located at Y-12. The Y-12 Plant air system (90 psig) serves those areas where air quality is not a concern. All three systems are supplied from the same set of compressors and are different only in the operating pressure and the cleanliness of the piping systems (i.e., the Y-12 Plant air piping system contains legacy oil and moisture from previous operations).

Liquid nitrogen is normally delivered to the Y-12 Plant by trailer truck. The Y-12 nitrogen supply system consists of five liquid-nitrogen storage tanks, a bank of atmospheric vaporizers, a steam-to-nitrogen vaporizer, and hot-water vaporizers. Nitrogen is delivered to all production facilities and laboratories at 90-psig through a network of 5-cm (2-in), 8-cm (3-in) and 10-cm (4-in) pipes.

Liquid oxygen is delivered to the Y-12 Plant by truck. The oxygen supply system consists of one 914,460-scf, vacuum-insulated storage tank for liquid oxygen. Oxygen is generated by passing the liquid oxygen through two banks of atmospheric vaporizers that have a capacity of 5800 scfh, or 4.1 million scf/month. The gas pressure is reduced to 90 psig, metered, and distributed to production facilities through a 5-cm (2-in) overhead pipeline.

Liquid argon also is delivered to the Y-12 Plant by trailer truck. The Y-12 Plant's argon system consists of five vacuum-insulated liquid storage tanks and 12 atmospheric fin-type vaporizers. The storage tanks have a combined capacity of 116,351 L (30,737 gal.) equivalent to approximately 3.4 million scf of gas. Gas is distributed to production areas and laboratories through a network of 5-cm (2-in) and 8-cm (3-in) pipes.

The Y-12 Plant receives and stores high-purity **helium** at 3,000 psig in a jumbo tube trailer. The helium facility at Building 9977-1 includes a jumbo tube trailer with a capacity of 160,000 scf. In addition, 36,000 scf of helium at 1800 psig is stored in a tube trailer and serves as emergency standby. The Building 9977-1 cylinder filing facility also houses the high pressure reducing station. Helium gas is distributed throughout the Y-12 Plant at 90 psig through a 5-cm (2-in) overhead pipeline.

The **hydrogen** supply at the Y-12 Plant is stored in Building 9977-2 in multi-cylinder tube trailers in open concrete block stalls. Four trailers are used on a rotating basis: one is in service, one is in ready standby, one is in emergency standby, and one is being refilled. Each trailer has a capacity of approximately 2,800 m^2 (30,000 scf), providing a total capacity of 8,400 m^2 (90,000 scf). Stored gas is pressurized at 2,000 psig. A two-stage pressure-reducing station delivers 50 psig gas through a meter. The gas is then distributed through a 5-cm (2-in) overhead pipeline to the Y-12 Plant and laboratory facilities.

4.8.3.11 *Telecommunications*

The four basic telecommunications systems within the Y-12 Plant are the Oak Ridge Federal Integrated Communications Network, the Cable Television Network (CATV), the unclassified Y-12 Intrasite Network, and the Y-12 Defense Programs Network (Y-12DPNet). The Oak Ridge Federal Integrated Communications Network consists of copper cable distributed throughout the Y-12 Plant and within all its buildings; this network is used for telephone, FAX, and special data and alarm circuits and is operated by USWest. The CATV network consists of coaxial cable that is run to selected sites within the Y-12 Plant. This network has the ability to send and/or receive video among the Oak Ridge plants, buildings at a given site, and some off-site locations. The unclassified Y-12 Intrasite Network consists of a fiber-optic backbone network with fiber-optic connectivity to most buildings within the Y-12 Plant; this network uses routed Ethernet service to separate Internet protocol sub-nets for each building. The Y-12 DPNET is the Classified Services Network and presently consists of a coaxial broadband network and a fiber-optic backbone network with fiber-optic connectivity to most buildings within the protected areas of the Y-12 Plant.

4.9 VISUAL RESOURCES

The ORR landscape is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. Much of the ORR's open fields (about 2,020 ha [5,000 acres]) have been planted in shortleaf and loblolly pine; smaller areas have been planted in a variety of deciduous and coniferous trees (DOE 1995c).

For the purpose of rating the scenic quality of Y-12 and surrounding areas, the Bureau of Land Management's (BLM) Visual Resource Management (VRM) Classification System was introduced into this analysis. Although this classification system is designed for undeveloped and open land owned by BLM, this is the only system of it's kind available for the analysis of visual resource management and planning activities. Currently, there is no BLM classification for Y-12, however, the level of development at the plant would be consistent with VRM Class IV which would be used to describe a highly developed are (see Glossary for definition of VRM classes). Most of the land surrounding the Y-12 plant area would be consistent with VRM Class II and III; left to its natural state with little to moderate changes. Continued management of Y-12 land should focus on limiting construction and future plant activities to within current site boundaries, therefore, preserving the character of the surrounding landscape.

The viewshed, which is the extent of the area that may be viewed from the ORR, consists mainly of rural land. The city of Oak Ridge is the only adjoining urban area. Viewpoints affected by DOE facilities are primarily associated with the public access roadways, the Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River. Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric conditions. Some partial views of the city of Oak Ridge water treatment plant facilities located at Y-12 can be seen from the urban areas of the city of Oak Ridge (DOE 1995c).

Y-12 is situated in Bear Creek Valley at the eastern boundary of the ORR. It is bounded by Pine Ridge to the north and Chestnut Ridge to the south. The area surrounding Y-12 consists of a mixture of wooded and undeveloped areas. Facilities at Y-12 are brightly lit at night making them especially visible. There are no visible day-time plumes over Y-12.

Structures at Y-12 are mostly low profile reaching heights of three stories or less. An exception are two meteorological towers erected in 1985 located on the east and west ends of the complex. The East tower, located in a field between Lake Reality and Scarboro Road, reaches a height of 100 m (328 ft). The tower is painted orange and white and is the only structure at the Plant tall enough to require aviation beacons. The West tower is located on a slight rise across from the intersection of Old Bear Creek Road and Bear Creek Road. While this tower only reaches a height of 60 m (197 ft), it is actually higher in elevation than the East tower. These towers are used to measure and transmit meterological data to ETTP databases (Shelton 1999).

The Scarboro community is the closest developed area located to the north of Y-12. However, as a result of their separation by Pine Ridge, Y-12 is not visible from the Scarboro community.

4.10 CULTURAL AND PALEONTOLOGICAL RESOURCES

4.10.1 Cultural Resources

Cultural resources are those aspects of the physical environment that relate to human culture and society, and those cultural institutions that hold communities together and link them to their surroundings. The cultural resources present within the ORR region are complex because of the long prehistoric use of the area; the relocation of the Cherokee from villages during historic times; the presence of well-established settlements prior to acquisition by the Federal government; the continuity of traditional American folklife traditions; and the importance of ORR facilities in the history of nuclear research and production activities for World War II and the Cold War era. An extensive discussion of cultural resources of the ORR region can be found in the DOE-ORO Cultural Resource Management Plan (Souza 1997).

A short history of the human use of the area surounding the ORR and Y-12 is presented to provide a background for the discussion of cultural resources. The ROI for cultural resources is the ORR. The ROI defines the general resource base and relevant cultural and historical contexts for addressing impacts in the area of potential effects. An area of potential effects is the geographic area within which an action may cause changes in the character or use of an historic property (36 CFR Section 800.2[d]). The resources of the ROI provide a comparative basis for establishing the relative importance of resources in the area of potential effects and considering the intensity of potential impacts. The area of potential effects for this SWEIS is the Y-12 Site.

Regional Cultural History. Archaeologists and historians have developed a basic framework to describe changes observed in the cultural traditions of the region. Human occupation and use of the East Tennessee Valley between the Cumberland Mountains and the southern Appalachians is believed to date back to the Late Pleistocene, at least 14,000 years ago. Archaeologists have traditionally believed that these Paleo-Indian bands subsisted primarily by hunting the large game of that era and collecting wild plant foods. More recent research indicates that a more generalized subsistence strategy was probably practiced. In response to warmer and drier climatic conditions and the subsequent loss of Pleistocene megafauna, hunter-gatherers practiced a more diverse subsistence strategy by targeting smaller game and increasing their plant gathering activities. More sedentary adaptations on river terraces and floodplains and labor specialization occurred concurrently with the development and refinement of fishing gear and the exploitation of additional plant materials. Between 3000 and 900 B.C., larger, multifamily communities evolved and primitive horticulture first appeared. Trade goods such as marine shell, copper goods and soapstone bowls also are first found on sites dating to this period. The introduction of pottery and a continued pattern of multiseasonal settlement along river terraces, refinement of agricultural practices, and the use of a broader scope of food resources characterized the next 1,800 years.

During the Mississippian cultural periods (900 A.D. to historic times), larger scale, permanent communities developed first along the alluvial terraces and later on the second river terraces in rich bottomlands suitable for intensive agriculture. These expanding villages included multiple structures, storage pits and hearths, mounds, stockades, plazas, and semisubterranean earth lodges. Archaeological evidence reflects an increasingly complex and specialized society with a high degree of organization, which included the development of elite classes. Just prior to Euro-American contact in the late 17th century, however, there appears to have been a breakdown in the hierarchies and a scaling back of both village size and elaborate public structures. The first Euro-Americans to visit the region were French and English traders and trappers who were soon followed by permanent settlers. These newcomers introduced a variety of domesticated animals, fruit trees, food crops, beads, metal, glass, and other raw materials and derived products to the native inhabitants, now known as the Overhill Cherokee. After a series of conflicts, most of the Cherokee were forcibly relocated to the Oklahoma Territory in 1838. Small, close-knit, agricultural communities developed and continued until 1942 when 23,705 ha (58,575 acres) were purchased by the U.S. government as a military reservation. To contribute to the development of nuclear weapons for the war effort, three production facilities (including Y-12) and a residential townsite were built inside the reservation. New facilities were constructed on the ORR after the war and new missions continued through the Cold War period to the present.

Cultural Resource Types. For this SWEIS, cultural resources have been organized into the categories of prehistoric resources, historic resources, and traditional cultural properties and practices. These types are not exclusive and a single cultural resource may have multiple components. Prehistoric cultural resources refer to any material remains, structures, and items used or modified by people before the establishment of a Euro-American presence in the region in the 17th century. Examples of prehistoric cultural resources recorded on the ORR include villages, potential burial mounds, camps, quarries, and scatters of prehistoric artifacts, such as pottery shards, shell remains, or stone tool-making debris.

Historic cultural resources include the material remains and landscape alterations that have occurred since the arrival of Euro-Americans in the region. Examples of historic cultural resources in the ORR area include homestead and agricultural features, foundations, roads, scatters of historic artifacts, post–contact Cherokee sites, and buildings associated with the Manhattan Project.

Traditional cultural properties and practices refer to places or activities associated with the cultural heritage or beliefs of a living community that are important in maintaining cultural identity. Examples of traditional cultural properties may include natural landscape features; places used for ceremonies and worship; places where plants are gathered that are used in traditional medicines and ceremonies; places where artisan materials are found; places where traditional arts are practiced or passed on; and features of traditional subsistence systems. Impacts to the maintenance of traditional cultural practices are also considered in this SWEIS.

Cultural Resources of ORR and Y-12. Methods used to identify the presence of cultural resources and to determine eligibility vary among the resource types. Pedestrian surveys are used to locate archaeological resources and a separate excavation phase is often required to evaluate archaeological resources for National Register of Historic Places (NRHP) eligibility. Approximately 90 percent of the ORR has been surveyed, on a reconnaissance level, for prehistoric and historic archaeological resources. Less than 5 percent has been intensely surveyed. To date, over 44 prehistoric sites and 254 historic sites, including 32 cemeteries, have been recorded within the current boundaries of the ORR. Fifteen prehistoric sites and 35 historic archaeological resources are considered eligible for listing on the NRHP (Souza 1997).

Several archaeological surveys have been conducted at Y-12 in the past. Surveys are not currently required for activities that do not exceed the depth and extent of previous ground-disturbing activities (PA 1994). Outside of the developed Y-12 Plant area, previously recorded and inventoried archaeological sites have been revisited and evaluated. Only one prehistoric archaeological site, a light scatter of artifacts, has been recorded in the Y-12 Site area. The remains of 16 pre-World War II structures and 7 historic period cemeteries have been identified. Of these, one pre-World War II structure (849A) has been determined eligible for the NRHP based on its early date of construction, current integrity, and its potential to contain undisturbed cultural features. A field review indicated that because of past disturbance the potential for discovery of NRHP-eligible archaeological resources was considered low. Likewise, remaining undisturbed areas are not considered likely locations for significant archaeological resources (DuVall and Associates 1999). It is assumed, however, that archaeological resources could exist in areas that have not yet been inventoried or that subsurface archaeological deposits may occur below shallow disturbances. Even in areas that have been inventoried, data collected on resource locations could be incomplete due to human error or conditions such as heavy vegetation cover, which can seriously affect the ability to see sites on the ground. Unidentified and unevaluated resources are treated as eligible until formal evaluation has been completed.

The survey of historic buildings and structures requires archival research to determine the role that the building may have played in historic events or its architectural significance, and field documentation to assess its current historical integrity. The NRHP has an additional eligibility requirement of "exceptional importance" that applies to properties less than 50 years old. All buildings and structures on the ORR have been surveyed and evaluated for NRHP eligibility. Of 254 pre-World War II buildings and structures evaluated, 35 were determined eligible for the NRHP as individual properties. Two concentrations of pre-war structures have also been designated as the Wheat Community and Gravel Hill Historic Districts. Surveys of World War II and post-World War II buildings encompassing the original Oak Ridge Townsite, ORNL, ETTP, the Oak Ridge Institute for Science and Education, and Y-12 have identified 5 Historic Districts with over 275 contributing structures, 1 designated and 2 proposed National Historic Landmark Properties, and over 25 individual buildings that have been determined eligible for listing on the NRHP. These properties are associated with the Manhattan Project or subsequent activities on the ORR. Other structures, and facility equipment of recent scientific significance that have been previously determined not eligible for listing on the NRHP due to their age or lack of historical context, may be reevaluated for future inclusion (Souza 1997).

All buildings and structures in Y-12 have been surveyed and evaluated. A historic district has been proposed which encompasses the original Y-12 Plant and consists of 92 contributing buildings and structures. The properties in this district are considered significant for their association with the Manhattan Project, Y-12's development as a nuclear weapons components plant after World War II, early nuclear research, and the engineering merits of many of the properties. The proposed district includes buildings that appear to meet the criteria of "exceptional importance" required for listing properties that are less than 50 years old.

Two buildings in Y-12 have been proposed for National Historic Landmark status as individual properties. Building 9731 is the oldest facility completed at Y-12 and played a major part in the Manhattan Project. The prototype calutron was housed and operated in this building and the building was also the location of the original production of stabilized metallic isotopes used in nuclear medicine. Building 9204-3 (Beta-3) functioned as a uranium enrichment facility during World War II and is significant for its pioneering role in the nuclear research in enriched uranium and the separation of stabilized isotopes (Thomason 1999).

Traditional cultural properties and practices are identified through ethnographic and folklore studies, and through direct consultation and site visits with tribal or other traditional practitioners. Ancestors of the Eastern Band of the Cherokee Indians and the Cherokee Nation of Oklahoma may be culturally affiliated with the prehistoric use of the ORR area. Procedures for consultation with the Cherokee regarding traditional cultural properties, religious use, excavation, and discovery of cultural items are in place. No Native American traditional use areas or religious sites are known to be present on the ORR or in the Y-12 Site area.

Also, no artifacts of Native American religious significance are known to exist or to have been removed from the ORR or Y-12 (Souza 1997).

As noted in the discussion of historic resources, the ORR and the Y-12 Site areas contain numerous cemeteries associated with Euro-American use of the area prior to World War II. These resources are likely to have religious or cultural importance to descendants and the local community. No other traditional, ethnic, or religious resources have been identified on the ORR and Y-12 Site areas.

4.10.2 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geologic age. Paleontological resources are important mainly for their potential to provide scientific information on paleoenvironments and the evolutionary history of plants and animals. Impact assessments for paleontological resources are based on the research potential of the resource, the quality of the fossil preservation in the deposit, and on the numbers and kind of resources that could be affected. Resources with high research potential include deposits with poorly known fossil forms fossils which originate from areas that are not well studied, well-preserved terrestrial vertebrates, unusual depositional contexts or concentrations, or assemblages containing a variety of different fossil forms.

Paleontological Resources of ORR and Y-12. The ORR is underlain by bedrock formations predominated by calcareous siltstones, limestones, sandstones, siliceous shales, and siliceous dolostones. The majority of geologic units with surface exposures on the ORR contain paleontological materials. All of these paleontological materials consist of common invertebrate remains which are unlikely to be unique from those available throughout the East Tennessee region.

4.11 ENVIRONMENTAL MANAGEMENT

In the Waste Management PEIS (DOE 1997c), DOE evaluated the environmental impacts of alternatives for managing five waste types generated by defense and research activities at a variety of DOE sites around the United States including ORR. Of the five waste types evaluated, ORR manages the following four types: LLW, mixed-LLW, TRU waste, and hazardous waste. DOE decided on January 23, 1998, that ORR TRU waste would be sent to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NM. DOE decided on August 5, 1998, that the ORR would continue to ship hazardous waste offsite for treatment and disposal. DOE's perferred alternative for management of LLW and mixed-LLW was issued December 5, 1999 (64 FR 69241, December 10, 1999). For the management of LLW and mixed-LLW, DOE prefers regional disposal at the Hanford Site and Nevada Test Site. ORR would continue disposal of LLW generated on-site including Y-12's. The ROD for LLW and unified LLW treatment and disposal was consistent with those preferred alternatives and was issued on February 25, 2000 (65 FR 10061, February 25, 2000). Currently, Y-12 stores liquid LLW and mixed-LLW for treatment and disposal. Solid LLW is currently stored pending ORR availability of off-site disposal or planned on-site disposal facilities. Solid mixed-LLW is shipped to ETTP for incineration and off-site commercial vendors for treatment and disposal (DOE 1999i, DOE 1997c).

Section 4.11.1 addresses the generation of waste from routine operations. Section 4.11.2 addresses the generation of waste from environmental restoration activities. Section 4.11.3 addresses the current status of Y-12's Pollution Prevention Program. The sections discuss the program's background and current elements, including details in areas of waste generation, waste facilities, administrative polices, assessments, technology transfer, recycling/reuse, treatment, and energy and water conservation.

4.11.1 Waste Generation from Routine Operations

The major waste types generated at Y-12 from routine operations include LLW, mixed-LLW, hazardous waste, and nonhazardous waste. Table 4.11.1–1 presents a summary of waste generation totals for routine operations at Y-12, ORNL, and ETTP during 1998. Other waste includes sanitary and industrial wastewater, PCBs, asbestos, construction debris, general refuse, and medical wastes. Y-12 and ETTP do not generate or manage high-level waste or TRU waste. In 1998, ORNL generated 3 m^3 (3.9 yd^3) of TRU waste during routine operations.

Low-Level Waste. Solid LLW, consisting primarily of radioactively contaminated scrap metal, construction debris, wood, paper, asbestos, filters containing solids, and process equipment is generated at Y-12. In FY 1998, Y-12 generated approximately 2,224 m^3 (2,909 yd^3) of LLW, of which 1,000 m^3 (264,172 gal) was liquid. Liquid LLW is treated in several facilities including the WETF (DOE 1996b). Y-12 is the largest generator of routine LLW at Oak Ridge.

TABLE 4.11.1–1.—*Summary of Waste Generation Totals by Waste Type in Kilograms (Cubic Meters)[a] for Routine Operations at Y-12, ORNL, and ETTP*

Waste Type	Y-12 (FY 1998)	ORNL (FY 1998)	ETTP (FY 1998)
Low-Level Waste	2.2 million (2,224)	291 (0.3 million)	0.1 million (123)
Mixed Low-Level Waste[b]	0.2 million (204)	4,000 (4 million)	0.15 million (151)
Hazardous Waste[b]	18,000 (18)	26,000 (26)	2,000 (2)
Sanitary/Industrial	6.8 million (6,795)	0.8 million (822)	0.4 million (390)

[a]Assumes 1000 kilograms (1 metric ton) equals 1 cubic meter.
[b]Includes TSCA wastes.
Source: LMES1999a.

Mixed Low-Level Waste. Mixed waste and LLW subject to treatment requirements to meet Land Disposal Restrictions (LDRs) under RCRA are generated and stored at Y-12. DOE is under a State Commissioner's Order (October 1,1995) to treat and dispose of these wastes in accordance with milestones established in the *Site Treatment Plan for Mixed Waste on the Oak Ridge Reservation* (DOE 1997) and for DOE to comply with an FFCA that went into effect June 12, 1992. TSCA-regulated waste (containing PCBs) that is also radioactive waste is managed under a separate FFCA, first effective February 20, 1992 (EPA 1997, revised).

Hazardous Waste. RCRA-hazardous waste is generated through a wide variety of production and maintenance operations. The majority of RCRA-hazardous waste is in solid form. Some RCRA-hazardous waste is treated on-site and may then be disposed of as nonhazardous waste. The remaining hazardous waste is shipped off-site for treatment and disposal at either DOE, or commercially-permitted, facilities (LMES 1999a, DOE 1999b). Information of waste management facilities at Y-12 is presented in Section 4.8 and in Appendix A.

Other Waste Types. Industrial wastewater is discharged from several locations including the WETF. Sanitary wastewater is discharged to the city of Oak Ridge publicly owned treatment works. For a detailed discussion of wastewater discharges, see Section 4.5. PCBs are transported to permitted facilities for treatment and disposal. Medical wastes are autoclaved to render them noninfectious and are then sent to a Y-12 sanitary industrial landfill as are asbestos wastes and general refuse. Construction, demolition, and nonhazardous industrial materials are disposed of in a construction/demolition landfill for hazardous waste facilities at Y-12 (DOE 1996b).

Capacities. Excess treatment and disposal capacity exist both on-site and off-site for hazardous waste facilities at Y-12. While exceedances of 1-year storage limit are possible, routine shipments should be adequate to prevent such an occurrence. Treatment on-site and disposal capacity of mixed waste facilities is increasing. Storage capacities at Y-12 are not currently exceeded. Capacities for LLW are adequate. Details are provided in Appendix A.

4.11.2 Waste Generation from Environmental Restoration Activities

Environmental Restoration Waste. EPA placed ORR on the National Priorities List (NPL) on November 21, 1989. EPA Region IV and TDEC completed a Federal Facility Agreement (FFA) effective January 1, 1992. This agreement coordinated ORR inactive site assessment and remedial action. By 2006 greater than 95 percent of the current EM work scope will be completed with 99 percent of the planned risk reduction accomplished. Groundwater, surface water, and soil contamination will be remediated to a level consistent with future use of these sites as identified in the CERCLA and RCRA processes. Long-term surveillance, maintenance, and post-closure activities will continue past 2006 (DOE 1999k, DOE 1996b, DOE 1996c).

Environmental restoration wastes for Y-12, ORNL, and ETTP are presented in Table 4.11.2–1. Environmental restoration waste is primarily contaminated soils and liquids generated from monitoring wells, soil removal, and cleaning of environmental restoration equipment. Table 4.11.2–1 addresses LLW, mixed-LLW, hazardous waste, and sanitary/industrial waste.

TABLE 4.11.2–1.—*Summary of Cleanup/Stabilization Related Waste Generation by Waste Type in Kilograms (cubic meters)[a] in 1998*

Waste Type	Y-12	ORNL	ETTP
Low-Level Waste	0 (0)	0.3 million (273)	0.24 million (237)
Mixed Low-Level Waste[b]	1.0 million (990)	29,000 (29)	0.65 million (646)
Hazardous Waste[b]	1.3 million (1,298)	14,000 (14)	2,000 (2)
Sanitary/Industrial	0.45 million (453)	0.77 million (770)	0.7 million (715)

[a] Assumes 1,000 kilograms equals 1 cubic meter.
[b] Includes TSCA wastes.
Source: DOE 1999i.

4.11.3 Pollution Prevention

The *Pollution Prevention Act* of 1990 and the *Hazardous and Solid Waste Amendments* of 1984 enabled Federal agencies to implement the pollution prevention program. NEPA's original purpose, which was to promote efforts that will prevent or eliminate damage to the environment was complemented by both acts. This relationship was further strengthened in a 1993 memorandum from the CEQ, which recommended that Federal agencies incorporate pollution prevention principles, techniques, and mechanisms throughout their NEPA planning and decision making processes. To comply with the waste minimization requirements, DOE-ORO established a Pollution Prevention and Waste Minimization Program. This section provides detailed information regarding pollution prevention and waste minimization at Y-12. For completeness and comparison, information regarding pollution prevention and waste minimization at ORNL and ETTP has also been included.

EPA has published strategies and guidelines to help facilities meet regulatory requirements. The *Pollution Prevention Act* establishes an environmental protection hierarchy, with source reduction as the most desirable environmental management option. If pollution cannot be prevented at the source, then the following waste management options should be explored in order of preference: reuse, recycling, treatment, and disposal. Waste avoidance is accomplished by source reduction or the recycling of solid wastes regulated by RCRA. Pollution prevention complements the concept of waste avoidance by focusing on source reduction and other practices that reduce or eliminate pollutants through increased efficiency in the use of raw materials, energy, water, or other resources or protection of natural resources by conservation. Waste avoidance is an applied element of the pollution prevention process.

Y-12 Pollution Prevention Program. The Y-12 Pollution Prevention Program is consistent with DOE and other legal requirements and designed to eliminate or minimize pollutant releases to all media and incorporate a pollution prevention ethic into the facility. In 1998, Y-12 reported 36 pollution prevention projects accounting for approximately 13,601 m^3 (13,601,247 kg) in waste reduction. The reported cost savings/avoidance was estimated at $3.6 million. In 1997, Y-12 reported 46 projects, 18,916 m^3 (18,916,347 kg) of reduction, and a cost savings/avoidance of $4.5 million (DOE 1999i).

This program has been distinguished with several awards including the White House Closing the Circle Award in 1995. More recently, two awards for an innovative approach to environmental restoration work at Y-12 were the 1998 Oak Ridge Operations Pollution Prevention Award and DOE's National Pollution Prevention Award, for work performed on the Chestnut Ridge Filled Coal Ash Pond Project and the Pollution Prevention Information Management System to track pollution prevention projects (DOE 1999k).

Source Reduction. Source reduction emphasizes the aspect of preventing and reducing the creation of wastes through process change, material substitution, and administrative policies. Efforts at Y-12 to reduce and eventually eliminate emissions and waste at the site have proven successful, shown by a decrease of LLW by more than 62 percent from 1993 to 1998. These reductions have meant significant savings on the cost of waste disposal as well as notable improvement to the environment. Cost savings/avoidance show a reduction of over $2 million during the last several years. Table 4.11.3–1 compares waste generation data for 1993 and 1998. Table 4.11.3–2 shows specific waste generation reduction measures to reduce for all waste types. Table 4.11.3–3 shows (for 1998) ORNL and ETTP efforts.

TABLE 4.11.3–1.—*Reduction in Waste Volumes at Y-12 from Total Operations in Kilograms (cubic meters)*[a]

Waste Type	1993	1998	% Reduction
Low-Level Waste	5.8 million (5,760)	2.2 million (2,200)	62
Mixed Low-Level Waste	2.6 million (2,630)	1.2 million (1,200)	54
Hazardous Waste	9.9 million (9,920)	1.3 million (1,300)	84
Nonhazardous Waste	43.9 million (43,900)	7.2 million (7,200)	84

[a]Assumes 1,000 kilograms equals 1 cubic meter.
Source: DOE 1999b; LMES 1999a.

Process Changes. Process changes (i.e., affirmative procurement, equipment or redesign procedural controls) were examined to ensure that wastes are avoided to an extent that is technically and economically feasible. In 1999, Y-12 began implementation of Affirmative Procurement Initiatives. The training and guidelines for all employees includes appropriate protocol for the purchase of the EPA-designated items, as well as appropriate protocol for making purchases (such as searching several databases before making outside purchases). The guidelines will also include steps to disposition materials when useful life has expired (DOE 1999i).

Material Substitution. Material substitution is the replacement of otherwise harmful chemicals with a more environmentally-friendly product which achieves the same level of efficiency. For example, since reducing the usage of solvents and cleaners containing CFCs by 98 percent, emissions have been reduced by 92 percent since 1992.

Administrative Policies. Top management is committed to take appropriate action to support the objectives of the Pollution Prevention and Waste Avoidance Program by ensuring the availability of adequate personnel, budget, training, and materials. Administrative polices at Y-12 assure involvement of all employees in the facilities program through the implementation of a Pollution Prevention and Waste Avoidance team, employee incentives, program feedback, employee training, database tracking system, and cost allocation. Information sharing and benchmarking activities included the Y-12 Pollution Prevention staff presenting an exhibit at the TDEC Annual Hazardous and Solid Waste Management Conference. The exhibit highlighted pollution prevention initiatives at the site such as the award fee incentive program, project successes, and other recognition programs. The Y-12 Plant Recycle Training and Procedure was revised to include a 12-minute video that outlines recycling initiatives at Y-12. A new informational brochure has also been prepared that provides recycling guidelines for plant recycling initiatives and activities (DOE 1999i).

TABLE 4.11.3–2.—*Pollution Prevention and Waste Avoidance Accomplishments at Y-12 in 1998*

Reduction Techniques	Specific Reduction Measures
Process Changes	Inventory reduction
Affirmative Procurement	Recycled materials purchased Disposition of material considered before purchase Content of hazards considered before products are purchased
Technical Redesign	Asbestos/Fibrous Waste Compactor Lathe modification eliminating LLW cutting fluid
Procedural Controls	Anion determination by microbore ion chromatography Implemented new oil preparation procedure Reduced analytical sample size
Maintenance Procedures	Consolidated waste oils from 8 storage tanks into 3 storage tanks using automated system Upgraded oiling system of various machines having excessive oil leaks
Material Substitution	Substituted lead-free wire for lead wire Filter substitution to acrylic, resin bonded, graded density cartridge filters for cotton string wound cartridge filters Switched to digital imaging from traditional photographs
Administrative Polices	Progress Reports
Pollution Prevention/Waste Avoidance Team	Set goals for reducing volume of wastes and other pollutants Performed waste stream assessments Member of Environmental ALARA Team
Employee Incentives	Conducted the 1998 Y-12 Plant Pollution Solutions Award Program ORR Pollution Prevention Program receives award
Employee Training	Recycle Training revised
Database Tracking	Provided demonstration of the Oak Ridge Reservation Pollution Prevention Information Management System to the West Valley Nuclear Facility
Waste Characterization	RCRA Annual Report Evaluated 838 waste streams Eliminated a regulated waste oil stream Elimination of F-listed waste stream
Recycling and Reuse	Established plant swap shop database for surplus reusable material Welding rod and wire were sold/donated for reuse Antifreeze recycling Scrap Metal Removal CFC Management Fluorescent and incandescent bulb recycling Dry transformers recycled Computer donations Scrap non-precious metal recycling including lead Cardboard recycling Auto parts recycling including tires Coal ash reuse as fill material at the Y-12 landfill Lead acid battery recycle Wood recycling as mulch Paper and office material recycling including toner cartridges, mixed paper, file folders, and aluminum cans

Source: DOE 1999i.

TABLE 4.11.3–3.—*Summary of Pollution Prevention Activities at Y-12, Oak Ridge National Laboratory and East Tennessee Technology Park in 1998*

Site	Number of Pollution Prevention Projects	Waste Reduction (m^3)	Reported Savings (Thousands)
Y-12	29	11,127	$2,429
ORNL	24	40,290	$14,566
ETTP	46	11,019	$5,287

Source: DOE 1999i.

Recycling and Reuse. Waste reduction and elimination are promoted through the implementation of onsite and offsite recycling, reuse, and reclamation activities. In 1998, the cleanup/cleanout campaign sold various scrap metals to an outside vendor for cleaning and recycling. This eliminated the need to transfer the scrap and reduce mixed-LLW by approximately 700 m^3 (916 yd^3) for a reported cost savings/avoidance of nearly $300,000. The scope of the recycling program focuses on hazardous and office-generated waste.

Solid waste recycling features techniques used to reduce landfill usage including source reduction of waste streams wherever feasible and efforts to achieve total recycling of waste streams such as paper, aluminum, and scrap wood. The Y-12 recycling program was designed to support four major goals: (1) increase the longevity of the Y-12 landfill, (2) reduce costs to Y-12, (3) conserve energy and natural resources, and (4) comply with federal waste minimization regulations. Due to the success of the plant-wide paper and aluminum recycling program (98 percent of aluminum cans were recycled in 1995), additional waste streams have been identified and targeted for recycling. These streams include coal ash recycling, automotive recycling in the Y-12 garage, fluorescent bulbs, toner cartridges, and implementation of the Y-12 Swap Shop (DOE 1999i).

Assessments. Y-12 created a Pollution Prevention and Waste Avoidance team to coordinate and track a program that promotes the exchange of related information. In 1998, the Y-12 Program evaluated over 838 waste streams, of which 148 waste streams were generated in 1998. Of these 148 generating waste streams, 68 met reduction goal criteria. There were 35 pollution prevention projects identified covering 36 waste streams, and 77 waste streams will be evaluated in the future, some of which currently meet reduction goal criteria (DOE 1999i).

Technology Transfer. The purpose of technology transfer programs is to enhance the competitiveness of U.S. industries in the global economy. Technology transfer opportunities will also aid in reducing DOE's cost for maintaining nuclear competence by making on-site facilities available to U.S. industries.

To reduce future emissions and stabilize wastes to meet LDR standards, DOE technology transfer efforts include the development of DOE and/or commercially available technologies. Y-12 is partnering through the Oak Ridge Centers for Manufacturing Technology sponsored by DOE's Office of Technology Development to develop and implement technologies. These technologies are to facilitate compliance with current and future environmental laws, regulations, and agreements; minimize the generation of wastes; clean up DOE sites at less cost than current technologies; and ensure a trained work force is available. For example,researchers are currently investigating the potential to selectively extract uranium from contaminated soils from the uranium processing facility at Y-12 (LMES nda).

Energy Conservation. The Y-12 energy management team reduced plant-wide energy use by 43.1 percent over a 13-year period and won a 1996 Renew America Award for its energy efficiency efforts (DOE 1996d).

Water Conservation. In 1994, 7.4 billion L (1.9 billion gal) of filtered water were consumed. By 1998, this decreased by 21 percent to 5.7 billion L (1.5 billion gal) of water.

4.12 OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY/RADIATION

Current activities associated with routine operations at Y-12 have the potential to affect worker and public health. Air emissions from Y-12 can expose both groups to radioactive and nonradioactive materials. Liquid effluents discharged to nearby water bodies may affect downstream populations using the water for drinking water purposes and recreation. Additionally, workers are exposed to occupational hazards similar to those experienced at most industrial work sites.

The following discussion characterizes the human health impacts from current releases of radioactive and nonradioactive materials at Y-12. It is against this baseline that the potential incremental and cumulative impacts associated with the No Action – Planning Basis Operations Alternative and other alternatives can be compared and evaluated.

4.12.1 Public Health

Radiological. In 1998, the potential MEI dose from Y-12 operations was 1.9 mrem. Atmospheric releases from Y-12 operations results in a dose of 0.53 mrem. Radioactivity in liquid effluents from ORR results in an MEI dose of 1.44 mrem. The MEI dose standard for all pathways is 100 mrem per year. The standard for airborne releases is 10 mrem per year and applies to the sum of doses from all airborne pathways (inhalation, submersion in a plume, exposure to radionuclides deposited on the ground surface, and consumption of foods contaminated as a result of deposition of radionuclides). Both the airborne and all pathway EDEs for the MEI are significantly below these limits. Additionally, DOE standards include a limit of 4 mrem per year to the MEI from the drinking water pathway. Of the estimated MEI dose of 2.1 mrem per year, 0.4 is from the drinking water pathway which is well below the 4 mrem limit. Table 4.12.1–1 summarizes these doses to the MEI.

Based on 1990 census data, the population within 80 km (50 mi) of Y-12 is approximately 880,000. In 1998 the collective EDE to that population (i.e., the total dose received by all 880,000 people) was 4.3 person-rem from atmospheric releases at Y-12. Populations drinking water from various water treatment plants downstream of Y-12 potentially received a collective dose equivalent of 1.8 person-rem. These doses from air and liquid releases represent approximately 0.002 percent of the collective dose received from naturally occurring sources of radiation. Based on a dose to risk conversion factor of 5.0 x 10^{-4} fatal cancers per person-rem (ICRP 1991), the collective EDE of 6.13 person-rem could result in less than one additional latent cancer death within the population. The collective dose is also presented in Table 4.12.1–1.

A more detailed discussion of sources of radiation exposure, calculating radiation doses, and estimating risk from exposure to radiation is presented in Appendix D, Human Health and Worker Safety.

TABLE 4.12.1–1.—*Potential Radiological Impacts to the Public Resulting from Normal Operation of Y-12*

Affected Environment	Dose
Maximally exposed individual (public)	
Atmospheric releases	
Dose (mrem/yr)	0.53
Percent of natural background[a]	0.18
Liquid releases	
Dose[b] (mrem/yr)	1.44
Percent of natural background[a]	0.48
Atmospheric and liquid releases	
Dose[c] (mrem/yr)	2.1
Percent of natural background[b]	0.9
Offsite population within 80 km	
Atmospheric and liquid releases	
Dose[d] (person-rem/yr)	6.13
Percent of natural background[a]	2.3×10^{-3}
Fatal cancer risk[e]	3.0×10^{-3}

[a] Dose from natural background radiation levels the average individual is exposed to is 300 mrem per year; to the population within 80 kilometers (880,000 persons) background levels are estimated to be 264,000 person-rem.
[b] Dose to the MEI include liquid effluents for ORR (drinking water at the Kingston Water Plant, fish consumption from Clinch River and Poplar Creek, and other water recreational activities), and direct shoreline radiation of 1 mrem to an individual at Poplar Creek.The dose does not include MEI dose from eating deer, geese, or turkey.
[c] This assumes that the same person receives both the maximum air and liquid doses, which is highly unlikely.
[d] Dose includes population exposure to radionuclides in airborne releases and consumption of drinking water from downstream sources.
[e] Based on dose-to-risk conversion factor of 5.0×10^{-4} latent cancer fatalities per person-rem of radiation exposure to the general public (ICRP 1991).
Source: DOE 1999k.

4.12.2 Worker Health

Radiological. One of the major goals of DOE is to keep worker exposures to radiation and radioactive material as low as reasonably achievable (ALARA). The purpose of an ALARA program is to minimize doses from both external and internal exposures. Such a program must evaluate individual and collective doses to ensure the minimization of both.

The average annual dose to an involved worker at Y-12 during 1998 was 11.4 mrem. The dose to the involved workforce of 3,563 radiation workers was estimated to be 40.6 person-rem. The individual and collective doses for the entire work force of 5,128 workers from 1990 to 1998 can be found in Table D.2.3.1–1 in Appendix D, Human Health and Worker Safety.

Workers exposed to radiation have a risk of 0.0004 per person-rem of contracting a fatal cancer (ICRP 1991 and NCRP 1993). Based on this dose to risk conversion factor, the entire exposed population of Y-12 radiation workers could expect to receive an additional 0.016 cancer deaths due to their 1998 exposure. Thus, as with the public, the annual radiation dose to Y-12 workers results in a calculated cancer fatality risk that is extremely small in comparison to the natural incidence of fatal cancer.

Y-12 worker doses have typically been well below DOE worker exposure limits. Table 4.12.2–1 lists the individual and collective doses for all radiation (involved) workers from 1990 to 1998, as presented in the Y-12 Dosimetry Record System database. Table 4.12.2–2 lists the individual collective doses for all monitored workers from 1990 to 1998. Monitored workers include radiation workers, nonradiation workers, and visitors.

Chemicals used at Y-12 that are of particular concern due to their extensive use in plant operations and the nature and the potential adverse health effects from exposure include mercury, beryllium, PCBs, polycyclic aromatic hydrocarbons, and volatile organic compounds. In addition to the risks from these chemicals, workers at Y-12 are at risk from potential industrial accidents, injuries, and illnesses due to everyday operations. Details on the consequences to worker exposures to workplace chemicals and to other potential sources of impacts to health and safety are discussed in Appendix D, Human Health and Worker Safety.

TABLE 4.12.2–1.—*Y-12 Radiological Worker Annual Individual and Collective Radiation Doses*

Year	Number of Radiological Workers	Average Individual Worker Dose (mrem)	Radiological Worker Collective Dose (person-rem)
1990	2,907	14.8	43.16
1991	3,050	7.3	22.27
1992	2,787	13.1	36.46
1993	2,701	6.8	18.48
1994	2,533	5.4	13.58
1995	2,924	3.1	9.10
1996	3,140	3.1	9.73
1997	3,552	2.96	10.51
1998[a]	3,563	11.4	40.61

[a]1998 data reflect higher doses due to the use of a more conservative risk model in 1998 than that used in previous years and the restart of some uranium operations.
Source: Y-12 1999b.

TABLE 4.12.2–2.—*Annual Radiation Doses for All Monitored Y-12 Workers*

Year	Number of Monitored Workers	Average Individual Worker Dose (mrem)	Site Worker Collective Dose (person-rem)
1990	9,799	5.0	48.95
1991	10,824	2.7	29.60
1992	10,273	3.7	37.91
1993	9,995	2.1	20.52
1994	9,748	1.6	15.31
1995	9,327	1.1	10.27
1996	9,159	1.2	10.90
1997	4,758	2.2	10.69
1998[a]	5,128	8.0	41.24

[a]1998 data reflect higher doses due to the use of a more conservative risk model in 1998 than that used in previous years and the restart of some uranium operations.
Source: Y-12 1999b.

4.13 ENVIRONMENTAL JUSTICE

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," signed by President Clinton in February 1994, requires each Federal agency to formulate a strategy for addressing environmental issues in human health- and environment- related programs, policies, planning and public participation processes, enforcement, and rulemakings. The White House memorandum accompanying the Executive Order directs Federal agencies to "analyze the environmental effects . . . of Federal actions, including effects on minority communities and low income communities, when such analysis is required by NEPA."

Any disproportionately high and adverse human health effects on minority populations or low income populations that could result from the Y-12 alternatives being considered are assessed for an 80-km (50-mi) radius around the site, the area for which health effects are assessed. Any health effects resulting from discharge to water pathways would also be assessed for this area. Minority and low-income populations in this area are shown in Figures 4.13–1 and 4.13–2, respectively. Figure 4.13–3 shows the census tracts surrounding the ORR. Minority populations for these tracts are shown in Table 4.13–1, and low-income populations are shown in Table 4.13–2. Socioeconomic impacts associated with environmental justice concerns are assessed for the four-county ROI described in Section 4.3, Socioeconomics.

Approximately 880,000 people live within a 80-km (50-mi) radius of ORR. Minorities compose 6.1 percent of this population. In 1990, minorities composed 24.1 percent of the population nationally and 17 percent of the population in Tennessee. There are no federally recognized Native American groups within 80 km (50 mi) of the Y-12 Plant. The percentage of persons below the poverty level is 16.2 percent, which is slightly higher than the 1990 national average of 13.1 percent but much lower than the statewide figure of 30 percent (Census 1990).

The Scarboro community is a primarily minority community located approximately 1 km (0.5 mi) north of Y-12. This community has been included in a number of epidemiological health studies conducted by an independent group overseen by the Tennessee Department of Health outlined in Appendix D. Mercury health studies have shown that estimates for mercury intake for Scarboro residents exceeded standards for inhalation of mercury during the years of peak mercury release in the late 1950s. Impacts of uranium releases to the air on the community between 1944 and 1995 were analyzed to determine if cancer risks from uranium releases are elevated for this community. The analyses reported career screening indexes that were slightly lower than the investigators decision guide for carcinogens, but with a great deal of uncertainty.

The Health Studies Report of PCB releases from the ORR prior to the early 1970's outlined in Appendix D concluded that some fishermen at the Clinch River and Watts Bar Reservoir have eaten enough fish from these sources to affect their health, including excess cancers, but estimates of how many have been affected are not possible at this time. Further studies were recommended, including studies of fish and turtle consumption, PCB blood levels in people consuming fish, PCB levels in core samples from the Clinch River and the Watts Bar Reservoir, PCB levels in the soils near EFPC, and PCB levels in cattle grazing near the creek. There are no populations in the area completely dependent on consumption of these fish from the Clinch River and the Watts Bar Reservoir for subsistence.

TABLE 4.13–1.—*Population Distribution by Race in Oak Ridge Census Tracts*

Tract	Total Population	White		Black		Other non-white		Hispanic[a]	
		Total	%	Total	%	Total	%	Total	%
201	2,767	1,620	58.5	951	34.4	196	7.1	19	0.7
202	6,260	5,820	93.0	228	3.6	212	3.4	124	2.0
203	4,395	4,107	93.4	232	5.3	56	1.3	39	0.9
204	4,544	4,231	93.1	251	5.5	62	1.4	93	2.0
205	3,932	3,625	92.2	257	6.5	50	1.3	26	0.7
206	2,735	2,478	90.6	158	5.8	99	3.6	72	2.6
301	2,567	2,438	95.0	71	2.8	58	2.3	64	2.5
Total	27,200	24,319	89.4	2,148	7.9	733	2.7	437	1.6

[a]Hispanic origin may be any race and is included in other totals.
Source: Census 1992.

TABLE 4.13–2.—*Oak Ridge Families Living Below Poverty Level, by Census Tract (1989)*

Census Tract	Number of Families Below Poverty Level	Percentage of Total Families in Census tract Below Poverty Level
201	142	20.9
202	68	3.8
203	59	4.4
204	95	7.0
205	195	17.6
206	0	0
301	9	1.1

Source: Census 1990.

Source: Census 1992.

FIGURE 4.13–1.—*Minority Population in the Region of Influence.*

Source: Census 1992.

FIGURE 4.13–2.—*Low Income Population in the Region of Influence.*

FIGURE 4.13–3.—*City of Oak Ridge Census Tracts.*

CHAPTER 5: ENVIRONMENTAL CONSEQUENCES

In accordance with CEQ regulations, the environmental consequences discussions provide the analytical detail for comparisons of environmental impacts associated with the various Y-12 Site-wide alternatives and proposed actions. Discussions are provided for each environmental resource and relevant issues that could be affected. For each resource or issue in Chapter 5, the impacts of two No Action scenarios for Y-12 operations are presented: 1) Status - Quo and 2) Planning Basis Operations. Analysis is also provided for each of the action alternatives for the Y-12 HEU Storage Mission (Alternative 2) and Special Materials Mission (Alternative 3). The potential combined impacts, if both the HEU Materials Facility and the Special Materials Complex are constructed, in addition to the Y-12 planning basis operations level impacts, are also included (Alternative 4).

For comparison purposes, environmental concentrations of emissions and other potential environmental effects are presented with the appropriate regulatory standards or guidelines. However, compliance with regulatory standards is not necessarily an indication that the environmental impacts are significant for purposes of NEPA.

The following discussion is a brief summary of the Y-12 No Action - Status Quo Alternative, No Action - Planning Basis Operations Alternative, and the alternatives for the HEU Storage Mission and Special Materials Mission.

Alternative 1A (No Action - Status Quo Alternative)

The No Action - Status Quo Alternative represents the current level of operations at Y-12 as reflected by the most recent monitoring data (1998) for the Y-12 Site and reported in the ASER issued in 1999. Although approximately 40 percent of the types of operations associated with DP's assigned mission were operational ready in 1998 (following the Y-12 Plant stand-down in 1994), the Y-12 Plant was only operating at 10 percent capacity. This operating level is used in the SWEIS as a basis for comparison of the impacts associated with the No Action - Planning Basis Operations Alternative and other action alternatives that reflect full Y-12 DP mission operations at required levels and recently approved projects by EM and ORNL at Y-12. The No Action - Status Quo Alternative is not considered reasonable for future Y-12 operations because it would not meet Y-12 mission needs and would not reflect DOE's decision in the SSM PEIS ROD (61 FR 68014) to maintain and downsize the DP missions including the weapons secondary and case component fabrication capability at Y-12.

Alternative 1B (No Action - Planning Basis Operations Alternative)

Under the No Action - Planning Basis Operations Alternative, Y-12 would continue facility operations at historical levels in support of assigned missions. The No Action - Planning Basis Operations Alternative reflects the implementation of the DOE decision in the SSM PEIS ROD (61 FR 68014) to maintain the DP national security mission at Y-12, but to downsize the Plant consistent with reduced requirements. This includes DP capabilities to produce and assemble uranium and lithium components, to recover uranium and lithium materials from the components fabrication process and disassembled weapons, to produce secondaries, cases, and related nonnuclear weapons components, to process and store enriched uranium and to supply enriched uranium, lithium, and other material products; EM activities at Y-12 related to environmental monitoring, remediation, deactivation and decontamination, and management of waste materials from past and current operations; Office of Science activities operated by ORNL at Y-12; and DP support of other Federal agencies through the Work-for-Others program, the National Prototype Center, and the transfer of highly specialized technologies to support the capabilities of the U.S. industrial base. The No

Action - Planning Basis Operations Alternative also includes activities to store surplus enriched uranium pending disposition in accordance with the S&D PEIS ROD (62 FR 3014).

Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)

This alternative includes the No Action - Planning Basis Operations Alternative plus a new HEU Storage Mission facility. There are two proposed options for the HEU Storage Mission at Y-12: (1) construct a new HEU Materials Facility at one of two potential candidate sites, and (2) construct an Upgrade Expansion to existing Building 9215. The preferred option is to construct and operate the new HEU Materials Facility, which would enable Y-12 to safely and securely store Categories I and II HEU, including canned subassemblies that contain HEU; HEU in metal and oxide forms in cans (part of the strategic reserve of excess inventories); and scrap metal that contains HEU awaiting recovery (Central Scrap Management Office scrap metal contaminated with HEU that is being returned from other DOE facilities and university programs).

Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)

This alternative includes the No Action - Planning Basis Operations Alternative plus a new Special Materials Complex at one of three candidate sites. The proposed action is to construct and operate a new Special Materials Complex which would enable Y-12 to ensure efficient production of adequate quantities of special materials for all anticipated scenarios considered for the enduring nuclear weapons stockpile while providing for worker health and safety. A key component of the proposed Special Materials Complex is the construction of a new Beryllium Facility to house all beryllium production operation at Y-12. Facility design would incorporate strategies that enhance the current administrative, safety and health controls, and personal protection equipment with engineered controls.

Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)

This alternative includes the No Action - Planning Basis Operations Alternative plus both a new HEU Materials Facility and a Special Materials Complex.

5.1 LAND USE

The land use resources analysis considers a ROI that includes the Y-12 area of responsibility, which covers 2,197 ha (5,428 acres), as well as the rest of the ORR (13,943 ha [34,513 acres]) and the adjoining properties of the city of Oak Ridge. The land use impacts of the No Action - Status Quo Alternative, No Action - Planning Basis Operations Alternative, and HEU Storage Mission and Special Materials Mission. Alternatives are compared with existing land use patterns, plans and policies.

5.1.1 Alternative 1A (No Action - Status Quo Alternative)

The main area of Y-12 (328 ha [811 acres]) is largely developed and because of the Site's defense support, manufacturing, and storage facilities, the land is classified in DOE's industrial use category. The land surrounding the main Y-12 Plant area is used primarily for environmental restoration, waste management, and environmental field research activities. The No Action - Status Quo DOE missions activities at Y-12 are consistent with current land use plans, classifications, and policies. There would be no land use impacts over the 10-year planning period under the No Action - Status Quo Alternative.

5.1.2 Alternative 1B (No Action - Planning Basis Operations Alternative)

Under Alternative 1B (No Action - Planning Basis Operations Alternative), activities associated with DP, Environmental Remediation, Nuclear Energy, Nonproliferation and National Security, the Work-for-Others Program, and Technology Transfer would not change and therefore, would not affect local short-term or long-term land use. Ongoing downsizing of the Y-12 Plant manufacturing and facility footprint may encourage more facilities to be declared surplus and recommended for D&D. If facilities declared surplus result in the reuse of the land and facilities for activities not related to weapons production operations, some local land use benefits may be realized.

Potential land use impacts from the Environmental Management Waste Management Facility and the ORNL NABIR Program Field Research Center component at Y-12 included in the No Action - Planning Basis Operations Alternative are described below.

Construction and operation of the Environmental Management Waste Management Facility at Y-12 could result in local short-term and long-term land use impacts from the commitment of the land for the disposal facility, and the potential benefit that local disposal capacity may impact the overall cleanup of ORR and resulting land use.

As discussed in Section 3.2.2.2, construction and operation of the new disposal facility would require clearing land within the Oak Ridge National Environmental Research Park (Research Park) (26 to 40 ha [64 to 99 acres]) and an increase of between 5 to 7 ha (12.4 to 17 acres) in the Y-12 West End Borrow Area. Construction, operation, and support activities in and around the facility could affect adjacent activities at the Research Park, such as research. Use of Research Park land for a disposal facility would represent a trade-off between current use of land for forest and use of land for waste disposal. The presence of the facility would influence the likelihood of that type of adjacent development likely, possibly increasing the chance of adjacent industrial development while decreasing the chance of extensive public use (e.g., recreation).

If local waste disposal capacity provided by the Environmental Management Waste Management Facility encourages cleanup of industrial sites, local land use benefits could be realized. The permanent commitment of land for the new facility (9 to 18 ha [22 to 44 acres]) may be at least partially affected by the cleanup and associated improvement or reuse of the land at individual CERCLA sites; however, these indirect potential benefits are uncertain and cannot be quantified. The overall beneficial or adverse impact, if any, depends on actions taken at those individual sites and on the willingness of future occupants to locate to these areas.

Potential impacts to Research Park environmental resources would be minimized by the buffer provided by the restricted area around the new Environmental Management Waste Management Facility and by use of best management practices including sufficient controls during cell operation. Following closure, much of the disturbed area would gradually be allowed to return to its natural forested state. No development of the cell or restricted area would be permitted, providing some future long-term habitat preservation and allowing environmental research to continue.

The Field Research Center component of the NABIR Program at Y-12 (see Section 3.2.2.6) is not expected to result in short-term or long-term land use impacts. The entire length of Bear Creek, from its beginning within the proposed contaminated area through the background area outside the Y-12 SWEIS analysis area, is designated as an Aquatic Natural Area. In addition, much of the land adjacent to the field research areas has been designated part of the Research Park. A portion of the contaminated area is contained within the Research Park. Activities needed to support site characterizations, to obtain research-quality samples, and in-situ research within the approximately 4 ha (10 acres) resource area would not impact or interfere with these designated areas. Any ongoing research projects in areas considered part of the Research Park or Field Research Center Research Area would be avoided.

The only intrusion expected to impact existing land use would be the placement of trailers to support activities near the location of discrete research areas within the Field Research Center. In all areas, trailers would be part of an already developed area and would be compatible with the immediate surroundings.

Activities under this alternative are consistent with recommendations made by the Oak Ridge End Use Working Group (PEC 1998) as well as the planned and proposed projects for the site appearing in the *Oak Ridge Reservation Site Development and Facilities Utilization Plan 1990 Update* (DOE 1991a).

5.1.3 Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)

Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility)

The new HEU Materials Facility, described in Section 3.2.3.2, would be compatible and consistent with the current land use at the Y-12 Plant and would not change the current industrial use classification that exists at both Site A and Site B (see Section 3.2.3.2 for a description of Sites A and B). Construction of and future operations at the HEU Materials Facility are consistent with recommendations made by the Oak Ridge End Use Working Group (PEC 1998) as well as the planned and proposed projects for the site addressed in the *Oak Ridge Reservation Site Development and Facilities Utilization Plan 1990 Update* (DOE 1991a).

Impacts to land surrounding the new facility would be limited to the lay-down areas for construction. The lay-down area for construction of Site A would be north of Bear Creek Road, just west of the new parking lot being constructed as part of the project (see Figure 3.2.3-3). The Site would be sufficiently graded and developed to accommodate a number of temporary construction trailers, storage buildings, and storage yards. A security fence would surround the Site. A smaller lay-down area would be located in the parking lot area next to the construction site to accommodate daily work activities. The lay-down area for the construction of Site B will be in the S-3 Parking Lot (see Figure 3.2.3-5). During construction, temporary parking spaces would be developed in the west tank farm area and just south of old Post 17 to replace the parking spaces lost due to the construction lay-down area.

Once the construction of the new facility Site A is complete, the lay-down area would be re-graded and seeded after removal of any soil that may have been contaminated with construction-related materials. Once the construction of the new facility at Site B is complete, the lot will be paved and the spaces will be relined for its original parking purposes.

Construction for the HEU Materials Facility would occur outside the current PIDAS for both Site A and Site B. Upon completion of the project, the PIDAS would be extended to surround the new facility. The No Action- Planning Basis Operations Alternative Plus the Construction and Operation of the HEU Materials Facility would potentially disturb up to 5 ha (12.4 acres) during construction (both Sites), and result in a potential permanent land requirement of up to 33 ha (82 acres) for operations (both Sites), a small percentage of Y-12 undeveloped land.

When the new HEU Materials Facility is completed and HEU currently stored at Y-12 is relocated to the new facility, the current HEU storage facilities could be declared surplus, reused for other support activities, or recommended for D&D. The final disposition of these facilities would be determined by the Y-12 Facility Transition Process described in Appendix A.1.2. This could result in the reuse of the land and facilities for activities not related to weapons production operations possibly allowing some local land use benefits.

Specific usage of these facilities may change but the overall industrial use classification would remain the same.

Alternative 2B (No Action - Planning Basis Operations Plus Upgrade Expansion of Building 9215)

Impacts on land use as a result of the expansion of Building 9215 (see Section 3.2.3.3) would be minimal under this alternative since the current usage of the proposed construction site is limited to temporary facilities and trailers, which would be demolished or salvaged prior to initiation of construction activities. The expansion would require approximately 0.8 ha (2 acres), west of Building 9212 and 9998 and north of 9215, to accommodate construction activities as well as the current expansion footprint of approximately 0.4 ha (1 acre). Impacts to land surrounding the expansion site would be limited to the lay-down areas for construction. The lay-down area would be the S-3 Parking Lot and would be developed as described above. Once the expansion is complete, the lot would be paved and the spaces would be relined for its original parking purposes. The construction and operation of the Upgrade Expansion to Building 9215 plus the No Action - Planning Basis Operations Alternative would disturb up to 52 ha (128 acres) during construction, and result in a potential permanent land requirement of up to 29.5 ha (72 acres) for operations.

The expansion to Building 9215 would be compatible and consistent with the current land use at the Y-12 Plant and would not change the current industrial use classification that exists for the Y-12 Site. Construction and HEU storage operations within the expansion are consistent with recommendations made by the Oak Ridge End Use Working Group (PEC 1998) as well as the planned and proposed projects for the site addressed in the *Oak Ridge Reservation Site Development and Facilities Utilization Plan 1990 Update* (DOE 1991a).

5.1.4 Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

Site 1 covers a total of 8 ha (20 acres) of land to the north of Bear Creek Road. There are no permanent or temporary structures located on the Site. Approximately 50 percent has already been cleared and the remaining 50 percent is covered with trees. The 0.8-ha (2-acre) construction lay-down area located to the east of the Site consists of a mixture of cleared and wooded land with no temporary or permanent structures. Surrounding development is limited to Building 9114 to the southeast while woodland extends to the north and northwest up to the DOE-ORR boundary.

There would be a change in land use for both the Site and the temporary construction lay-down area, but no change in the industrial use classification of the area. Following completion of construction, the construction lay-down area would be regraded and incorporated into the landscape design of the Special Materials Complex. Construction of the Special Material Complex at Site 1 would be outside the Y-12 Plant PIDAS. The proposed area is still within the recommended development area for this type of activity and would be consistent with recommendations made by the Oak Ride End Use Working Group (PEC 1998) as well as the planned and proposed projects for the site addressed in the *Oak Ridge Reservation Site Development and Facilities Utilization Plan 1990 Update* (DOE 1991a).

Site 2 covers approximately 5 ha (12.4 acres) of land currently used as a Scrap Metal Yard for the Y-12 Plant, and is located southeast of Building 9114 and east of the westernmost portion of the PIDAS. The construction lay-down area for the project would be located at the S-3 Parking Lot. Temporary parking spaces would be provided in the west tank farm area to mitigate the lost parking used by the new construction lay-down area. Once the new Special Materials Complex is complete, the lot would be paved and relined for original parking purposes. Construction of the Special Materials Complex and future operations at Site

2 would be consistent and compatible with ongoing activities at the Y-12 Plant, would not change the current industrial use classification for the area, and is consistent with recommendations made by the Oak Ridge End Use Working Group (PEC 1998) as well as the planned and proposed projects for the site addressed in the *Oak Ridge Reservation Site Development and Facilities Utilization Plan 1990 Update* (DOE 1991a).

Site 3 is the same location as Site B under the new HEU Materials Facility construction alternative and covers approximately 5 ha (12.4 acres). The 0.8 ha (2-acre) construction lay-down area for the construction at Site 3 would be in the S-3 Parking Lot. A temporary parking lot would be developed in the west tank farm area and just south of old Post 17 during construction of the Special Materials Complex. Once the construction of the new Special Materials Complex at Site 3 is complete, the S-3 Parking Lot would be paved and the spaces would be relined for original parking purposes. Construction of the Special Materials Complex and future operations at Site 3 would be consistent and compatible with ongoing operations at the Y-12 Plant, would not change the current industrial use classification for the area, and are consistent with recommendations made by the Oak Ridge End Use Working Group (PEC 1998) as well as the planned and proposed projects for the site addressed in the *Oak Ridge Reservation Site Development and Facilities Utilization Plan 1990 Update* (DOE 1991a).

The No Action - Planning Basis Operations Plus the construction and operation of the Special Materials Complex would potentially disturb up to 59 ha (146 acres) (Site 1) and 56 ha (138 acres) (Sites 2 and 3) during construction, and result in a permanent land requirement of up to 33 ha (82 acres) for operations, a small percentage of available undeveloped Y-12 land.

When the new Special Materials Complex is completed, the facilities currently used for the mission at the Y-12 Plant could be declared surplus, reused for other support activities, or recommended for D&D. The final disposition of these facilities would be determined by the Y-12 Facility Transition Process described in Appendix A. This could result in reuse of the land and facilities for activities not related to weapons production operations, possibly allowing some local land use benefits. Specific usage of these facilities may change, but the overall industrial use classification would remain the same.

5.1.5 Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)

Construction and operation of the HEU Materials Facility and the Special Materials Complex, when combined with the No Action - Planning Basis Operations activities, would result in land use impacts from temporary disturbance and the permanent commitment of land for new facilities. Construction activities would disturb up to 64 ha (158 acres). New facilities and support operations (i.e., Y-12 West End Borrow Area) would require the permanent use of a total of 26 to 37 ha (64 to 91 acres) of land. Only 18 to 29 ha (44 to 72 acres) would be land that did not have existing structures prior to construction. The siting of the proposed new facilities (i.e., Environmental Management Waste Management Facility, the Field Research Center, the HEU Materials Facility, and the Special Materials Complex) would be consistent with ORR and Y-12 land use plans and policies, and consistent with the recommendations of the Oak Ridge End Use Working Group (PEC 1998) as well as the planned and proposed projects for the site addressed in the *Oak Ridge Reservation Site Development and Facilities Utilization Plan 1990 Update* (DOE 1991a).

5.2 TRAFFIC AND TRANSPORTATION

Three major interstate highways (I-40, I-75, and I-81) and other state routes (TSR 61, TSR 62, and US 25W at Clinton) provide off-site access for traffic to and from the Y-12 Site. Primary roads on the ORR serving Y-12 include TSRs 95, 58, 62, and 170 (Bethel Valley Road), and Bear Creek Road. In its analysis of impacts, DOE examined the potential for the various alternatives to affect local traffic patterns. To accomplish this, DOE reviewed the roadways that serve Y-12 and the surrounding Oak Ridge area and then used projections based on changes in worker population and construction activities to determine how traffic patterns could be affected.

DOE also performed an analysis of transportation of materials to and from the Y-12 Plant for each alternative to determine incident-free impacts and accident impacts of material transportation, including vehicular accident impacts. The transportation-related impact evaluation includes the calculation of:

- Incident-free radiological doses and corresponding potential latent cancer fatalities (LCFs) to the transportation crew and public from radiation exposure
- Dose risks due to transportation accidents
- Traffic fatalities that are independent of the cargo
- LCFs due to vehicle emissions

Appendix A.6 gives a detailed discussion of the methodology, models, and analyses for transportation impacts. To estimate these impacts, DOE determined the types of material that would be shipped and the origin and destination of the shipments. Radiological consequences were calculated using the RADTRAN computer program (SNL 1992). Nonradiological impacts were estimated using unit risk factors (SNL 1986), which express the risk per kilometer traveled and were developed from national statistics for high accident-related deaths. The unit risk factors used in this SWEIS are presented in Table 5.2–1 and include the risk of a LCF from vehicle emissions and the risk of traffic fatalities.

5.2.1 Alternative 1A (No Action - Status Quo Alternative)

Primary roads on the ORR serving Y-12 include TSRs 95, 58, 62, and 170 (Bethel Valley Road), and Bear Creek Road. All are public roads except Bear Creek Road which traverses the ORR. The traffic statistics associated with No Action - Status Quo Y-12 missions are presented in Section 4.2, Table 4.2.1–1. Average daily traffic on ORR and area roads serving Y-12 ranges from 3,200 vehicles per day on West Bear Creek Road (LOS A) to 28,320 vehicles per day on TSR 62 from TSR 170 to TSR 95 (LOS E). Major off-site area roads for long-distance transport of materials and waste include I-40, I-75, and I-81. There would be no change in traffic or transportation impacts over the 10-year planning period under the No Action - Status Quo Alternative.

TABLE 5.2–1.—*Nonradiological Unit-Risk Factors for Truck Transport*

Exposure	Rural	Suburban	Urban
Nonoccupational Latent Fatalities (fatalities/km)	–	–	1.0×10^{-7}
Nonoccupational Fatalities (fatalities/km)	5.3×10^{-8}	1.3×10^{-8}	7.5×10^{-9}
Occupational Fatalities (fatalities/km)	1.5×10^{-8}	3.7×10^{-9}	2.1×10^{-9}

Source: SNL 1986.

5.2.2 Alternative 1B (No Action - Planning Basis Operations Alternative)

The No Action - Planning Basis Operations Alternative includes continuation of the present Y-12 missions as well as the construction and operation of the Environmental Management Waste Management Facility and implementation of the Field Research Center activities. The Field Research Center activities would result in a slight increase in traffic on those routes needed by staff members and researches who travel to and from research locations within ORNL. However, because the number of people associated with this project is relatively small, DOE does not expect significant impacts on traffic from the Field Research Center activities. Some interruption of normal traffic flow might occur as a result of drilling rigs and on-site field trailer transport. This activity would be of short duration and would not result in long-term impacts. The construction and operation of the Environmental Management Waste Management Facility could result in some traffic increases. During the construction of the disposal facilities, the commuting workforce would result in a maximum of an additional 75 vehicles per day on Bear Creek Road. This workforce represents less than 1 percent of the total workforce on ORR, and the majority of construction workers would be from the existing workforce. This would have a negligible impact to Y-12 Site traffic and LOS on area roads.

Waste transportation to the disposal facility during operation would be at a maximum rate of 20 trucks per day. Most waste would originate and terminate within boundaries of the Y-12 Site and ORR; therefore, no appreciable change in use of public roads off-site is expected. In addition, up to eight truckloads per day of leachate would be transported to the ORR Technology Park Central Neutralization Facility. These additional vehicles could result in minor traffic delays to the Y-12 Plant workers, but no overall decrease in LOS or increased likelihood of on-site traffic accidents is expected.

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 Alternative)*

Material Type	Incident-Free Doses (person-rem)				Accident Risk to Public* (person-rem)
	Crew	Offlink	Onlink	Stop	
Radioactive Materials	13.3	0.95	9.8	164.4	183.1
Radioactive Waste	1.4	0.08	0.9	11.3	11.3

Note: Offlink-Exposure of members of the public who reside adjacent to routes of travel, Onlink-Exposure of members of the public sharing the right-of-way.
Source: Appendix D based on SNL 1992.
*Probability weighted dose due to an accident

Under the No Action - Planning Basis Operations Alternative, transportation activities for the shipment of materials, wastes, and chemicals are projected to be the same as described under the No Action - Status Quo Alternative based on expected operational levels. A detailed analysis of transportation activities is presented in Appendix A.6.

The calculated incident-free radiological doses to crew and public, and the accident risk (probability weighted dose due to an accident) to the public due to annual radiological shipments for Y-12 under Alternative 1B (No Action - Planning Basis Operations Alternative) are presented in Table 5.2.2–1. The impacts for the No Action - Planning Basis Operations Alternative in terms of incident-free LCFs, LCFs due to radiological accident risk, latent fatalities due to exposure to potential vehicle emissions, and traffic fatalities are presented in Table 5.2.2–2.

The risk due to radiation exposure during incident-free transportation of all waste to the Environmental Management Waste Management Facility is estimated to be 0.001 LCF for local truck transport. Risk from exposure to radiation materials that resulted from releases during a transportation accident is estimated to be 7.0 x 10^{-7} LCF for local truck transport. The risk of traffic fatalities due to a transportation accident is estimated to be 0.3 for local truck transport.

TABLE 5.2.2–2.—*Annual Transportation Impacts for Y-12 Operations Under Alternative 1B (No Action - Planning Basis Operations Alternative)*

Material Type	Latent Cancer Fatalities					Traffic Fatalities	LCFs due to vehicle emissions
	Incident-Free				Accident Risk		
	Crew	Offlink	Onlink	Stop			
Radioactive Materials	5.3 x 10^{-3}	4.8 x 10^{-4}	4.9 x 10^{-3}	0.082	0.092	0.150	4.8 x 10^{-3}
Radioactive Wastes	5.6 x 10^{-4}	4.0 x 10^{-5}	4.5 x 10^{-4}	5.7 x 10^{-3}	5.7 x 10^{-3}	0.017	4.0 x 10^{-4}
Nonradioactive Wastes & Chemicals	–	–	–	–	–	0.010	4.2 x 10^{-4}

Note: Offlink-Exposure of members of the public who reside adjacent to routes of travel, Onlink-Exposure of members of the public sharing the right-of-way.
Source: Appendix D based on SNL 1982.

5.2.3 Alternative 2 - (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)

Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility)

Under this alternative, construction related impacts to local traffic could occur as the new HEU Materials Facility is being built. During peak construction, an estimated 220 workers would be needed for the new facility. Assuming the daily increase in worker traffic is 75 percent of the estimated peak construction workforce, approximately 165 additional vehicles per day are expected. An additional 8 trucks per day during the peak construction phase would be anticipated from concrete and steel trucks. DOE expects these construction-related transportation impacts to be temporary, localized to the general construction area, and minor since most construction traffic would occur during off-peak traffic periods. The operation of the HEU Materials Facility Plus the No Action - Planning Basis Operations Alternative would potentially add an additional 34 vehicles per day on area roads during construction. There will be no additional worker traffic associated with the HEU Materials Facility Operations because existing workforce would be used.

The existing inventory of stored HEU would be relocated to the new HEU Materials Facility or the Building 9215 Addition. There would be a one-time transportation risk associated with the relocation of the stored uranium to this new facility. It is anticipated that the relocation would be completed within one year and require an estimated 3,000 on-site truck trips using SSTs. The transportation impacts are based on the total relocation of the materials.

The incident-free radiological risk to the transport crew, based on the calculated dose of 8.7x10-^{2} person-rem, is estimated to be 3.5 x 10^{-5} LCF. The incident-free radiological risk to the Y-12 Plant population including the handlers, based on the calculated dose of 0.14 person-rem, is estimated to be 7.0 x 10^{-4} LCF. The risk to the Y-12 Plant population due to radiation release during an accident is estimated to be 7.5 x 10^{-5} LCF. The risk to the public due to traffic fatalities is calculated to be 1.3 x 10^{-4}.

After the transfer of the existing inventory of stored HEU material is complete, DOE expects that the routine shipment and receipt of various materials and waste would be comparable to that under Alternative 1B (No Action - Planning Basis Operations Alternative). Therefore, no appreciable change in transportation impacts from the No Action - Status Quo Alternative is expected.

Alternative 2B (No Action - Planning Basis Operations Plus Upgrade Expansion of Building 9215)

Under this alternative, construction related impacts to local traffic could occur as the Upgrade Expansion is being constructed. An estimated 220 workers would be required during peak construction for the Building 9215 expansion. Assuming the daily increase in worker traffic is 75 percent of the estimated peak construction workforce, approximately 165 additional vehicles per day are expected. An additional three trucks per day during the peak construction phase would be anticipated from concrete and steel trucks. DOE expects these construction-related transportation impacts to be temporary, localized to the general construction area, and not significant since most construction traffic would occur during off-peak traffic periods. The operation of the Upgrade Expansion to Building 9215 plus the No Action - Planning Basis Operations Alternative would potentially add an additional 34 vehicles per day on area roads during construction. There will be no additional worker traffic associated with the Upgrade Expansion of Building 9215 because existing workforce would be used. During operation of the upgraded facility, DOE expects that the routine shipment and receipt of various materials and waste would be comparable to that under the No Action - Status Quo Alternative. Therefore, no appreciable change in transportation impacts from the No Action - Status Quo Alternative is expected.

5.2.4 Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

Under this alternative, short-term construction related impacts to local traffic impacts could occur as the new facilities are being built. An estimated 210 workers would be required during peak construction for the Special Materials Complex. Assuming the daily increase in worker traffic is 75 percent of the estimated peak construction workforce, approximately 157 additional vehicles per day are expected. An additional five trucks per day during the peak construction phase (lasting approximately 1 year) would be anticipated from concrete and steel trucks. The No Action - Planning Basis Operations Alternative combined with the operation of the Special Materials Complex would potentially add an additional 34 vehicles per day on area roads during construction. There will be no additional worker traffic associated with the Special Materials Complex because existing workforce would be used. DOE expects these worker transportation impacts to be temporary, localized to the general construction area, and not significant since most construction traffic would occur during off-peak traffic periods. No change in area road LOS is expected.

5.2.5 Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)

Construction of the HEU Materials Facility and the Special Materials Complex when combined with the No Action - Planning Basis Operations Alternative would result in an additional 420 vehicles per day on area roads. This would represent approximately a 3 percent increase in traffic on East Bear Creek Road (if all traffic entered the Y-12 Site from that one road) and would not be expected to change the existing LOS C rating. DOE expects these worker and construction traffic impacts to be minor since most construction traffic would occur during off-peak traffic periods. There will be no additional worker traffic associated with the HEU Materials Facility and the Special Materials Complex because existing workforce would be used. Operations traffic under this alternative would result in approximately 34 additional vehicles per day on area roads and would have no impact on the LOS of area roads.

5.3 SOCIOECONOMICS

Socioeconomic impacts are addressed in terms of both direct and indirect impacts. Direct impacts are changes in Y-12 employment and expenditures expected to take place under each alternative and include both construction-phase and operations-phase impacts. Indirect impacts include (a) the impacts to ROI businesses and employment resulting from changes in DOE purchase or nonpayroll expenditures, and (b) the impacts to ROI businesses and employment that result from changes in payroll spending by affected Y-12 employees. The total economic impact to the ROI is the sum of direct and indirect impacts. Both the direct and indirect impacts are estimated for the ROI described in Section 4.3. The direct impacts estimated in the socioeconomic analysis are based on project summary data developed by DOE in cooperation with Y-12 contractors and their representatives. Direct employment impacts represent actual increases or decreases in Y-12 staffing; they do not include changes in staffing due to reassignment of the existing workforce at Y-12. Total employment and earnings impacts were estimated using Regional Input-Output Modeling System (RIMS II) multipliers developed specifically for the Y-12 ROI by the U.S. Bureau of Economic Analysis. These multipliers are based on national input-output tables developed by BEA and adjusted to reflect the regional industrial structure and trading patterns. These tables show the distribution of the inputs purchased and the outputs sold for each industry. Multipliers are used with information on initial changes in output, earnings, and employment associated with the proposed project to estimate the total impact of the project on regional output, earnings, and employment.

The importance of the actions and their impacts is determined relative to the context of the affected environment. Projected baseline conditions in the ROI, as presented in Section 4.3, Socioeconomics, provide the framework for analyzing the importance of potential socioeconomic impacts that could result from implementation of any of the new facility construction alternatives. Baseline employment and population represent socioeconomic conditions expected to exist in the ROI through 2025. Each HEU Storage Mission or Special Materials Mission alternative is expected to generate short-term increases in employment and income as a result of construction and longer-term decreases as a result of reductions in the Y-12 workforce.

5.3.1 Alternative 1A (No Action - Status Quo Alternative)

The ROI where more than 90 percent of the ORR workforce resides is a four-county area in Tennessee comprised of Anderson, Knox, Loudon, and Roane Counties. In 1997, almost 40 percent of the ORR workforce resided in Knox County, 29 percent in Anderson County, 16 percent in Roane County, and 6 percent in Loudon County. The remaining 9 percent of the workforce resides in other counties across Tennessee, none of which is home to more than 3 percent of the workforce (DOE 1999f).

ROI employment grew from 231,822 in 1990 to 268,748 in 1995, and continued to grow totaling 269,466 in 1998. The ROI labor force totaled 278,866 in 1998. The ROI unemployment rate was 3.4 percent in 1998. The unemployment rate in Tennessee was 4.2 percent in 1998 (BLS 1999). Per capita income in the ROI was $23,520 in 1997, while the per capita income in Tennessee was $22,699 (BEA 1999). Y-12 employs approximately 8,900 workers, including DOE employees and contractors. As a whole, DOE employees and contractors number more than 13,700 in Tennessee, primarily in the ROI.

Between 1990 and 1998, ROI population growth increased 1.1 percent annually while the state population increased 1.4 percent annually. Population in all counties in the ROI is projected to continue to grow at a somewhat slower rate between 1998 and 2020. Knox County is the largest county in the ROI with a 1998 population of 366,846. Loudon County is the smallest county in the ROI with a total population of 39,052.

There would be no change in the regional economic characteristics or the population of the ROI over the 10-year planning period under Alternative 1A (No Action - Status Quo Alternative).

5.3.2 Alternative 1B (No Action - Planning Basis Operations Alternative)

Under this alternative, there would be no substantial change in the 8,900 person Y-12 Site workforce to resume uranium operations and other stand-down operations at Y-12. Therefore, there would be no change in the No Action - Status Quo Alternative regional economic characteristics or the population of the ROI.

Potential socioeconomic impacts from the Environmental Management Waste Management Facility and the Field Research Center included under Alternative 1B (No Action - Planning Basis Operations Alternative) are described below.

The socioeconomic impacts associated with the workforce required for construction, operation, and closure of the Environmental Management Waste Management Facility would not adversely affect nor would it benefit the region's economic conditions. The workforce would vary with project phases. For the high-end waste volume scenario, an average of about 75 workers per year would be needed during construction, peaking at 100 workers in FY 2000-2001. This peak, projected to occur during Phase II construction of the cell with Phase I still in operation, represents an increase of less than 1 percent of the current total ORR workforce. This workforce would likely be drawn from the local labor market, resulting in minimal influx of workers to the area. The 25 workers estimated to be needed for operation of the on-site disposal facility would also likely be drawn from the local workforce.

The workforce for the Field Research Center is anticipated to be small: a construction workforce of up to ten and a staff of up to six individuals during operations, some of whom would be part-time employees of the Field Research Center. Researchers from ORNL, other national laboratories, universities, and other research institutions would visit the Field Research Center to conduct experiments and collect samples. The numbers of visitors at any one time would be small, but could be as many as 24 on occasion. Visiting staff and scientists would contribute in a beneficial manner to the local economy by staying in local hotels and using local services. There would be no negative impact to the socioeconomics of the Oak Ridge area as a result of ORNL Field Research Center activities.

5.3.3 Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternative)

Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility)

For the construction of the HEU Materials Facility at Site A or Site B construction activities would require approximately 220 workers (see Table 3.2.3–1), generating a total of 460 jobs (220 direct and 240 indirect) in the ROI during the peak year of construction, an increase of 0.1 percent in ROI employment. This would increase total ROI income by approximately $12 million, approximately 0.2 percent of ROI income. These changes would be temporary, lasting only the duration of the 4-year construction period. The existing ROI labor force could likely fill all of the jobs generated by the increased employment and expenditures. Therefore, there would be no impacts to the ROI's population or housing sector. Because there would be no change in the ROI population, there would be no change to the level of community services provided in the ROI.

Operation of the HEU Materials Facility at any of the sites would not result in any change in workforce requirements. As shown in Table 3.2.3–2, the facility would require a workforce of 100 during the first year transition period and approximately 30 for normal operation at Sites A or B. The additional workers in the first year (e.g, 70 workers) would be primarily security forces related to the movement of the material. The facility would be staffed by the existing Y-12 workforce. Therefore, there would be no change from baseline Y-12 Site employment and no impacts to ROI employment, income, or population.

The No Action - Planning Basis Operations Alternative plus the construction of a new HEU Materials Facility would require a total of approximately 330 construction workers. A total of 690 jobs (330 direct and 360 indirect) would be generated. This would increase No Action - Status Quo Alternative ROI employment by approximately 0.2 percent. Total No Action- Status Quo Alternative ROI income would increase by approximately $17.8 million, or 0.1 percent.

The new HEU Materials Facility would be operated by the existing Y-12 workforce. Therefore, the only impacts during operation would be from the No Action - Status Quo Alternative, as discussed in Section 5.3.2.

Alternative 2B (No Action - Planning Basis Operations Plus Upgrade Expansion of Building 9215)

Impacts from construction-related activities for the Upgrade Expansion of Building 9215 would be the same as for Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility).

As shown in Table 3.2.3–4, operation of the facility would require a workforce of 100 for the first year transition period and 49 for normal operations. The facility would be staffed by the existing Y-12 workforce. Therefore, there would be no change from No Action - Planning Basis Operations Y-12 Site employment and no impacts to ROI employment, income, or population.

Because construction and operations employment requirements for the Upgrade Expansion of Building 9215 would be similar to the requirements to construct and operate a new HEU materials facility, the impacts from the Upgrade Expansion of Building 9215 plus the No Action - Planning Basis Operations would be similar to
the impacts from the construction and operation of a new HEU materials facility plus the No Action - Planning Basis Operations Alternative.

5.3.4 Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

Construction of the Special Materials Complex at Site 1, Site 2, or Site 3 would require 210 workers at the peak of construction (see Table 3.2.4–1), generating a total of 440 jobs (210 direct and 230 indirect) in the ROI, an increase of 0.1 percent in current ROI employment. This would increase total ROI income by approximately $12 million, approximately 0.2 percent of ROI income. These changes would be temporary, lasting only the duration of the 3.5-year construction period. The existing ROI labor force could fill all of the jobs generated by the increased employment and expenditures. Therefore, there would be no impacts to the ROI's population or housing sector. Because there would be no change in the ROI population, there would be no change to the level of community services provided in the ROI.

Operations of the Special Materials Complex at the sites would not result in any change in workforce requirements. As shown in Table 3.2.4–2, the facilities would require a workforce of 36 for normal operations. The facilities would be staffed by the existing Y-12 workforce. Therefore, there would be no change from the No Action - Status Quo Alternative Y-12 Site employment and no impacts to ROI employment, income, or population.

The No Action - Planning Basis Operations plus the construction of a new Special Materials Complex would result in a total of approximately 320 construction workers. A total of 670 jobs (320 direct and 350 indirect) would be generated. This would increase ROI employment by approximately 0.2 percent. Total No Action -

Status Quo ROI income would increase by approximately $17.2 million, or 0.1 percent.

The new Special Materials Complex would be operated by the existing Y-12 workforce. Therefore, the only impacts during operation would be from the No Action - Planning Basis Operations activities, as discussed in Section 5.3.2.

5.3.5 Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)

The construction periods of the HEU Materials Facility and the Special Materials Complex could overlap with the construction activities included under the No Action - Planning Basis Operations. In that case, there would be a greater construction workforce at Y-12 at one time, resulting in a greater increase in ROI employment, and income in any one year. The peak construction employment could reach approximately 540 direct employees, generating a total 1,130 jobs (540 direct and 590 indirect). This would be an increase of approximately 0.4 percent in No Action - Status Quo Alternative ROI employment and would result in an increase in ROI income of almost $30 million, or 0.2 percent. These changes would be temporary, lasting only the duration of the construction period. The existing ROI labor force could likely fill all of the jobs generated by the increased employment and expenditures. Therefore there would be no impacts to the ROI's population or housing sector. Because there would be no change in the ROI population, there would be no change to the level of community services provided in the ROI.

Because both the HEU Materials Facility and the Special Materials Complex would be staffed by the existing Y-12 workforce during operations, there would be no change from the No Action - Status Quo Alternative Y-12 workforce and no impacts to ROI employment, income, or population.

5.4 GEOLOGY AND SOILS

The geology and soils analysis considers a ROI which includes the Y-12 area of analysis as well as the rest of the ORR. Impacts to these resource areas were determined by assessing potential changes in existing geology and soils that could result from construction activities and operations under each of the alternatives.

5.4.1 Alternative 1A (No Action - Status Quo Alternative)

Y-12 is located within Bear Creek Valley, which is underlain by Middle to Late Cambrian strata of the Conestoga group. The Conestoga Group consists primarily of highly fractured and jointed shale, siltstone, calcareous siltstone, and limestone in the Site area. The bedrock at the Y-12 Site is adequate to support structures using standard construction techniques. Bedrock in the Y-12 area is overlain by alluvium, colluvium, man-made fill, fine-grained residuum from the weathering of the bedrock, saprolite, and weathered bedrock. The overall thickness of these materials in the Y-12 area is typically less than 12 m (40 ft).

Bear Creek Valley lies on well to moderately-well-drained soils underlain by shale, siltstone, and silty limestone. Y-12 lies on soils of the Armuchee-Montevallo-Hamblen, the Fullerton-Claiborne-Bodine, and the Lewhew-Armuchee-Muskinghum associations. Soil erosion due to past land use has ranged from slight to severe. Wind erosion is slight and shrink-swell potential is low to moderate. The soils at the Y-12 Site are generally stable and acceptable for standard construction techniques. Because no new construction or land disturbing activities are expected under the No Action - Status Quo Alternative no impacts to soils and geology are anticipated.

The Oak Ridge area lies at the boundary between seismic Zones 1 and 2 of the Uniform Building Code, indicating that minor to moderate damage could typically be expected from an earthquake. Y-12 is cut by many inactive faults formed during the late Paleozoic Era (DOE 1996e). There is no evidence of capable faults in the immediate area of Oak Ridge, (surface movement within the past 35,000 years or movement of a recurring nature within the past 500,000 years) as defined by the NRC's "Reactor Site Criteria" (10 CFR 100). The nearest capable faults are approximately 480 km (300 mi) west of the ORR in the New Madrid Fault zone. No change in seismic related impacts are expected.

5.4.2 Alternative 1B (No Action - Planning Basis Operations Alternative)

Under the No Action - Planning Basis Operations Alternative, activities associated with DP, Nuclear Energy, Nonproliferation and National Security, Work-for-Others Program, or Technology Transfer would not discernibly affect local short-term or long-term geologic or soil resources. No new construction or land disturbing activities are expected during the 10-year planning period for these missions. Ongoing Environmental Remediation activities would employ best management practices. All soil disturbing activities would be performed in accordance with RCRA and CERCLA regulations, and project plans/procedures.

Construction and operation of the Environmental Management Waste Management Facility at Y-12 could result in minimal local short-term soil impacts. Since the site where the Environmental Management Waste Management Facility would be constructed is within an existing waste management/industrial area, no adverse geologic impacts are expected.

As discussed in Section 3.2.2.2, construction and operation of the new disposal facility would require clearing land within the Research Park and the Y-12 West End Borrow Area. Construction, operation, and support activities could lead to a possible temporary increase in erosion as a result of stormwater runoff and wind action.

Impacts to geologic or soil resources from the Field Research Center component of the NABIR Program at Y-12 are expected to be minor. Soils within the project contamination area are previously disturbed and, therefore, impacts to soils would be minimal. Activities would disturb these soils only in areas where drilling, boring, or well installation would occur. Additional contamination would be minimal with current waste management procedures.

5.4.3 Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)

Alternatives 2A and 2B (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility or Upgrade Expansion of Building 9215)

Construction and operation of a new HEU Materials Facility at Site A, Site B, or the Upgrade Expansion of Building 9215 would have no impact on geological resources, and the hazards posed by geological conditions are expected to be minor.

Slopes and underlying foundation materials are generally stable at Y-12. Landslides or other nontectonic events are unlikely to affect Site A, Site B, or the expansion site for Building 9215. Sinkholes are present in the Knox Dolomite, but it is unlikely that they would impact the project, as the Knox Dolomite is not present in the Y-12 Plant area.

Based on the seismic history of the area, a moderate seismic risk exists at Y-12. This should not impact the construction and operation of the HEU Materials Facility at either Site A, Site B, or the expansion site for Building 9215. The foundation soils are not susceptible to liquefaction during or after seismic events. All new facilities and building expansions would be designed to withstand the maximum expected earthquake-generated ground acceleration in accordance with DOE Order 420.1, *Facility Safety*, and accompanying safety guidelines.

During construction activities, excavation of spoil, limestone, and shale bedrock would occur. There is sufficient capacity to either stockpile these materials or dispose of them during the construction at Site A, Site B, or the expansion site for Building 9215. Soil disturbance from new construction would occur at building, parking, and construction lay-down areas, and lead to a possible temporary increase in erosion as a result of storm water runoff and wind action. Soil loss would depend on the frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of ground disturbance; and the duration of time the soil is bare. A small volume of spoil, limestone, and shale bedrock may be excavated during the construction process. However, this material could be stockpiled for use as fill.

Existing soil contamination found in the Site B project area is due to past waste handling practices. The contamination includes volatile organic compounds (VOCs), metals, and radionuclides from nearby former S-3 Ponds and the Y-12 Scrap Metal Yard (DOE 1998b). The potential for additional soil contamination from project activities at Site A, Site B, or Building 9215 would be minimized by current waste management procedures. These procedures are based on current Federal, state, and local regulations that regulate the hazardous material releases that could impact soil resources. In addition, the potential for soil contamination during the movement of HEU from existing Y-12 storage facilities to a new facility would be minimal due to required safe transportation and packaging practices.

5.4.4 Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

Construction and operation of a new Special Materials Complex would have no impact on geological resources; hazards posed by geological conditions are expected to be minimal. Site 1 is an undisturbed area and impacts to soil resources would be greater in this area. Soil disturbance at Site 1 from new construction would alter the soil profile. Sites 2 and 3 are previously disturbed areas and the impacts to soils from construction would be minimal.

Slopes and underlying foundation materials are generally stable at Y-12. Landslides or other nontectonic events are unlikely to affect Site 1, 2, or 3. Sinkholes are present in the Knox Dolomite, but it is unlikely that they would impact the project, as the Knox Dolomite is not present in the Y-12 Plant area.

Based on the seismic history of the area, a moderate seismic risk exists at Y-12. This should not impact the construction and operation of the Special Materials Complex at either Site 1, 2, or 3. The foundation soils are not susceptible to liquefaction. All new facilities and building expansions would be designed to withstand the maximum expected earthquake-generated ground acceleration in accordance with DOE Order 420.1, *Facility Safety*, and accompanying safety guidelines.

During construction activities, excavation of spoil, limestone, and shale bedrock would occur. There is sufficient capacity to either stockpile these materials or dispose of them during construction at Site 1, 2, or 3. Soil disturbance from new construction would occur at construction lay-down areas, altering the soil profile, and leading to possible temporary erosion as a result of stormwater runoff and wind action. Initial soil disturbance will also occur at Site 1 altering the soil profile and leading to possible temporary increase in erosion. Soil loss would depend on the frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of ground disturbance; and the duration of time the soil is bare.

The potential for soil contamination from the project activities at Site 1, 2, or 3 would be minimal under current waste management procedures. These procedures are based on current Federal, state, and local regulations that regulate hazardous material releases that could impact soil resources.

5.4.5 Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)

Construction of the HEU Materials Facility and the Special Materials Complex, when combined with the No Action - Planning Basis Operations, would have minimal impact on geological resources; the hazards posed by geological conditions are expected to be minor.

Based on the seismic history of the area, a moderate seismic risk exists at Y-12. This should not hinder the construction and operation of the proposed new facilities (i.e., the HEU Materials Facility and the Special Materials Complex). All new facilities and building expansions would be designed to withstand the maximum expected earthquake-generated ground acceleration in accordance with DOE Order 420.1, *Facility Safety*, and accompanying safety guidelines.

During construction activities, there is sufficient capacity to either stockpile the materials excavated or dispose of them. Soil disturbance from new construction would occur at building, parking or construction lay-down areas, and lead to possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil loss would depend on the frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of ground disturbance; and the duration of time the soil is bare.

Soils within the proposed project areas, with the exception of Site 1, are previously disturbed, and therefore, impacts to soils would be minimal. The potential for additional soil contamination from the project activities would be minimal under current waste management procedures. These procedures are based on current Federal, state, and local regulations that regulate the hazardous material releases that could impact soil resources.

5.4.6 Mitigation

Potential impacts to soil resources would be minimized by the design features and the buffer provided by the restricted area around the new Environmental Management Waste Management Facility. Best management practices would include sufficient controls of surface water drainage during construction and cell operation to minimize soil erosion. Following closure, much of the disturbed area would gradually return to its natural state. Any contaminated sediment soils collected in storm drainage basins would be disposed of in accordance with site-specific management plans.

5.5 HYDROLOGY

Potential impacts to surface water for each alternative include:

- Changes in surface water quality due to runoff or contamination releases from specific land areas
- Stormwater control measures
- Water requirements for construction and operation of proposed projects compared with the capacity of the existing water supply resource (Clinch River) and the capacity of the water supply system

Impacts to groundwater conditions include:

- Pathways through which groundwater contamination could occur
- The types and levels of existing groundwater contamination

A qualitative assessment of water quality impacts from wastewater (sanitary and process), stormwater runoff, and soil erosion is identified and described in the following sections. Proposed candidate sites for new facilities are compared with the 500-yr floodplain (see Figure 4.5.1-2).

5.5.1 Surface Hydrology

5.5.1.1 *Alternative 1A (No Action - Status Quo*)

Y-12 Surface Drainage Systems. The major surface water body in the immediate vicinity of the ORR, the Clinch River, borders the Site to the south and west. Within the Y-12 area the two major surface water drainage basins are those of Bear Creek and East Fork Poplar Creek (EFPC). The upper reaches of EFPC drain the majority of the industrial facilities of Y-12. The in-plant portion of EFPC has been designated as Upper East Fork Poplar Creek (UEFPC). The natural drainage pattern of the UEFPC has been radically altered by the construction of Y-12. Portions of Y-12 lie within the 100- and 500-year floodplains of EFCP; however, proposed alternative facilities are located outside the 500-year floodplain (see Figure 4.5.1-2).

As a result of reduced operations and elimination of inadvertent direct discharges of contaminated water to UEFPC, flow in UEFPC decreased from 38 to 57 MLD (10 to 15 MGD) in the mid-1980s to about 9 MLD (2.5 MGD) in the mid-1990s. Since mid-1996, water has been added to the western portion of the open channel in order to maintain flow of 26 MLD (7 MGD) at Station 17. Raw water usage has still remained well within historic water use levels and well below Y-12 capacity. No change in the UEFPC water flow from current levels is expected during the 10-year planning period under the No Action - Status Quo Alternative. Therefore, no change in UEFPC impacts is expected.

Bear Creek Valley west of Y-12 is drained by Bear Creek. Bear Creek flow is maintained by inputs from tributary streams flowing in from the north (mostly) from Pine Ridge. The channel of Bear Creek is less modified that of UEFPC, but several short reaches have been relocated to accommodate construction (e.g., Bear Creek Road) at the west end of Y-12. No change in Bear Creek Valley surface water flows is expected.

The Clinch River and connected waterways supply all raw water for the ORR and provide potable water for Y-12. Y-12 uses approximately 7,530 MLY (1,989 MGY) of water. The ORR water supply system, which includes the city of Oak Ridge treatment facility and the ETTP treatment facility, has a capacity of 44,347 MLY (1,716 MGY). No impacts to Clinch River water resources is expected during the 10-year planning period under the No Action - Status Quo Alternative.

The streams and creeks of Tennessee are classified by TDEC and defined in the State of Tennessee Water Quality Standards. The Clinch River is the only surface water body on ORR classified for domestic water supply. Most of the streams at ORR are classified for fish and aquatic life, livestock watering, wildlife, and recreation. At Y-12, there are six treatment facilities with NPDES-permitted discharge points to UEFPC. The current Y-12 Plant NPDES permit, issued on April 28, 1995, and effective on July 1, 1995, requires sampling, analysis, and reporting at approximately 100 outfalls. Discharges to surface water allowed under the permit include storm drainage, cooling water, cooling tower blowdown, and treated process wastewaters, including effluents from wastewater treatment facilities. The effluent limitations contained in the permit are based on the protection of water quality in the receiving streams. Y-12 is also permitted to discharge wastewater to the city of Oak Ridge Wastewater Treatment Facility. The water quality of surface streams in the vicinity of Y-12 is affected by current and past operations. No additional adverse impacts to surface water quality are expected under the No Action - Status Quo Alternative.

5.5.1.2 *Alternative 1B (No Action - Planning Basis Operations Alternative)*

The source of water for activities at the Y-12 Plant is the Clinch River. Under Alternative 1B (No Action - Planning Basis Operations Alternative), surface water usage at the Y-12 Plant would increase slightly from the No Action - Status Quo Alternative (20.8 MLD to 21.1 MLD [5.5 MGD to 5.6 MGD]) due to the resumption of enriched uranium operations and other stand-down operations. This would represent less than a 2 percent increase in raw water use. Infrastructure maintenance and repairs planned as part of normal Y-12 Plant activities would continue. Other programs, particularly the Environmental Restoration Program, would continue to address surface water contamination sources and, over time, improve the quality of water in both UEFPC and Bear Creek, the two surface water bodies most directly impacted by activities at the Y-12 Plant. The new Environmental Management Waste Management Facility in eastern Bear Creek Valley is included under the No Action - Planning Basis Operations Alternative. The selection of a preferred site and evaluation of the environmental impact have been presented in the *Record of Decision for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste, Oak Ridge, Tennessee* (DOE 1999j). Potential short-term impacts to surface water resources could result from sediment loading to surface water bodies or migration of contaminants. Land clearing and construction activities would expose varying areas depending on the ultimate size of the facility. Best management practices, including standard erosion controls such as siltation fences and buffer zones of natural riparian vegetation, during construction activities would minimize the potential impacts to surface water resources. Vegetation preserved in the riparian zone (adjacent to tributaries) would serve as a filter strip for eroded soil, help prevent stream banks from eroding or slumping, and moderate water temperatures through shading. Grass would be planted in cleared areas to minimize the time that soils are exposed, stabilize the soil, and control erosion. Some impacts to surface water would be expected. Tributary NT-4 would be rerouted and partially eliminated during construction at the East Bear Creek Valley Site. Construction and rerouting of NT-4 would impact some areas of wetland (approximately 0.4 ha [1 acre]) which will be mitigated as part of a wetlands mitigation plan for all CERCLA activities in Bear Creek Valley (DOE 1999j).

Sediment detention basins would control surface water runoff from uncontaminated areas of the waste cell. These basins would prevent increased sediment discharge to the streams and even out discharge during storms. A perimeter ditch would be constructed around the waste cell to prevent surface run-on and direct the water to the sediment basins before release to local streams.

Potentially contaminated runoff from the disposal cell, water used for decontamination, water from the leachate detection/collection system, and other wastewater would be collected in storage tanks. This water would be sampled and transported to an appropriate treatment facility, as required. The potential for impact to surface water resources from the migration of contaminants from the disposal cell in groundwater would be exceedingly low because of engineered and active controls. Little or no overall short-term impacts to surface water resources would be expected with the exception of direct impacts to any water course or wetlands displaced or eliminated by construction.

The new disposal cell would be designed, constructed and maintained to prevent releases that could adversely affect surface water quality in the long term. After the period of active institutional controls, erosion of the cell could eventually expose waste, resulting in release to surface water; however, the cell is designed to resist erosion with minimal maintenance, and only extensive erosion would breach containment. Contaminant releases to groundwater from leachate migrating from the cell are unlikely but could also eventually impact surface water quality.

The No Action - Planning Basis Operations Alternative also includes activities of the Field Research Center at the Y-12 Site. The Field Research Center includes use of an area of contaminated groundwater near the headwaters of Bear Creek Valley (in the vicinity of the former S-3 Ponds). Activities of the Field Research Center include small area studies in support of developing in-situ groundwater remediation technologies. As part of these studies, minor ground-surface disturbances may occur such that surface runoff to Bear Creek would be controlled by standard construction practices (e.g., silt fencing). This is particularly important in the headwaters of Bear Creek Valley where near surface soils often contain contaminants (DOE 1997a).

The primary activities of the Field Research Center at Y-12 comprise subsurface injections of possible treatment additives into the groundwater at the contaminated area. Additives may include small quantities of nontoxic tracers, nutrients, electron donors (e.g., glucose, acetate, molasses) or acceptors (e.g., oxygen, sulfate), and microorganisms. Although only small volume injections are planned, it is possible that the groundwater additives might pass through the subsurface and reach the surface waters of Bear Creek. However, previous experiences with larger tracer injections near Bear Creek (DOE 1997a, LMER 1999c) and close monitoring of environmental conditions at the contaminated area suggest that the impacts to surface waters are predictable and would be minor.

5.5.1.3 *Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)*

Alternatives 2A and 2B (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility or Upgrade Expansion of Building 9215)

Y-12 Plant surface water withdrawals and discharges would not increase substantially during construction of the HEU Materials Facility whether at construction Sites A or B or during Upgrade Expansion of Building 9215.

Construction water requirements are very small and would not raise the average daily water use for the Y-12 Plant. During construction, stormwater control and erosion control measures would be implemented to minimize soil erosion and transport to UEFPC. Neither of the proposed construction sites (Sites A or B) or the Upgrade Expansion Site (Building 9215) is located within either the 100-year or 500-year floodplains.

HEU storage operations, whether located in a new HEU Materials Facility or in the upgraded/expanded Building 9215, would require an estimated 550,000 L to 720,000 L (146,000 GPY to 190,000 GPY), a small percentage of the No Action - Status Quo Alternative Y-12 Plant water usage of approximately 5,680 MLY (1,500 MGY).

The No Action - Planning Basis Operations Alternative plus the operation of the HEU Materials Facility or the Upgrade Expansion of Building 9215 would increase water use requirements by approximately 140 MLY (37 MGY) from the 5,680 MLY (1,500 MGY) water use under No Action - Status Quo. This represents an increase of approximately 2.5 percent. Sufficient excess water capacity exists to accommodate the additional 140 MLY (37 MGY). No adverse impacts to surface water resources or surface water quality are expected because all discharges would be maintained to comply with NPDES permit limits.

5.5.1.4 *Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)*

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

Surface water withdrawals and discharges would not increase substantially during construction of the Special Materials Complex. Construction water requirements are very small and would not raise the average daily water use for the Y-12 Plant. During construction, stormwater control and erosion control measures would be implemented to minimize soil erosion and transport to surface water (UEFPC). None of the proposed sites (Sites 1, 2, or 3) are located within either the 100-year or 500-year floodplains (see Figure 4.5.1-2).

Operations of the Special Materials Complex would require an estimated 59 MLY (15.5 MGY) (approximately 53 MLY [14 MGY] for cooling tower make-up water and 6 MLY [1.5 MGY] for processes). This would be approximately 1 percent of No Action - Status Quo Y-12 Site water usage of 5,680 MLY (1,500 MGY). This water use would potentially be offset by the vacating of operations in existing special materials operations facilities. No adverse impacts to surface water or surface water quality are expected because all discharges would be monitored to comply with the NPDES permit limits.
The No Action - Planning Basis Operations Alternative plus the operation of the Special Materials Complex would increase water use requirements by approximately 197 MLY (52 MGY) from the 5,680 MLY (1,500 MGY) water use under No Action - Status Quo. This represents an increase of approximately 3.5 percent. Sufficient excess water capacity exists to accommodate the additional 197 MLY (52 MGY). No adverse impacts to surface water resources or surface water quality are expected because all discharges would be monitored to comply with NPDES permit limits.

5.5.1.5 *Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)*

Under the alternative, surface water withdrawals and discharges for operations would increase slightly. Water requirements would increase by approximately 197 MLY (52 MGY) from the 5,680 MLY (1,500 MGY) water usage under the No Action - Status Quo Alternative. This represents an increase of 3.5 percent. Historical water used by Y-12 has been on high or 8,328 MLY (2,200 MGY). Sufficient excess water capacity exists to accommodate the additional 197 MLY (52 MGY) increase. No adverse impacts to surface water or surface water quality are expected because all discharges would be maintained to comply with the NPDES permit limits.

5.5.2 Groundwater

5.5.2.1 *Alternative 1A (No Action - Status Quo Alternative)*

Y-12, bound on the north by Pine Ridge and on the south by Chestnut Ridge, is located near the boundary between the Knox Aquifer and the ORR Aquitards. ORR Aquitards underlie Pine Ridge and Bear Creek Valley, which contains the main Plant area of Y-12 and the disposal facilities of western Bear Creek Valley.

Groundwater at Y-12 has been divided into three hydro geologic regimes: UEFPC, Bear Creek, and Chestnut Ridge. A surface water divide at the west end of Y-12 effectively separates the UEFPC and Bear Creek hydro geologic regimes with groundwater flow directions generally to the west in the Bear Creek regime and toward the east in the UEFPC regime.

In Bear Creek Valley, depth to groundwater is generally 6 to 9 m (20 to 30 ft) but is as little as 2 m (7 ft) in the area of Bear Creek near Highway 95. On Chestnut Ridge, the depth to the water table is greatest (>30m [100 ft] below ground surface) along the crest of the ridge, which is a groundwater flow divide and recharge area. Recharge occurs over most of the area but is most effective where over burden soils are thin or permeable. Although most active groundwater flow occurs at a depth less than 30 m (100 ft) below ground surface, contaminants in groundwater more than 61 m (200 ft) below ground surface in the Aquitard indicate permeable flowpaths at depth. In the main Plant area of Y-12, the surface water drainage system has been drastically altered by construction.

There are no Class I sole-source aquifers that lie beneath ORR. Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORR. No change in groundwater use is expected during the 10-year planning period under the No Action - Status Quo Alternative.

Groundwater in Bear Creek Valley west of Y-12 has been contaminated by hazardous chemicals and radionuclides (mostly uranium) from past weapons production waste disposal activities (DOE 1997a). The contaminant sources include past waste disposal facilities sited on Aquitard bedrock north of Bear Creek. Former disposal facilities include the S-3 Ponds, the Oil Land farm, the Boneyard/Burnyard Site, and the Bear Creek Burial Grounds, all closed since 1988.
Historical monitoring of groundwater in the UEFPC Y-12 area has been used to define an area of contamination that extends throughout Y-12 and east into Union Valley. The groundwater contamination is the result of a commingling of releases from multiple sources within Y-12. The most widespread contaminant types are VOCs, such as solvents PCE, TCE, DCE, carbon tetrachloride, and chloroform; and fuel components such as benzene, toluene, ethylbenzene, and xylenes. Other groundwater contaminants include nitrate, gross alpha activity (primarily uranium isotopes), gross beta activity (primarily uranium isotopes and ^{99}Tc). The most frequently detected metals are boron, beryllium, cobalt, copper, chromium, lead, lithium, mercury, manganese, nickel, and total uranium (DOE 1998b).

The Chestnut Ridge hydro geologic area is dominated by several closed and operating disposal facilities including the closed Chestnut Ridge Security Pits, Chestnut Ridge Sediment Disposal Basin, United Nuclear Corporation Site, and five nonhazardous waste landfills. Groundwater monitoring data collected since the mid-1980s indicate limited groundwater contamination. Contaminants consist primarily of VOCs detected in scattered watering wells.

No change in groundwater impacts are expected during the 10-year planning period for Alternative 1A (No Action - Status Quo Alternative), because of discharge compliance measures and ongoing remediation and monitoring.

5.5.2.2 *Alternative 1B (No Action - Planning Basis Operations Alternative)*

Under this alternative, all water would be taken from the Clinch River, with no plans for withdrawal from groundwater resources. All process, utility, and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with NPDES permits. Minimal impact to groundwater quality is expected from Y-12 Site mission activities, except as noted below.

As described in Section 5.5.1, the Environmental Management Waste Management Facility in eastern Bear Creek Valley is included in the No Action - Planning Basis Operations Alternative (See Section 3.2.1.2 for a description of the new facility.) The selection of a preferred site and evaluation of the environmental impact has been presented in the *Record of Decision for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste, Oak Ridge, Tennessee* (DOE 1999j). The engineered disposal cell is the key element of the Environmental Management Waste Management Facility. The disposal cell would be designed to comply with requirements for disposal of RCRA-hazardous waste and low level radioactive waste. The cell design includes a multi-layer basal liner with a double leachate collection/detection system to isolate the waste from groundwater and a multi-layer cap to reduce infiltration and subsequent leachate production. The cell design also includes a clay-fill geologic buffer up to 3-m (10-ft) thick below the basal liner to provide added groundwater protection. Groundwater monitoring would begin during construction activities to establish a baseline database for comparison with post-operational monitoring data.

Groundwater resources could be degraded by contaminant releases during construction and operation of the surface or disposal cell that migrate to groundwater. Contaminant sources include construction materials (e.g., concrete and asphalt), spills of oil and diesel fuel, releases from transportation or waste handling accidents, and accidental releases of leachate from the disposal cell. Compliance with an approved erosion and sedimentation control plan and a spill prevention, control, and countermeasures plan would mitigate potential impacts from surface spills. Engineered controls and active controls, including the leachate collection system, would drastically reduce the potential for impact to groundwater resources that could result from contaminant migration from the disposal cell. Construction and operation of the disposal cell would result in few or no overall short-term impacts to groundwater resources.

In the long-term, the design, construction, and maintenance of the new disposal facility would prevent or minimize contaminant releases to groundwater. These control elements would include a multi-layer cap to minimize infiltration, synthetic and clay barriers in the cell liner, a geologic buffer, and institutional controls that would include monitoring and groundwater use restrictions. If releases were detected during the period of active institutional controls, mitigative measures would be implemented to protect human health and the environment. Long-term impacts to groundwater quality resulting from the disposal cell are expected to be insignificant.

As described in Section 5.5.1, research activities of the Field Research Center at the Y-12 Site would focus on injections of additives to the groundwater at both the background and contaminated areas. The intent of the research activities is to evaluate in-situ remediation methods. Although the additives would modify the chemistry of the groundwater in the immediate study area, injections of additives would be so small that impacts would be limited to the immediate study areas. Previous experience with larger tracer studies in Bear Creek Valley suggests that the impacted area of the injections can be predicted.

Groundwater would be extracted in the Field Research Center contaminated area at Y-12 as part of characterization-related hydraulic tests. However, groundwater extractions associated with major hydraulic tests would collect no more than 76,000 L (20,000 gal) of groundwater per year (DOE 2000b). Sampling activities in years with no major hydraulic testing would collect no more than 7,600 L (2,000 gal) of groundwater. All extracted groundwater would be collected and treated in on-site facilities prior to surface water discharge to meet existing NPDES permit limits.

5.5.2.3 *Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)*

Alternatives 2A and 2B (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility or Upgrade Expansion of Building 9215)

All water for construction and operation of the HEU Materials Facility would be taken from the Clinch River as part of the normal water uses at the Y-12 Plant. Some groundwater may be extracted during construction activities at either construction site (Sites A or B) or during the Upgrade Expansion of Building 9215 to remove water from excavations. Based on the results of the Remedial Investigation of UEFPC (DOE 1998b), groundwater extracted from excavations at Site A and in the area of the Upgrade Expansion of Building 9215 probably would not be contaminated. Groundwater extracted from excavations at Site B would probably be contaminated with VOCs, metals, and radionuclides from the nearby former S-3 Ponds and the Y-12 Scrap Metal Yard (DOE 1998b). Construction at Site B may require plugging and abandonment of groundwater monitoring wells. The monitoring wells should be replaced as part of the long-term monitoring program for remediation of that portion of the Y-12 Plant. Minimal impacts to groundwater quality are expected because, regardless of site, extracted groundwater would be collected and treated in on-site treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water; no plans exist for routine withdrawal from groundwater resources; as a storage facility there would be no process water; and utility and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with the existing NPDES permits.

5.5.2.4 *Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)*

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

All water for construction and operation of the Special Materials Complex would be taken from the Clinch River as part of the normal water uses at the Y-12 Plant. Some groundwater may be extracted during construction activities to remove water from excavations. Based on the historical site use and the results of the Remedial Investigation of the UEFPC (DOE 1998b), groundwater extracted from excavations at Site 1 probably would not be contaminated. Construction at Site 1 would probably require plugging and abandonment of several groundwater-monitoring wells in the area. The monitoring wells have not been sampled recently and are not part of any routine groundwater monitoring program at the Y-12 Plant. Groundwater extracted from excavations at Sites 2 and 3 would be the same as that described for the HEU Materials Facility Site B. The groundwater is contaminated with VOCs, metals, and radionuclides from the nearby former S-3 Ponds and the Y-12 Scrap Metal Yard (DOE 1998b). Construction at either Sites 2 or 3 would require plugging and abandonment of groundwater monitoring wells. The monitoring wells should be replaced as part of the long-term monitoring program for remediation of that portion of the Y-12 Plant. Minimal impacts to groundwater quality are expected because, regardless of site, extracted groundwater would be collected and treated in on-site treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water; utility and sanitary wastewater would be treated prior to discharge into the UEFPC in accordance with the existing NPDES permits; and no plans exist for routine withdrawal from groundwater resources to support either construction or operation of the Special Materials Complex.

5.5.2.5 *Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)*

Under this alternative, all water requirements would be taken from the Clinch River. No groundwater would be used for construction or operations of facilities. Some groundwater may be extracted during construction, from excavation and field research activities. Depending on the construction site, extracted groundwater may be contaminated with VOCs, metals, and radionuclides. Minimal impacts to groundwater and groundwater quality are expected because extracted groundwater would be collected and treated in on-site treatment facilities to meet discharge limits of the NPDES permit prior to release to surface water; no plans exist for routine withdrawal from groundwater resources; and utility and sanitary wastewater would be treated prior to discharge into UEFPC in accordance with the existing NPDES permits.

5.6 BIOLOGICAL RESOURCES

This analysis focuses on Y-12 and the area within the SWEIS study area boundary (see Figure 1.1.3–1). Potential impacts are assessed based on the degree to which various habitats or species could be affected by Y-12 proposed actions and alternatives. Where possible, impacts are evaluated with respect to Federal and state protection regulations and standards.

Impacts to wildlife are evaluated in terms of disturbance, displacement, or loss of wildlife. Impacts are assessed based on proximity of wetlands to Y-12 current mission operations, the proposed construction and operation of new facilities, and any related discharge. A list of species potentially present at Y-12 was obtained from USFWS was used in the process of assessing whether Y-12 current mission operations or proposed new facilities would impact any plant or animal under Section 7 of the *Endangered Species Act* (USFWS 1999c).

5.6.1 Alternative 1A (No Action – Status QuoAlternative)

Biological resources at Y-12 include terrestrial resources, wetlands, aquatic resources, and threatened and endangered (T&E) species.

Within the fenced, developed portion of Y-12, grassy and devegetated areas surround the entire facility. Buildings and parking lots dominate the landscape in Y-12, with limited vegetation present (ORNL 1992a). Fauna within the Y-12 area is limited by the lack of large areas of natural habitat. Impacts on terrestrial resources are minimal.

A Biological Monitoring and Abatement Program was established in conjunction with the NPDES permit issues to Y-12 in 1992. The program includes toxicity monitoring, bioaccumulation studies, biological indicator studies, and ecological surveys. Toxicity testing and bioaccumulation studies indicate that the exposure of aquatic organisms in UEFPC to toxicants has been steadily decreasing as a result of remedial activities such as implementations of flow management and continuing mercury reductions at Y-12 (LMER 1999a).

Existing impacts to biological resources would continue and are not expected to increase during the 10-year planning period under Alternative 1A (No Action - Status Quo Alternative) because no new construction or implementation of new processes or missions is expected. The mitigation measures discussed in Section 5.6.6 are intended to minimize the impacts to biological resources that might occur during operation activities associated with this alternative.

5.6.2 Alternative 1B (No Action - Planning Basis Operation Alternative)

Under Alternative 1B (No Action - Planning Basis Operation Alternative), most current Y-12 mission operations would continue as described in Section 3.2.2. Existing impacts to biological resources described under the No Action - Status Quo Alternative would not change because resumption of enriched uranium and other operations still in stand-down mode would not involve new construction, or new processes or emissions. Two activities included under the No Action - Planning Basis Operations Alternative, however, would result in potential impacts to biological resources. The Environmental Management Waste Management Facility and the Field Research Center are described in Sections 3.2.2.2 and 3.2.2.6, respectively.

The Environmental Management Waste Management Facility will be constructed at the East Bear Creek Valley Site just west of the Y-12 Plant main area, immediately south of Pine Ridge, and located between tributaries NT-3 and NT-5 well north of Bear Creek (DOE 1999j).

Impacts to terrestrial biotic resources would result primarily from land clearing and result in the loss of grassland and old-field successional regimes that provide browse and cover, as well as the loss of mixed-hardwood/conifer forests (see Figures 3.2.2-7 and 3.2.2-9). Clearing of forest at the selected site, use of the haul road, and the Y-12 West End Borrow pit would increase forest fragmentation. Consequently, some small animal dislocation and reduction in abundance could be expected. Large animals would be largely excluded from controlled areas by access control fences. The presence of surrounding forested areas would somewhat reduce the impact that clearing would have on habitat continuity and biological diversity.

The Environmental Management Waste Management Facility site contains suitable habitat for several sensitive plant and animal species. The Remedial Investigation/Feasibility Study (DOE 1998a) provides a detailed discussion of these species. Forest clearing would directly impact portions of Habitat Area 2 and could directly impact the western portions of RA5 and the eastern portions of NA28, depending on the exact design and size of the cell (See Figure 3.2.2-7). Habitat Area 2 hosts the Tennessee endangered species pink lady slipper. NA28, Eastern Bear Creek Rein-Orchid Wetland, hosts a small population of the Tennessee threatened species tuberculed rein-orchid. RA5, Quillwort Temporary Pond, hosts Carolina quillwort and may be an important amphibian breeding site. While best management practices, including various engineering and administrative controls, would reduce potential impacts to these areas, noise, the loss of adjacent forest habitat, and possibly dust and exhaust emissions may impact the adjacent sensitive resources.

The disposal facility construction site would be surveyed for the presence of listed species before construction and the USFWS and TWRA consulted. Impact mitigation plans would be developed.

Since construction would require rerouting of 330 m (1,000 ft) of NT-4, the associated wetland (approximately 0.4 ha [1 acre] in size) would be impacted by potential construction-related sediment and loss of adjacent wooded areas. A programmatic wetlands mitigation plan covering all activities in Bear Creek Valley will be included as part of the remedial action work plan, a post-ROD document. This includes mitigation of wetlands impacted by the new disposal facility as well as other activities in Bear Creek Valley (DOE 1999j).

The Field Research Center would be located within 80 ha (200 acres) of the Bear Creek Valley. However, most portions of the Field Research Center contaminated area within the Y-12 Site area would involve plots less than 0.4 ha (1 acre) in size. Where possible, these research test plots would be located in areas where site clearing and past construction have occurred or past construction activities have already changed the predominate landscape (see Figure 3.2.2-10). Therefore, few terrestrial species would be affected by the project (DOE 2000b). In the event that previously unknown sensitive resources were discovered during planning activities (e.g., site plan evaluations or site design construction), efforts to avoid impacts would be conducted and specific reserved sites would be away from sensitive resources.

The USFWS has indicated that the gray bat (*Myotis grisescens*) and Indiana bat (*Myotis sodalis*) might live near the proposed Field Research Center (USFWS 1999b). Although EFPC and Bear Creek Valley offer riparian habitat suitable for these species, neither species was captured in mist net surveys conducted specifically for bats in the EFPC (DOE 2000b). In February 2000, ORNL completed an assessment and evaluation of potential roosting and foraging habitats for the gray and Indiana bats (DOE 2000b). The assessment concluded that the Field Research Center would not adversely affect either bat species. Also, since no proposed or designated critical habitats are present on the Site, none would be affected. The USFWS concurred with this conclusion in a letter dated February 10, 2000 (DOE 2000b).

Much of the proposed contaminated area and background area for the Field Research Center is situated either in the riparian zone of Bear Creek or adjacent to it. The Tennessee dace (*Phoxinus tennesseensis*), a minnow, listed by the TWRA as a species in need of management is the only aquatic protected or special status species likely to occur in the proposed site area. Although Bear Creek is still considered impaired, recent research has indicated an improvement in species diversity within the upper reaches of this body of water. The small scale of disturbance required for Field Research Center research plots in the contaminated area should preclude impact to this species (DOE 2000b). While it is not anticipated that Field Research Center related activities would have any impact on aquatic resources, the sensitive status of the Tennessee dace in Bear Creek makes it likely that additional measures to protect the species might be required if a specific research plot is chosen in proximity to Bear Creek. Any such additional measures would be determined and documented during the project's environmental review process. Other evaluations could include conducting and monitoring activities to determine the pre-existing condition of specific reaches of Bear Creek in proximity to selected research plots. Periodic monitoring by ORNL of aquatic and benthic resources within adjacent reaches might be conducted to determine if Field Research Center activities would result in impact to the Tennessee dace or its forage base (DOE 2000b).

The mitigation measures discussed in Section 5.6.6 are intended to minimize the impacts to biological resources that might occur during construction and operation activities associated with this alternative.

5.6.3 Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)

Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility)

Under this alternative, potential impacts to biological resources from the construction and operation of a new HEU Materials Facility would be minimal because both candidate sites (Site A is the Y-12 West Portal Parking Lot; Site B is located at the Y-12 Scrap Metal Yard) are located in areas of Y-12 that have been previously disturbed. Some dislocation of small urban type species (i.e., rodents) could be expected because of the presence of humans.

In conjunction with the construction and operation of a new HEU Materials Facility, other ancillary actions would include the temporary use of construction staging or "lay-down" areas, a parking lot, and utility relocation. In the case of Site A, a construction staging area would occupy about 0.8 ha (2 acres) of land north of Bear Creek Road. A 200-space parking lot would be built to replace the parking spaces lost to the proposed HEU Materials Facility, if it is located at Site A. The new parking lot would be an expansion of the existing Polaris Parking Lot, which is also located north of Bear Creek Road, just northwest of the HEU Materials Facility Site. A short stretch of Bear Creek Road could be relocated and a new lane added. In the case of Site B, the S-3 Ponds Parking Lot would be used as a construction staging area. New parking space would not be required, except on a temporary basis for construction workers. The temporary lot, about 0.8 ha (2 acres), would be developed in the west tank farm area just south of old Post 17. The construction and operation of an HEU Materials Facility at either Site A or Site B would require the relocation of utilities. Section 3.2.3.2 provides details of the potential utility relocation requirements.

The location of ancillary actions associated with the HEU Materials Facility candidate site, as described above, is in previously disturbed or heavily industrialized portions of the Y-12 Site that do not contain habitats sufficient to support a biologically diverse species mix. Some dislocation of small urban type species (i.e., rodents) could be expected because of the presence of humans.

The forest vegetation on the northwest side of Bear Creek Road has been cleared approximately one-quarter to one-half the distance up the side of Pine Ridge. The cleared areas are now maintained in grass and other nonnative herbaceous species. Kudzu has covered some of the steep slopes. EFPC tributary streams originate on the lower slopes of Pine Ridge in the altered areas. All of the tributaries have had large portions of their lower reaches piped and/or filled. Those sections of the stream bottoms not filled or piped have been filled with rock. Emergent wetlands and scrub/shrub wetlands have been identified in the stream bottom remnants. Three wetlands identified in the Wetland Survey of Selected Areas in the Oak Ridge Y-12 Plant Area of Responsibility report prepared in 1997 (ORNL 1997a) could be potentially impacted or altered by ancillary actions associated with Site A (see Figure 3.2.3–3). The construction staging area and parking lot could either eliminate the wetland or result in a temporary increase of sedimentation from construction activities. Each of these wetlands is surrounded on three or four sides by grass that is regularly mowed. All the wetlands are and dominated by black willow, rice cutgrass, seedbox, and dotted smartweed.

The mitigation measures discussed in Section 5.6.6 are intended to minimize the impacts to biological resources that might occur during construction and operation activities associated with this alternative.

Alternative 2B (No Action - Planning Basis Operations Plus Upgrade Expansion of Building 9215)

The 0.8 ha (2 acres) of land required for the Upgrade Expansion of Building 9215 would occupy a parcel of land located west of Buildings 9212 and 9998 and north of Building 9215. The parcel is currently occupied by trailers and temporary facilities within the heavily industrialized portion of the Y-12 Site. The parcel does not contain habitat sufficient to support a biologically diverse species mix. There would be no impacts to biological resources.

The mitigation measures discussed in Section 5.6.6 are intended to minimize the impacts to biological resources that might occur during construction and operation activities associated with this alternative.

5.6.4 Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternatives)

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex Facility

Under this alternative, a new Special Materials Complex would be constructed at Site 1, Site 2, or Site 3 (Site 3 is the same as HEU Materials Facility Site B). Sites 2 and 3 are located in lightly developed areas of Y-12 that have been previously disturbed and contain minimal biological resources. The impact associated with ancillary actions, construction of parking lots, and construction staging areas would be the same as described under Alternative 2A. In the case of Site 2, only temporary parking would be needed during construction. Sites 2 and 3 do not have the habitat to support a biologically diverse species mix. Some dislocation of small animals could be expected.

However, Site 1 is located in an approximately 8-ha (20-acre) area north of Bear Creek Road and in relatively close proximity to wetlands K and L identified in a wetland survey for Y-12 (ORNL 1994). Construction of the Special Materials Complex at Site 1 would eliminate up to 4 ha (10 acres) of vegetation. Vegetation on the remainder of the Site has been previously removed to accommodate the power line corridor and past Y-12 support activities. Vegetation in cleared areas consists of grass and nonnative herbaceous species (ORNL 1994).

The mitigation measures discussed in Section 5.6.6 are intended to minimize the impacts to biological resources that might occur during construction and operation activities associated with this alternative.

5.6.5 Alternative 4 (No Action - Planing Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)

Under this alternative, current operations would continue in conjunction with the construction of the HEU Materials Facility and the Special Materials Complex. The impacts of this alternative represent the sum of the impacts described in Sections 5.6.2, 5.6.3, and 5.6.4 above.

No adverse impacts to federally-listed T&E species are anticipated as discussed in Section 5.6.2. Depending on the final design and size of the Environmental Management Waste Management Facility, potential impacts could occur to the Tennessee endangered species pink lady slipper in Habitat Area 2, and the Tennessee threatened species tuberculed rein-orchid in the Eastern Bear Creek Rein-Orchid Wetland.

Activities associated with the Environmental Management Waste Management Facility, Field Research Center activities, and construction and operation of the HEU Materials Facility and Special Materials Complex is anticipated to disturb natural habitat as discussed above during land cleaning activities for new facilities. If the HEU Materials Facility is constructed at Site A, potential impacts may occur to three man-made wetlands approximately 0.4 ha (1 acre) in size. Additionally, construction of the Environmental Management Waste Management Facility would require rerouting of 330 m (1,000 ft) of NT-4, and the associated wetland, approximately 0.4 ha (1 acre) in size, would be impacted by potential construction related sediment and loss of adjacent wooded areas.

The mitigation measures discussed in Section 5.6.6 are intended to minimize the impacts to biological resources that might occur during construction and operation activities associated with this alternative.

5.6.6 Mitigation

For any of the alternatives discussed in Sections 5.6.1 through 5.6.5, potential impacts to terrestrial plant and animal species and wetland areas would be mitigated to avoid or minimize potential impacts. Proposed construction sites would be surveyed for the presence of special status species before construction begins, and mitigation actions would be developed, if appropriate, in consultation with the USFWS and TWRA. Appropriate runoff and siltation controls would be implemented to minimize potential impacts during construction and operation to adjacent wetland areas. Following construction, temporary structures would be removed and the sites reclaimed.

5.7 AIR QUALITY/NOISE

Airborne discharges from Y-12 facilities are subject to regulation by the EPA, TDEC Division of Air Pollution Control, and DOE Orders. Y-12 has a comprehensive air regulation compliance assurance and monitoring program to ensure that airborne discharges meet all regulatory requirements and therefore do not adversely affect ambient air quality. Common air pollution control devices employed include exhaust gas scrubbers, baghouses, and other exhaust filtration systems designed to remove contaminants from exhaust gases before their release to the atmosphere. Process modifications and material substitutions are also made to minimize air emissions.

5.7.1 Nonradiological Air Quality

The assessment of nonradiological air emissions at Y-12 is used to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS) and the rules of Tennessee Department of Environment and Conservation (TDEC) (TDEC 1999a) for criteria pollutants and guidelines for chemical concentrations. Nonradiological air quality impacts were determined by modeling site emissions of criteria and chemical pollutants from the applicable Y-12 mission facility operations. These site-specific emissions were modeled in accordance with the guidelines presented in the EPA Guideline on Air Quality Models (40 CFR 51, Appendix W) using the EPA-recommended Industrial Source Complex model, Version 3 (EPA 1995b) as the most appropriate model to perform the air dispersion modeling analysis from stationary continuous emission sources.

Nonradiological airborne discharges from Y-12 facilities consist of those criteria and chemical pollutant emissions from the Y-12 Steam Plant and chemical emissions that are specific to the alternative under consideration.

Section 176 (c)(1) of the *Clean Air Act* (CAA) requires Federal agencies to assure that their actions conform with applicable implementation plants (in most cases the State implementation plan) for achieving and maintaining the NAAQS for the criteria pollutants, ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, lead, and PM-10 (particulate matter with an aerodynamic diameter less than or equal to 10 microns). In 1993, the EPA issued general conformity regulations (40 CFR 93, Subpart B) that included procedures and criteria for determining whether a proposed Federal action would conform with the State implementation laws. In the first phase a conformity review is undertaken to establish whether conformity regulations would apply to a proposed action/alternatives. If such a review determines the proposed action/alternatives is in an attainment area, the action/alternative is exempt from conformity requirements. The Y-12 site associated with the proposed alternatives lies within an attainment area for all criteria pollutants. Consequently, no further reviews of the proposed action/alternatives are required under the CAA general conformity requirements (DOE 2000c).

Criteria Pollutants Impact Analysis Methodology

Y-12 is classified as a Major Source having the potential to emit 90,720 kg (100 tons) per year or more of regulated air pollutants in accordance with *Rules of the TDEC Chapter* 1200-3-9-.02(11)(b)(14)(ii). Allowable emissions at the Y-12 Steam Plant are greater than 90,720 kg (100 tons) per year of regulated air pollutants for particulates, sulfur oxides, and nitrogen oxides.

Maximum concentrations of the six criteria pollutants included in the primary and secondary NAAQS (40 CFR 50) were assessed, including carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter less than 10 microns in diameter (PM_{10}), sulfur dioxide (SO_2), and ozone (O_3). Gaseous fluorides such as HF, included in the *Rules of TDEC*, were also assessed. Ambient air monitoring data were used to supplement modeled pollutant concentrations for those pollutants for which no emission data were available.

Chemical Emissions Impact Analysis Methodology

In accordance with *Rules of the TDEC Chapter* 1200-3-9.02(11)(b)(14)(i), Y-12 is classified as a major source under Section 112 of the CAA; that is, Y-12 has a potential to emit 9,000 kg (10 tons) per year or more of a hazardous air pollutant (HAP) which has been listed in Section 112(b) of the CAA, or 22,500 kg (25 tons) or more of combined HAPs. For example, Y-12 emits greater than 9,000 kg (10 tons) per year of methanol and greater than 22,500 kg (25 tons) per year for a mixture of HAPs such as benzene, chlorine, hydrochloric acid, hydrogen fluoride (hydrofluoric acid), toluene, etc., where no one pollutant exceeds the 9,000 kg (10 ton) single pollutant threshold (LMES 1997a).

Chemical pollutant concentrations were compared with human health guidelines derived from occupational exposure limits and concentrations corresponding to cancer risks of 10^{-8} risk levels in lieu of established regulatory ambient air quality standards. The chemicals were categorized into two groups, noncarcinogenic chemicals and carcinogenic chemicals, to address the differences in health effects. Each group was evaluated using a screening technique comparing each chemical's estimated emission rate to a health-risk based Threshold Emission Value (TEV). Current dose-to-risk conversion factors and the "best available technology" were used in assessing impacts to human health (Appendix D). Consistent with the human health impacts assessment methodology, appropriate health risk values were used in the chemical process to derive chemical-specific TEVs. Because of different health effects (noncarcinogenic and carcinogenic), two methods were applied to derive chemical-specific TEVs. Chemicals that failed the screening process were assessed in more detail. This approach is consistent with EPA guidance and focuses detailed analyses only on those chemicals of concern that have the potential to cause adverse health effects. Appendix Section E.3 describes in detail the screening methodology used for both noncarcinogenic and carcinogenic chemical emissions.

5.7.1.1 *Alternative 1A (No Action - Status Quo Alternative)*

The following describes the impacts of the No Action - Status Quo Alternative at Y-12 and the surrounding region with respect to nonradiological air quality.
Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA, the TDEC Division of Air Pollution Control, and DOE Orders. Each ORR facility has a comprehensive air regulation compliance assurance and monitoring program to ensure that airborne discharges meet all regulatory requirements and therefore do not adversely affect ambient air quality.

The TDEC performs ambient air monitoring throughout the State of Tennessee and within the vicinity of the ORR. Concentration of regulated pollutants observed during 1999 at locations near the ORR indicate that only the 1-hr ozone concentration exceeds the standards.

The observed concentrations of mercury vapor at Y-12 under the No Action - Status Quo Alternative are well below the ACGIH threshold limit value of 50 $\mu g/m^3$. Annual average mercury vapor concentrations have declined in recent years when compared with concentrations measured from 1986 through 1988. The decrease in ambient mercury recorded at Y-12 since 1989 is thought to be related to the reduction in coal burned at the Y-12 Steam Plant beginning in 1989 and to the completion prior to 1989 of several major engineering projects (e.g., New Hope Pond closure, the PIDAS, Reduction of Mercury in Plant Effluent, and Utility Systems Restoration).

Under the No Action - Status Quo Alternative (for 1998), the average 7-day concentration of uranium at the three Y-12 monitored locations ranged from a low of 0.00001 $\mu g/m^3$ at Station 5 and 8 to a high of 0.00044 $\mu g/m^3$ at Station 4.

The release of nonradiological contaminants into the atmosphere at Y-12 occurs as a result of Plant production, maintenance, and waste management operations and steam generation. TDEC has issued over 50 air permits that cover Y-12 emission sources. The allowable level of air pollutant emissions from emission sources in 1997 under the No Action - Status Quo Alternative was approximately 10,033 tons per year of regulated pollutants. The actual emissions are much lower than the allowable amount (DOE 1999k).

The level of pollutant emissions is expected to decline in the 10-year planning period under Alternative 1A (No Action - Status Quo Alternative) because of the reduced activity levels of Y-12, consolidation efforts, and downsizing of production areas. More than 90 percent of the pollutants under the No Action - Status Quo Alternative are attributed to the operation of the Y-12 Steam Plant. The nonradiological air quality for the criteria pollutants under this alternative is represented by the Y-12 Steam Plant operating at the calculated heat input capacity of 522 million Btu/hr. This heat input capacity represents the actual fuel consumption (coal and natural gas) on February 6, 1996, the coldest day in the last 5 years according to local meteorological data. The calculated criteria pollutant emissions based upon this Y-12 Steam Plant operation are assumed to represent a reasonable upper limit for estimating criteria pollutant concentrations at or beyond the site boundary.

Concentrations of chemical pollutants during normal operations are represented by chemical emissions from the combustion of coal by the Y-12 Steam Plant at the calculated heat input capacity of 522 million Btu/hr and estimates of chemical concentrations based upon the conservative assumption that 100 percent of the chemicals during 1998 are released to the atmosphere from Y-12 facilities. Nonradiological airborne emissions of materials for Y-12 under the No Action - Status Quo Alternative have been estimated and are provided in Chapter 4, Tables 4.7.2–5 and 4.7.2–6.

5.7.1.2 *Alternative 1B* (*No Action - Planning Basis Operations Alternative*)

Criteria Pollutants

The nonradiological air quality for criteria pollutants at Y-12 under Alternative 1B (No Action - Planning Basis Operations Alternative) was represented by the Y-12 Steam Plant emissions using Alternative 1A (No Action - Status Quo Alternative) as a baseline. This is due to the fact that more than 90 percent of the criteria pollutants from Y-12 can be attributed to the operation of the Y-12 Steam Plant (DOE 1999k). The No Action - Planning Basis Operations Alternative provides for Y-12 to operate at planned mission and workload levels.

Emissions from the Y-12 Steam Plant vary throughout the year depending on the demand for steam. To assess the maximum impact to air quality from operation of the Y-12 Steam Plant, the emission rates associated with operation of the facility at the calculated heat input capacity input of 522 million Btu/hr was used as input to the ISC3 model (see Appendix E). The calculated heat input capacity of 522 million Btu/hr represents actual fuel consumption on February 6, 1996, the coldest day in the last 5 years according to local meteorological data.

Maximum background concentrations of criteria pollutants from Tennessee air quality monitors located in Anderson, Knox, and Roane Counties are presented in Table 5.7.1–1. These background concentrations represent concentrations from all nearby sources including the Y-12 Steam Plant. The modeled pollutant concentrations from the Y-12 Steam Plant emissions were added to the background concentrations for the respective pollutant to calculate the percent of standard. The maximum modeled criteria pollutant concentrations do not occur at the location of the monitor for which background concentrations are presented. Therefore, not only do the background concentrations contain contributions from the Y-12 Steam Plant, but the maximum modeled and background concentrations occur at different locations. In addition, the Y-12 Steam Plant emissions are based upon the maximum daily facility operation in the last 5 years, which used twice the average annual rate for use of natural gas at the Steam Plant. The sum of the modeled and background concentrations therefore overestimates the cumulative pollutant concentrations resulting from the background and modeled Y-12 Steam Plant concentrations.

As shown in Table 5.7.1–1, ozone (which is not directly emitted from the Y-12 Plant), exceeds the 1-hour standard at the monitor located at Freels Bend Study Area at Melton Lake. All other criteria pollutant concentrations are below the national and TDEC standards. As discussed above, the criteria pollutant concentrations listed in Table 5.7.1–1 represent a conservative bounding case for Alternative 1B (No Action - Planning Basis Operations Alternative). DOE therefore believes that no adverse direct or indirect air quality impacts are expected for criteria pollutants from activities associated with continuation of Y-12 missions under the No Action - Planning Basis Operations Alternative.

Chemical Emissions

The combustion of coal produces emissions of HAPs as well as criteria pollutants. The Y-12 Steam Plant noncarcinogenic HAP emissions are presented in Table 5.7.1–2. The emission rates are based upon operation of the facility at the calculated heat input capacity of 522 MBtu/hr, AP-42 emission factors for pulverized coal boilers (uncontrolled HAP emissions) (EPA 1995a), and the baghouse efficiency (99 percent) except for mercury, for which no emission controls were assumed.

TABLE 5.7.1–1.—*Modeled Criteria Pollutant Concentrations from the Y-12 Steam Plant Under Alternative 1B (No Action - Planning Basis Operations Alternative)*

Pollutant	Averaging Time	NAAQS Standard (μg/m³/ppm)	Tennessee Standard (μg/ppm)	Maximum Concentration (μg/m³/ppm)	Background Concentration (μg/m³/ppm)	Percent of Standard
Ozone (O_3)	1-hour	235/0.12	235/0.12	NA	240/0.122[a]	102
Carbon Monoxide (CO)	8-hour	10,000/9	10,000/9	52.5/0.002	4,466/39	45
	1-hour	40,000/35	40,000/35	4.3/0.004	12,712/11,1	32
Nitrogen Dioxide	Annual	100/0.053	100/0.53	19.1/0.005	11.3/0.006	20
Sulfur Dioxide (SO_2)	Annual	80/0.03	80/0.03	20.7/0.008	7.9/0.003	36
	24-hour	365/0.14	365/0.14	174.6.8/0.07	49.7/0.019	61
	3-hour	1,300/0.5	1,300/0.5	523.8/0.02	240.8/0.092	59
	30-minute	–	1,021/0.4	NA	NA	NA
Particulate Matter (PM_{10})	Annual	50 μg/m³	50 μg/m³	0.2 μg/m³	30.6	62
	24-hour	150 μg/m³	150 μg/m³	1.5 μg/m³	71	48
Lead	Calendar Quarter	1.5 μg/m³	1.5 μg/m³	NA	0.33 μg/m³	22
Gaseous Fluorides Expressed as (HF)	30-day	–	1.2/1.5	NA	NA	NA
	7-day	–	1.6/2.0	NA	NA	NA
	24-hour	–	2.9/3.5	0.72/0.0009	NA	25
	12-hour	–	3.7/4.5	NA	*NA*	*NA*

[a] Maximum 1-hour ozone concentration for 1998 from Tennessee air quality monitor located in Anderson County at Freels Bend Study Area Melton Lake.
Note: NA - Not Available.
Source: LMES 1997a, 40 CFR 50, TDEC 1999a.

Table 5.7.1–2.—*Y-12 Facility Operations Maximum Boundary and On-Site Noncarcinogenic Hazardous Air Pollutant Chemical Concentrations*

CAS Number	Chemical	Maximum Boundary Concentration (μg/m³)	Maximum On-site Concentration (μg/m³)
007440-48-4	Cobalt and Compounds	3.31×10^{-2}	58.8
007439-92-1	Lead Compounds	3.43×10^{-2}	61.0
007439-97-6	Mercury	1.99×10^{-2}	35.4
000101-68-8	Methylene Bisphenyl Isocyanate	9.82×10^{-2}	175

Note: CAS - Chemical Abstracts Service Registry Number.
Source: LMES 1997a.

Noncarcinogenic chemical emissions from Y-12 operations were also evaluated. An annual chemical concentration was calculated for the Y-12 Site boundary while an 8-hr concentration was calculated for evaluation of impacts to the on-site worker. A 1 gram per second emission rate was modeled from a stack located centrally within the Y-12 complex of facilities. Appendix Table E.3.1–1 presents the stack parameters used in the modeling analysis of Y-12 facility operations.

The noncarcinogenic HAP emission rates for the Y-12 Steam Plant and for Y-12 operations were compared with the respective TEVs as discussed in Appendix Section E.3. If the HAP emission rates were greater than the respective TEV, then the chemical concentration was considered a chemical of concern; conversely, if the concentration was less then the TEV, then the chemical was not considered a threat to public health.

The screening results for the Y-12 Steam Plant are included in Appendix Table E.3.1–2 and shows that none of the four noncarcinogenic HAP emissions (chromium, lead, manganese, and mercury) exceeded the TEV and therefore are not chemicals of concern. The screening results for Y-12 Plant operations, shows that 4 of the 61 evaluated noncarcinogenic HAPs exceed the TEV. Table 5.7.1–2 presents the maximum annual Y-12 Site boundary and on-site maximum 8-hr concentrations representing exposure to the general public and on-site worker, respectively, for those noncarcinogenic HAPs that exceed the screening criteria. The human health impacts of these HAPs are discussed in Section 5.12.

Carcinogenic chemicals released from the Y-12 Steam Plant from burning coal and from Y-12 operations were screened according to the criteria discussed earlier and described in Appendix Section E.3. The results of the screening analysis for the Y-12 Steam Plant are presented in Appendix Table E.3.2–1. In each case, the calculated emission rate is greater than the TEV. The site boundary carcinogenic chemical concentrations from the Y-12 Steam Plant are presented in Table 5.7.1–3, and the human health impacts of these concentrations are evaluated in Section 5.12.

Y-12 operations, in general, are also expected to result in the release of carcinogenic HAPs. Screening was performed on 18 carcinogenic HAPs from Y-12 operations as presented in Appendix Table E.3.2–3. The results of the screening indicate that one carcinogenic HAP (cadmium and cadmium compounds) from Y-12 exceeds the respective TEV. An annual chemical concentration was calculated for the Y-12 Site boundary while an 8-hr concentration was calculated for evaluation of impacts to the on-site worker. Maximum concentrations of cadmium and its compounds for Y-12 Site boundary and on-site locations are presented in Table 5.7.1–4. The human health impacts of these concentrations are discussed in Section 5.12.

Other Activities at the Y-12 Site

In addition to operation of the existing facilities at the Y-12 Site, other activities could affect air quality at Y-12, including the construction and operation of the Environmental Management Waste Management Facility (see Section 3.2.2.2) and the use of Y-12 for the Field Research Center activities (see Section 3.2.2.6). The construction of the Environmental Management Waste Management Facility could have short-term adverse impacts due to fugitive dust emissions with a large portion being due to earth-moving activities and traffic on non-paved roads. The fugitive dust emissions during the construction period could exceed TDEC fugitive dust emissions standards within a few hundred to approximately 1,400 meters of the construction activities if no dust control measures were implemented. However, engineered controls, such as the application of water or chemical dust suppressants and seeding of soil piles and exposed soils, would be implemented to minimize fugitive dust emissions. Based on the activities and the dust control measures, DOE expects that dust emissions at the Y-12 Site boundary would be below the PM_{10} NAAQS at the DOE boundary and only negligible levels of airborne dust would be expected at the nearest residential area.

TABLE 5.7.1–3.—*Y-12 Steam Plant Maximum Boundary Hazardous Air Pollutant Carcinogenic Chemical Concentrations*

Building Number	CAS Number	Chemical	Maximum Boundary Concentration
Y-9401-3	7440-38-2	Arsenic	3.40×10^{-5}
Y-9401-3	7440-41-7	Beryllium	5.10×10^{-6}
Y-9401-3	7440-02-0	Nickel	8.14×10^{-5}

Note: CAS - Chemical Abstracts Service Registry Number.
Source: LMES 1997a.

Table 5.7.1–4.—*Y-12 Facility Operations Maximum Boundary and On-Site Carcinogenic Hazardous Air Pollutant Chemical Concentrations*

CAS Number	Chemical	Maximum Boundary Concentration (μg/m³)	Maximum On-site Concentration (μg/m³)
007440-43-9	Cadmium & Cadmium Compounds	1.42×10^{-2}	2.52×10^{-2}

Note: CAS - Chemical Abstracts Service Registry Number.
Source: LMES 1997a.

Drilling and associated sampling actions of the Field Research Center would not produce significant amounts of fugitive dust. It is expected that these activities would generate much less dust than normal farming practices (which is negligible) in the surrounding Oak Ridge area. Because of the larger number of existing wells and existing research support infrastructure at ORNL, it is anticipated that minimal land disturbance would be required.

Operation of the Field Research Center would use standard, construction best management practices to mitigate any airborne releases. Common measures include application of water for dust suppression and to control fugitive emissions during drilling and other activities. It is anticipated that these and other construction/drilling management practices should adequately control fugitive emissions of radionuclides and any other air pollutants. These actions are not expected to generate criteria pollutants that would not be adequately accounted for by the estimates presented above for the No Action - Planning Basis Operations Alternative. It is not anticipated the Field Research Center activities would result in additional radiological contaminants being released into the atmosphere. Final project plans would be evaluated for applicability of these best management practices and the requirements of any permits would be complied with if required.

Other substances, which could be released into the air at the Field Research Center, include oxygen, hydrogen, nitrogen, and methane. None of these are regulated under state or Federal air regulations. Groundwater collected during the research activities would not be expected to contain pollutants that would volatize into the air. No adverse impacts to air quality would be expected from Field Research Center activities.

5.7.1.3 *Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)*

Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility)

Two potential sites have been proposed for the construction of the HEU Materials Facility: Site A and Site B. Site A (approximately 4 ha [10 acres] in size) is in the Y-12 West Portal Parking Lot, just north of Portal 16 located approximately 300 m (1,000 ft) from the Y-12 Site boundary. Site B, similar in size to Site A, is located in the Y-12 Scrap Metal Yard approximately 760 m (2,500 ft) from the Y-12 Site boundary.

Fugitive dust emissions would result from construction of the new facilities at Sites A or B. Demolition at Site B of Structures 9831, 9720-15, 9814, 9819, 9420, 9420-1, 9627, and 9626 would result in slightly more fugitive dust emissions at Site B compared to Site A.

Emissions during construction at these two sites would be associated with land clearing, drilling, ground excavation, earth moving, and construction of the facility itself. Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operation, and the prevailing meteorological conditions. A large portion of the emissions would result from construction equipment traffic over temporary roads at the construction site. Construction at either site would result in dust emissions that may have a temporary adverse impact on local air quality.

Based on the size of the construction site and the expected construction activities, the 24-hr PM_{10} standard may be exceeded by uncontrolled fugitive dust emissions. Effective control measures commonly used to reduce fugitive dust emissions include wet suppression, wind speed reduction using barriers, vehicle speed, and chemical stabilization. Chemical stabilization alone could reduce emissions by up to 80 percent (EPA 1998). Necessary control measures would be applied to ensure that PM_{10} concentrations remain below applicable standards. The extent of land disturbance and construction equipment-related activity is expected to be less under this alternative than for the Environmental Management Waste Management Facility construction under Alternative 1B (No Action - Planning Basis Operations Alternative). Previous analysis indicates that fugitive dust emissions from the Environmental Management Waste Management Facility would not exceed applicable standards when dust suppression methods are used, and DOE therefore expects that construction of the new HEU Materials Facility would result in similarly low impacts (DOE 1998).

Impacts from operation of a new HEU Materials Facility would not depend on site location. No criteria or toxic pollutants would be generated from the new facility itself. Additional steam-generated heat would be required from the Y-12 Steam Plant; however, because of the conservative assumptions used in Alternative 1A (No Action - Status Quo Alternative), the additional heating requirements for the new HEU Materials Facility would not change the level of emissions estimated for Alternative 1B (No Action - Planning Basis Operations Alternative). Depending on the reuse of vacated HEU storage facilities (shutdown, cold standby, or reuse for some other Y-12 support activity), the additional heating requirement for the new facility could be offset by a reduction in heating requirements for the old facilities.

Alternative 2B (No Action - Planning Basis Operations Plus Upgrade Expansion of Building 9215)

The new addition to Building 9215 would have minimal impact to air quality at Y-12. Construction of the expanded facility would generate fugitive dust that would be mitigated with appropriate control measures similar to that described above for construction activities at Sites A and B to ensure that PM_{10} concentrations remain below applicable standards. Because of the smaller construction area (approximately 2 acres), the type of structure proposed, and the construction activities expected with building the new addition, potential fugitive dust emissions would be less than what would be expected for constructing the new HEU Materials Facility at Site A or Site B.

Operation of the new storage addition to Building 9215 would require additional steam generated by the Y-12 Steam Plant for heating. No criteria or toxic pollutant emissions would be generated from the new building expansion itself. Because of the conservative assumptions used in Alternative 1A (No Action - Status Quo), DOE believes that the additional heating requirements for the building expansion would not change the level of emissions estimated for Alternative 1B (No Action - Planning Basis Operations). Depending on the reuse of vacated HEU storage facilities (shutdown, cold standby, or reuse for some other Y-12 support activity), the additional heating requirement for the upgraded facility could be offset by a reduction in heating requirements for the old facilities.

5.7.1.4 *Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)*

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

Three potential sites are considered for the new Special Materials Complex. Site 1 consists of 8 ha (20 acres) and is located northwest of Building 9114 and on the north side of Bear Creek Road approximately 1,700 ft from the Y-12 Site boundary. Site 2 consists of approximately 8 ha (12.4 acres) and is located at the Y-12 Scrap Metal Yard inside the PIDAS approximately 762 m (2,500 ft) from the Y-12 Site boundary. Site 3 consists of approximately 8 ha (12.4 acres) and is located at the Y-12 Scrap Metal Yard west of the PIDAS approximately 2,500 ft from the Y-12 Site boundary.

Fugitive dust emissions would result from construction at any of the sites. Additional fugitive dust would be generated if Sites 2 or 3 were selected due to demolition of structures 9720-16 and 9720-24 at Site 2 and demolition of structures 9831, 9720-15, 9814, 9819, 9420, 9420-1, 9627, and 9626 at Site 3.

Emissions during construction at any of these three sites would be associated with land clearing, drilling, ground excavation, earth moving, and construction of the facility itself. Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operation, and the prevailing meteorological conditions. A large portion of the emissions would result from construction equipment traffic over temporary roads at the construction site. Construction at the selected site would result in dust emissions that may have a temporary adverse impact on local air quality.

Based on the size of the construction site and the expected construction activities, the 24-hr PM_{10} standard may be exceeded by uncontrolled fugitive dust emissions. Effective control measures commonly used to reduce fugitive dust emissions include wet suppression, wind speed reduction using barriers, vehicle speed, and chemical stabilization. Chemical stabilization alone could reduce emissions by up to 80 percent (EPA1998, Supplement E to AP-42). Necessary control measures would be applied to ensure that PM_{10} concentrations remain below applicable standards. The extent of land disturbance and construction equipment-related activity is expected to be less under this alternative than for the Environmental Management Waste Management Facility activities included under Alternative 1B (No Action - Planning Basis Operations Alternative). Previous analysis indicates that fugitive dust emissions from the Environmental Management Waste Management Facility would not exceed applicable standards when dust suppression methods are used, and DOE therefore expects that construction of the New Special Materials Complex would result in similarly low impacts (DOE 1998a).

Emissions from the beryllium operations in the new Beryllium Facility would be exhausted through a newly designed 99.5 percent pre-filtration system prior to passing through a HEPA filtration system. This should further reduce beryllium emissions below those currently estimated under the No Action - Status Quo Alternative (modeled as 1 gram per year in Appendix E for conservatism). Impacts from operation of the new Special Materials Complex would not depend on site location.

In addition to beryllium emissions, approximately 380 L (100 gal) of acetonitrile emissions are expected from purification operations. Table 5.7.1–5 presents the modeled boundary and on-site concentrations from these emissions. The risk to human health from these pollutants is presented in the human health and worker safety section (Section 5.12).

TABLE 5.7.1–5.—*Maximum Boundary and On-Site Chemical Concentrations from Special Materials Complex Operations*

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	Emissions Rate (g/s)	Maximum Boundary Concentration (μg/m³)		Maximum On-site Concentration (μg/m³)	
					8-hr	**Annual**	**8-hr**	**Annual**
000075-05-8	Acetonitrile	297.42	2.97×10^5	4.19×10^{-2}	1.88	1.61×10^{-2}	28.6	1.65

Source: Appendix E.

5.7.1.5 *Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)*

Fugitive dust emissions would result from construction of the HEU Materials Facility and the Special Materials Complex. Demolition of structures at Site B for the HEU Materials Facility and Sites 2 and 3 for the Special Materials Complex would result in additional fugitive dust emissions.

Emissions during construction at potential sites would be associated with land clearing, drilling, ground excavation, earth moving, and construction of the facilities themselves. Dust emissions would vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions would result from construction equipment traffic over temporary roads at the construction sites. Construction at the related sites would result in dust emissions that may have a temporary adverse impact on local air quality. Because the schedule for construction of the Special Materials Complex would fall after the completion of the major portion of the HEU Materials Facility, the potential fugitive dust emissions would not be additive. Necessary control measures would be applied to ensure that PM_{10} concentrations remain below appropriate standards.

No criteria pollutant emissions would be generated from the HUE Materials Facilities or the Special Materials Complex facilities themselves. Because of the conservative assumptions used in Alternative 1A (No Action - Status Quo Alternative), DOE believes that the additional heating requirements for the new facilities would not change the level of emissions estimated for Alternative 1B (No Action - Planning Basis Operations Alternative). Depending on the reuse of vacated facilities (shutdown, cold standby, or reuse for some other Y-12 support activity), the additional heating requirement for the new facilities could be offset by a reduction in heating requirements for the old facilities.

Other hazardous emissions (i.e., beryllium and acetronitrile associated with various operations of the new Special Materials Complex would be the same as described in Section 5.2.1.4.

5.7.2 Radiological Impacts

Radiological discharges to the atmosphere would occur as a result of the operation of facilities at Y-12. To analyze the impacts of these emissions by alternative, DOE identified the facilities with the potential for radiological emissions and then estimated the amount of emissions that could result based on the projected use of the facilities.

After determining the emissions rates, the CAP88 computer code was used to estimate radiological doses to the MEI, the populations surrounding Y-12, and Y-12 workers. The CAP88 code is a Guassian plume dispersion model used to demonstrate compliance with the radionuclide NESHAP (40 CFR 61). Y-12 specific parameters including meteorological data, source characteristics, and population data were used to estimate the radiological doses. Detailed information on the CAP88 dispersion modeling is presented in Appendix E.4.

5.7.2.1 *Alternative 1A (No Action - Status Quo Alternative)*

The release of radiological contaminants, primarily uranium, into the atmosphere at Y-12 under Alternative 1A (No Action - Status Quo Alternative) occur almost exclusively as a result of plant production, maintenance, and waste management activities. An estimated 0.017 Ci (9.97 kg) of uranium was released into the atmosphere in 1998 as a result of Y-12 activities.

The radiological doses to the MEI and the population surrounding Y-12 were calculated using CAP88-PC model. The detailed input parameters used for the No Action - Status Quo Alternative for the Y-12 Plant are presented in the Radionuclide NESHAP report (DOE 1999k).

Under the No Action - Status Quo Alternative for 1998, six emissions points at Y-12 were modeled; each of these points included one or more individual sources of emissions. The total effective dose equivalent (TEDE) to the hypothetical MEI from Y-12 emissions was estimated at 0.53 mrem, which is 5.3 percent of the 10 mrem per year EPA standard. The MEI for Y-12 is located about 1,080 m (0.7 mi) north-northeast of the Y-12 release point. The collective (population) EDE due to Y-12 emissions was estimated at 4.3 person-rem, which is approximately 35 percent of the collective EDE due to emissions from the entire ORR (DOE 1999k).

5.7.2.2 *Alternative 1B* **(***No Action - Planning Basis Operations Alternative)*

Under Alternative 1B (No Action - Planning Basis Operations Alternative), the annual enriched uranium emissions and other effluents for the period 2001-2010 was assumed to be 65 percent of the 1987 levels (see Section 3.1.2), an increase from Alternative 1A (No Action - Status Quo Alternative) emissions.

The radiological doses to the MEI and the population surrounding Y-12 were calculated using CAP88-PC model. The detailed input parameters used for the No Action - Planning Basis Operations Alternative for the Y-12 Plant are presented in Appendix E.4. The TEDE received by the hypothetical MEI for Y-12 was calculated as 4.5 mrem/yr for the No Action - Planning Basis Operations Alternative. The dose is well below the NESHAP standard of 10 mrem/yr. The MEI is located 1,080 m (3,543 ft) north-northeast of the Y-12 Plant release point. The collective EDE to the population residing within 80 km (50 mi) of Y-12 for Alternative 1B (No Action - Planning Basis Operations Alternative) was calculated to be 33.7 person-rem. The risk to human health associated with the above doses is discussed in the human health section (see Section 5.12). The uranium emission for the No Action - Planning Basis Operations Alternative includes all the emissions from the storage of HEU in existing facilities.

The nonradiological air quality for criteria pollutants under the No Action - Status Quo and No Action - Planning Basis Operations Alternative is represented by the Y-12 Stream Plant operating at the calculated heat input capacity of 522 million Btu/hr. This heat input capacity represents the actual fuel consumption (coal and natural gas) on February 6, 1996, the coldest day in the last 5 years according to local meteorological data. The calculated criteria pollutant emissions based upon this Y-12 Steam Plant operation are assumed to represent a reasonable upper limit for estimating criteria pollutant concentrations at or beyond the Site boundary.

Concentrations of chemical pollutants during normal operations are represented by chemical emissions from the combustion of coal at the Y-12 Steam Plant at the calculated heat input capacity of 522 million Btu/hr and estimates of chemical concentrations based upon the conservative assumption that 100 percent of the purchased chemicals during 1998 are released to the atmosphere from Y-12 facilities.

The collective population doses (person-rem) from air emissions for all the workers (radiological and nonradiological) for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative) are given in Table 5.7.2–1.

The summary of the radiological doses to the workers for the No Action - Status Quo and No Action - Planning Basis Operations Alternatives for each operation and the Y-12 Plant as a whole is presented in Appendix E.4.2. The risk to human health associated with the above doses is discussed in the human health section (Section 5.12).

TABLE 5.7.2–1.—*Radiological Doses for Collective Y-12 Workers*

Operations	Alternative 1A No Action - Status Quo (person-rem)	Alternative 1B No Action - Planning Basis Operations (person-rem)
Enriched Uranium[a]	3.14	5.71
Depleted Uranium	1.78	2.59
Assembly/Disassembly/Quality Evaluation	1.28	1.86
Product Certification	1.2	1.83
Analytical Services	1.30	2.09
Lithium	0.29	0.62
Special Materials Organization	0.36	0.52
Y-12 Plant	41.02	59.48

[a] Includes HEU Storage.
Source: Appendix D and Y-12 1999b.

5.7.2.3 *Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)*

The construction and operation of either the new HEU Materials Facility (Alternative 2A) or the Upgrade Expansion to Building 9215 (Alternative 2B) would result in some radiological emissions. The current design for either option calls for appropriately sized filtered HVAC systems. In addition, the facilities would not have airborne uranium emissions under routine operations because material would be contained in appropriate storage containers. Therefore, DOE believes that the radiological emissions for Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives) would be the same as Alternative 1B (No Action - Planning Basis Operations Alternative). Until a final Safety Analysis Report has been completed for the new facilities, the actual radiological emissions will not be known. However, based on the new facility design and expected operations, these radiological emissions from HEU storage could be lower than the current radiological impacts described under the No Action - Status Quo Alternative. For purposes of analysis, DOE has assumed that the impacts under Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility) and Alternative 2B (No Action - Planning Basis Operations Plus Upgrade Expansion of Building 9215) would remain unchanged from the No Action - Planning Basis Operations Alternative impacts (i.e., 4.5 millirem per year for the MEI, and 33.7 person-rem for the off-site population). The collective dose to the workers (35) under the No Action -

Planning Basis Operations Alternative for the existing HEU Storage Mission is 0.74 person-rem. The collective dose to workers due to relocation of existing stored HEU to the new HEU storage facility is 5.25 person-rem. The collective dose to workers (14) during normal operations due to storage of HEU in the HEU Materials Facility is 0.29 person-rem. The risk to human health associated with the above doses is addressed in the human health section (Section 5.12).

5.7.2.4 *Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)*

The proposed Special Materials Complex would not contribute to the radioactive emissions at Y-12 as the facilities do not handle radioactive materials. Radiological impacts would be the same as described in Section 5.7.2.2 under Alternative 1B (No Action - Planning Basis Operations Alternative).

5.7.2.5 *Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)*

Under this alternative, the collective dose to workers at the Y-12 Plant would be the same as Alternative 1B (No Action - Planning Basis Operations Alternative) and shown in Table 5.7.2–1. There would be a slight decrease in HEU storage mission worker collective dose from 0.74 person-rem to 0.29 person-rem if the HEU Materials Facility were constructed and operated. This reduction is due to the decrease in number of workers from 35 under the No Action - Planning Basis Operations Alternative to 14 workers for the new HEU Materials Facility. The overall collective Y-12 worker dose however would not change from the 59.48 person-rem shown in Tale 5.7.2–1 because of the increased production levels and radiological emissions associated with enriched uranium operations. The Special Materials Complex is a non-rad facility and does not handle radioactive materials.

The MEI and population dose within 80 km (50 miles) of the Y-12 Site under this alternative would be the same as those for Alternative 1B (No Action - Planning Basis Operations Alternative). The dose received by the hypothetical MEI is 4.5 mrem/yr. The collective population dose would be 33.7 person-rem. This would be a substantial increase from Alternative 1A (No Action - Status Quo Alternative) dose to the MEI and population of 0.53 mrem/yr and 4.3 person-rem, respectively. The increase is due to the Y-12 Plant enriched uranium and other stand-down operations resuming to planned and required workload levels under Alternative 1B (No Action - Planning Basis Operations Alternative).

5.7.3 Noise

The process of quantifying the effects of sound begins with establishing a unit of measure that accurately compares sound levels. The physical unit most commonly used is the decibel (dB). The decibel represents a relative measure or ratio to a reference pressure. The reference pressure is a sound approximating the weakest sound that a person with very good hearing can hear in an extremely quiet room. The reference pressure is 20 micropascals, which is equal to 0 (zero) dB.

A-weighted sound levels (dBA) are typically used to account for the response of the human ear. A-weighted sound levels represent adjusted sound levels that are made according to the frequency content of the sound. Figure 5.7.3–1 presents a comparison of decibel levels of everyday events with the threshold of human audibility.

5.7.3.1 *Alternative 1A (No Action - Status Quo Alternative)*

Major noise emission sources within Y-12 include various industrial facilities, equipment and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most Y-12 industrial facilities are at a sufficient distance from the Site boundary so noise levels at the boundary from these sources would not be distinguishable from background noise levels.

The acoustic environment along the ORR Site boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with the day-average sound level in the range of 35 to 50 dBA. Areas near the site within the city of Oak Ridge are typical of a suburban area, with the average day-night sound level in the range of 53 to 62 dBA. The primary source of noise at the Site boundary and at residences located near roads is traffic.

No change in noise impacts is expected during the 10-year planning period under Alternative 1A (No Action - Status Quo Alternative).

TABLE 5.7.3–1.—*Permissible Noise Exposure*

Duration Per Day, hours	Sound Level dBA Slow Response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
½	110
0.25 or less	115

Note: When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

5.7.3.2 *Alternative 1B (No Action - Planning Basis Operations Alternative*)

The No Action - Planning Basis Operations Alternative includes Y-12 mission operations at planned levels, which would represent baseline background noise levels typical of industrial facilities ranging from 50 to 70 dBA. Manufactured noise generated in and around the Y-12 surrounding area includes traffic, generators, air conditioners, and ventilation systems. Under the No Action - Planning Basis Operations Alternative, Y-12 would not experience an appreciable change in traffic noise from the No Action - Status Quo Alternative because the number of workers is not expected to increase. On-site operational noise sources would increase due to increased operation levels from the No Action - Status Quo Alternative. Non-traffic noise sources are located at a sufficient distance from off-site receptors so the contribution to off-site noise levels would continue to be below off-site background levels.

Industrial and construction activities are another source of noise. Some of these activities could affect the occupational health of Y-12 personnel, but measures are in effect to ensure that hearing damage to personnel does not occur. These measures include regulations contained within the *Noise Control Act of 1972* (42 U.S.C.§4901), *Contractor Industrial Hygiene Program* (DOE Order 5480.10), and *Occupational Noise Exposure* (29 CFR 1910.95).

For Y-12 personnel, protection against effects of noise exposure is provided when the sound levels exceed those shown in Table 5.7.3–1 when measured on the A scale of a standard sound level meter at slow response. When employees are subjected to sound exceeding those listed in Table 5.7.3–1, feasible administrative or engineered controls are used. If such controls fail to reduce sound levels within the levels of the table, personal protective equipment (e.g., ear plugs) is provided and used to reduce sound levels within the levels of the table.

Continued compliance measures would be taken to ensure that hearing damage to personnel does not occur. Noise from traffic sources in and around Y-12 would continue unchanged under the No Action - Planning Basis Operations Alternative.

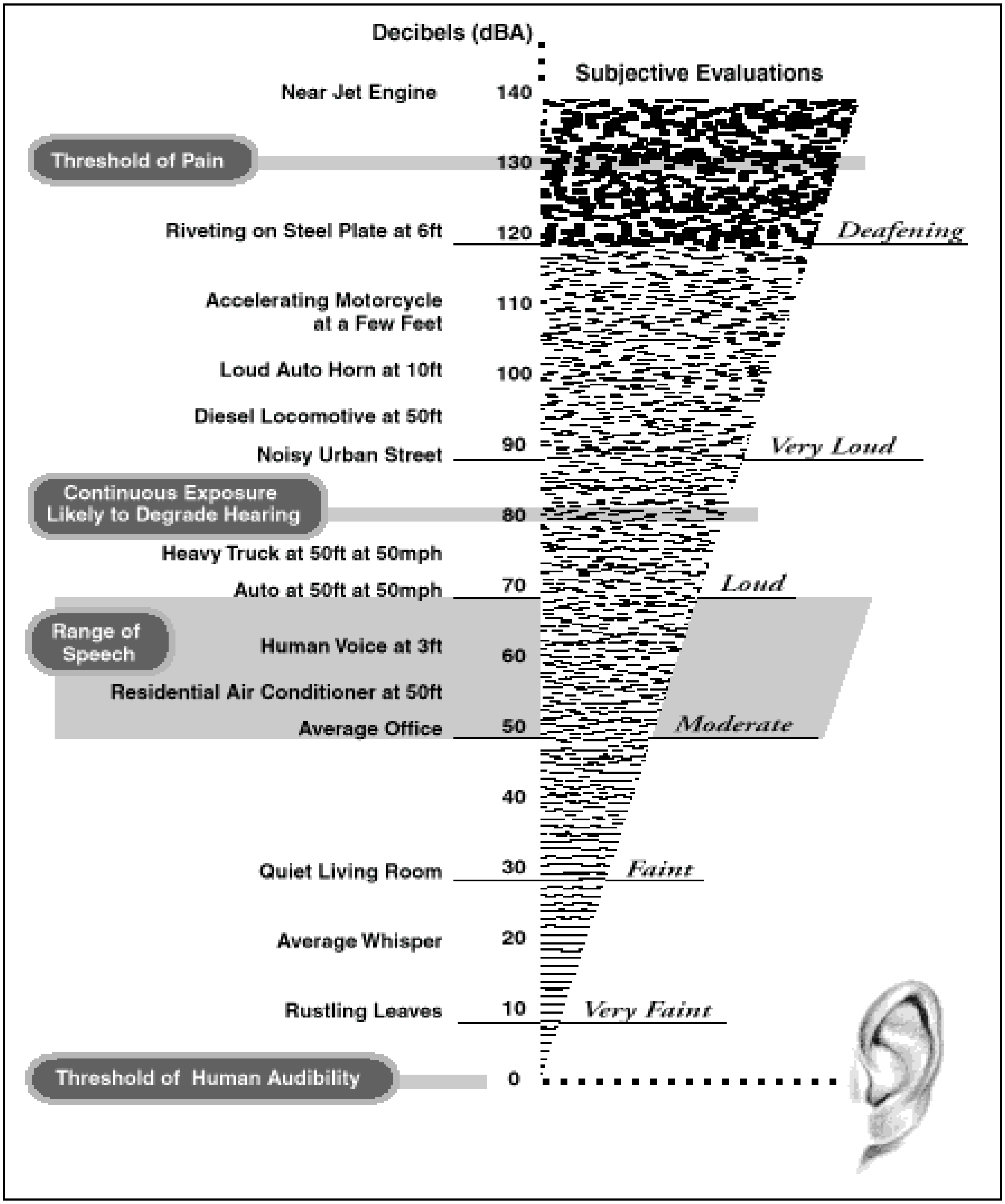
5.7.3.3 *Alternatives 2 and 3 (No Action - Planning Basis Operations Plus HEU Storage Mission and Special Materials Mission Alternatives*)

The on-site and off-site acoustical environments may be impacted during construction and operation of the proposed HEU Materials Facility and the Special Materials Complex. Construction activities would generate noise produced by heavy construction equipment, trucks, power tools, and percussion from pile drivers, hammers, and dropped objects. In addition, traffic and construction noise is expected to increase during construction on-site and along off-site local and regional transportation routes used to bring construction material and workers to the site. The levels of noise would be representative of levels at large-scale building sites. Table 5.7.3–2 describes peak attenuated noise levels expected from operation of construction equipment.

Relatively high and continuous levels of noise in the range of 89 to 108 dBA would be produced by heavy equipment operations during the site preparation phase of construction. However, after this time, heavy equipment noise would become more sporadic and brief in duration. The noise from trucks, power tools, and percussion would be sustained through most of the building construction and equipment installation activities on the proposed facility site. As construction activities reach their conclusion, sound levels on the proposed facility site would decrease to levels typical of daily facility operations (50 to 70 dBA). These construction noise levels would contribute to the ambient background noise levels for the duration of construction, after which ambient background noise levels would return to pre-construction levels.

Sites A and B for the HEU Materials Facility are approximately 520 and 760 m (1,700 and 2,500 ft), respectively, from the Y-12 Site boundary. Sites 1, 2, and 3 for the Special Materials Complex are 305 m (1,000 ft), 760 m (2,500 ft) and 760 m (2,500 ft), respectively, from the Y-12 Site boundary. Peak attenuated noise levels from construction of these facilities would be below background noise levels (53 to 62 dBA) at off-site locations within the city of Oak Ridge as shown in Table 5.7.3–2.

Operation of the HEU Materials Facility and the Special Materials Complex would generate some noise, caused particularly by site traffic and mechanical systems associated with operation of the facility (e.g., cooling systems, transformers, engines, pumps, paging systems, and materials-handling equipment). In general, sound levels are expected to be characteristic of a light industrial setting within the range of 50 to 70 dBA and would be within existing No Action - Status Quo levels. Effects upon residential areas are attenuated by the distance from the facility, topography, and by a vegetated buffer zone.



Source: DOE 1999c

FIGURE 5.7.3–1.—*Decibel Levels Compared to the Threshold of Human Audibility.*

TABLE 5.7.3–2. —*Peak Attenuated Noise Levels (in dBA) Expected from Operation of Construction Equipment*

Source	Peak Noise Level	Distance from Source						
		15 m (50 ft)	30 m (100 ft)	61 m (200 ft)	100 m (400 ft)	305 m (1,000 ft)	518 m (1,700 ft)	762 m (2,500 ft)
Heavy trucks	95	84-89	78-83	72-77	66-71	58-63	54-59	50-55
Dump trucks	108	88	82	76	70	62	58	54
Concrete mixer	108	85	79	73	67	59	55	51
Jackhammer	108	88	82	76	70	62	58	54
Scraper	93	80-89	74-82	68-77	60-71	54-63	50-59	46-55
Bulldozer	107	87-102	81-96	75-90	69-84	61-76	57-72	53-68
Generator	96	76	70	64	58	50	46	42
Crane	104	75-88	69-82	63-76	55-70	49-62	45-48	41-54
Loader	104	73-86	67-80	61-74	55-68	47-60	43-56	39-52
Grader	108	88-91	82-85	76-79	70-73	62-65	58-61	54-57
Dragline	105	85	79	73	67	59	55	51
Pile driver	105	95	89	83	77	69	65	61
Forklift	100	95	89	83	77	69	65	61

Note: 1ft = 0.305 m

Source: Golden et al. 1980.

5.7.3.4 *Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)*

Construction related noise impacts under Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex) would result from relatively high and continuous levels of noise in the range of 89 to 108 dBA. Because of the distance between construction sites and locations relative to Y-12 Plant facilities cumulative noise impacts to Y-12 employees population would be the mitigated to acceptable levels (approximately 70 dBA). Noise impacts to Y-12 workers would be further mitigated by the buildings in which employees were working. However, the number of Y-12 Plant workers exposed to increased construction noise levels under this alternative would be larger (basically the west end of the Y-12 Plant) than under Alternative 1B (No Action - Planning Basis Operations Alternative), Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternative), or Alternative 3A (No Action - Planning Basis Operations Plus Construct and Operate Special Materials Complex). Potential construction activity locations under the alternative are at sufficient distance from the ORR boundary and the city of Oak Ridge to result in no change to background noise levels at these areas.

5.8 SITE FACILITIES AND SUPPORT ACTIVITIES

Changes to site facilities and support activities were assessed by comparing the support requirements of the No Action - Planning Basis Operations Alternative (continue Y-12 mission operations) and the proposed HEU Storage Mission Alternatives and Special Materials Mission Alternative with the existing Y-12 No Action - Status Quo Alternative and Y-12 Site infrastructure capacities and facilities. These assessments focus upon electrical power, fuel requirements, and water usage. Projections of electricity availability, site development plans, and other Y-12 mid- and long-range planning documents were used to project Site infrastructure conditions for the evaluated alternatives. In addition, facilities that could be surplus to DP due to construction of new facilities were identified.

5.8.1 Alternative 1A (No Action - Status Quo Alternative)

The site facility and support requirements for this alternative are taken to be the same as those utilized during the most recent year when uranium operations were in stand-down and complete figures were available (i.e., 1998). Table 5.8.1-1 shows these requirements compared to the capacity of the Y-12 Site. The Site capacity in all cases is appreciably larger than requirements under the No Action - Status Quo Alternative. No adverse impacts are expected from operations under the No Action - Status Quo Alternative.

5.8.2 Alternative 1B (No Action - Planning Basis Operations Alternative)

Alternative 1B (No Action - Planning Basis Operations Alternative) would not result in major upgrades or new construction to DP facilities or operations. Under this alternative, DP and most site program missions would be performed in existing facilities. This alternative would require additional energy usage above that used under Alternative 1A (No Action - Status Quo Alternative) during 1998, principally due to the restart of uranium and other operations which were suspended in 1994. Table 5.8.2-1 shows the projected annual resource requirements for the No Action - Planning Basis Operations Alternative compared to usage under the No Action - Status Quo Alternative for the Y-12 Site.

5.8.3 Alternative 2 (No Action - Planning Basis Operations Plus HEU Storage Mission Alternatives)

Alternative 2A (No Action - Planning Basis Operations Plus Construct and Operate a New HEU Materials Facility)

Under this alternative, a new HEU Materials Facility would be built on either candidate Site A or Site B as described in Section 3.2.3.2. HEU materials storage operations currently located in Buildings 9204-2, 9204-2E, 9204-4, 9215, 9720-5, and 9998 (shown in Figure 5.8.3–1) would be relocated to the new facility regardless of which site is selected. Areas in these buildings vacated by HEU storage operations would be available for other uses or could be declared as excess.

If the new facility is constructed at Site A, electrical and water utilities would be relocated and a sanitary sewer main would be extended to the new facility from a point just west of Building 9703-11. A new comprehensive storm sewer system would be provided with capacity for a 100-year storm; and the system would also accommodate the simultaneous failure of two 5.7 million L (1.5 million gal) water tanks on the south side of Pine Ridge.

If the new facility is constructed at Site B, Buildings 9831, 9720-15, 9814, 9819, 9429, 9420-1, 9626, and 9627 would be demolished. In addition, existing utilities would need to be relocated, including steam and condensate lines that serve the Y-12 WETF and Building 9114; overhead electrical lines, and a 143.8-kV line that runs along Old Bear Creek Road. New utilities would be extended to the new facility from existing tie points.

TABLE 5.8.1–1.—*Y-12 Site Energy and Resource Requirements—Alternative 1A (No Action - Status Quo Alternative)*

Resource	Units	Alternative 1A No Action - Status Quo Usage (1998)	Y-12 Site Capacity
Electrical energy	MWh/yr	377,140	1,752,000
Natural gas	m^3/yr	3,800,000	As needed
Coal	t/yr	78,500	As needed
Steam[a]	kg/hr @ 250 psi	83,900	363,000
Raw water	L/day	17,900,000	20,820,000
Treated water	L/day	15,700,000	26,500,000
Demineralized water	L/day	7,400	545,110
Sanitary sewer	L/day	2,880,000	5,680,000
Compressed air	m^3/min	296	595
Nitrogen	m^3/yr	5,465,000	33,980,000
Oxygen	m^3/yr	94,000	1,388,000
Helium	m^3/yr	63,150	As needed (5,550 m^3 Storage)
Hydrogen	m^3/yr	10,100	As needed (2,550 m^3 Storage)

[a] Average steam load.
Source: LMES 1999d, LMES 2000a.

TABLE 5.8.2–1.—*Y-12 Site Energy and Resource Requirements—Alternative 1B (No Action - Planning Basis Operations Alternative)*

Resource	Units	Alternative 1A No Action - Status Quo Usage (1998)	Alternative 1B No Action - Planning Basis Usage
Electrical energy	MWh/yr	377,140	565,710
Natural gas	m^3/yr	3,800,000	4,000,000
Coal	t/yr	78,500	81,000
Steam[a]	kg/hr @ 250 psi	83,900	103,000
Raw water	L/day	17,900,000	17,900,000
Treated water	L/day	15,700,000	20,200,000
Demineralized water	L/day	7,400	16,880
Sanitary sewer	L/day	2,880,000	2,650,000
Compressed air	m^3/min	296	420
Nitrogen	m^3/yr	5,465,000	8,380,000
Oxygen	m^3/yr	94,000	116,400
Helium	m^3/yr	63,150	67,110
Hydrogen	m^3/yr	10,100	10,100

[a] Average steam load.
Source: LMES 2000a, LMES 1999d.

Alternative 2B (No Action - Planning Basis Operations Plus Upgrade Expansion of Building 9215)

Under this alternative, a new two-story addition would be added to the north end of Building 9215 (see Section 3.2.2.3). HEU materials storage operations currently located in Buildings 9204-2, 9204-2E, 9204-4, 9215, 9720-5, and 9998 (shown in Figure 5.8.3–1) would be relocated to the new storage addition of Building 9215. Areas in these buildings vacated by HEU storage operations would be available for other uses or could be declared as excess.

Construction of the new addition to Building 9215 would not involve removing any major permanent structures since the proposed site is occupied by trailers and temporary facilities. Existing on-site utilities and infrastructure would be tied into the new facility with minimal relocation and modification necessary.

Table 5.8.3–1 shows the construction-related estimated resource requirements for HEU Storage Mission Alternatives. These requirements are small when compared to No Action - Status Quo or No Action - Planning Basis Operations usage and are well within existing Y-12 Site capacity.

Source: Tetra Tech, Inc./LMES 2000b.

FIGURE 5.8.3–1.—*Potentially Affected Facilities Due to Construction of Highly Enriched Uranium Materials Facility or Building 9215 Expansion*.

TABLE 5.8.3–1.—*HEU Storage Mission Alternatives Construction Requirements*

Requirements	New HEU Materials Facility	Upgrade Building 9215
Materials/Resource		
Electrical energy (MWh)	5,000	5,000
Concrete (m^3)	25,100	7,650
Steel (t)	2,100	1,100
Liquid fuel and lube oil (L)	568,000	265,000
Treated Water (L)	7,571,000	5,678,000
Land (ha)	5	1

Source: LMES 2000b.

Table 5.8.3–2 shows the long-term utility usage and resource requirements for the No Action - Planning Basis Operations Alternative along with the projected utility usage and resource requirements for the HEU Storage Mission Alternatives. The projected requirements in this table account only for the new facilities and do not account for potential reductions in utility usage or resource requirements due to demolition or reduced use of excess facilities. Because the existing utility and resource capacity at the Y-12 Site is sufficient to accommodate any projected changes resulting from the operation of a new storage facility, DOE expects no adverse impact on utilities or infrastructure due to the implementation of this alternative.

TABLE 5.8.3–2.— *Annual Operation Requirements for the Alternative 1B (No Action - Planning Basis Operations Alternative) and the HEU Storage Mission Alternatives*

Requirements	Alternative 1A No Action - Status Quo	Alternative 1B No Action - Planning Basis Operations	Alternative 2A HEU Materials Facility	Alternative 2B Upgrade Building 9215	Combined Alternative s 1B and 2A
Electrical energy (MWh)	377,140	565,710	5,900	10,900	571,610
Treated Water (L/day)	15,700,000	20,200,000	1,510	1,975	20,202,200

Source: LMES 2000a, LMES 2000b.

5.8.4 Alternative 3 (No Action - Planning Basis Operations Plus Special Materials Mission Alternative)

No Action - Planning Basis Operations Plus Construct and Operate a New Special Materials Complex

Under this alternative, a new facility would be constructed to fulfill the Special Materials Mission at one of three candidate sites as discussed in Section 3.2.4.2. Special Materials Operations currently located in Buildings 9202, 9731, 9204-4, 9204-2E, 9805-1, 9721-46, 612 (shown in Figure 5.8.4–1) would be relocated to the new facility regardless of which site is selected. Plant storm sewer system, and water, electrical, and other utilities would be extended from within the Protected Area of Y-12. When completed, the new facility would have no overhead utilities.

Source: Tetra Tech, Inc./LMES 2000b.

FIGURE 5.8.4–1. ***Potentially Affected Facilities Due to Construction of Special Materials Complex.***

If Site 2 is selected, Buildings 9720-16, 9720-24, 9720-53, 9824-1, and 9824-2 would be demolished. As with Site 1, a comprehensive storm sewer system would be installed, and utilities would tie into existing systems at the Y-12 Plant.

If Site 3 is selected, Buildings 9831, 9720-15, 9814, 9819, 9420, 9420-1, 9626, and 9627 would be demolished. In addition, several trailers would be moved from the site. As with Sites 1 and 2, a comprehensive storm sewer system would be installed, and utilities would tie into existing systems at the Y-12 Plant.

Table 5.8.4–1 shows the construction-related estimated resource requirements for the proposed new Special Material Complex for the three candidate sites. These requirements are small when compared to usage under the No Action - Planning Basis Operations or No Action - Status Quo Alternative and are well within existing Y-12 Site capacity.

TABLE 5.8.4–1.—*Special Materials Complex Construction Requirements*

Requirements	Site 1	Site 2	Site 3
Materials/Resource			
Electrical energy (MWh)	8,000	8,000	8,000
Concrete (m^3)	13,800	14,500	14,500
Steel (t)	3,000	3,200	3,200
Liquid fuel and lube oil (L)	984,200	1,582,300	1,582,300
Industrial gases (m^3)	5,700	5,700	5,700
Treated Water (L)	5,700,000	5,700,000	5,700,000
Land (ha)	8	5	5

Source: LMES 2000c.

TABLE 5.8.4–2.—*Annual Operation Requirements Special Materials Complex Annual Operation Requirements*

Requirements	Alterative 1A No Action - Status Quo	Alternative 1B No Action - Planning Basis Operations	Alternative 3 New Special Materials Complex	Combined Usage
Electrical energy (MWh)	377,140	565,710	30,400	596,110
Steam kg/hr	83,900	103,000	3,262	106,300
Demineralized Water (L/day)	7,400	16,880	5,393	22,270
Industrial gas				
Helium (m^3)	63,150	67,110	14,725	81,840
Oxygen (m^3)	94,000	116,400	396	116,800
Nitrogen gas (m^3)	5,465,000	8,380,000	1,500,800	9,881,000
Treated Water (L/day)	15,700,000	20,200,000	228,600	20,430,000

Source: LMES 2000a, LMES 2000c.

Table 5.8.4–2 shows the long-term utility usage and resource requirements for Alternative 1B (No Action - Planning Basis Operations) along with the projected utility usage and resource requirements for the proposed new Special Materials Complex. The projected requirements in this table account only for the new facilities and do not account for potential reductions in utility usage or resource requirements due to demolition or reduced use of excess facilities. Because the existing Y-12 Site utility and resource capacity is sufficient to accommodate any projected changes resulting from the operation of a new Special Materials Complex, DOE expects no adverse impact on utilities or Y-12 infrastructure due to implementing this alternative.

5.8.5 Alternative 4 (No Action - Planning Basis Operations Plus HEU Materials Facility Plus Special Materials Complex)

Construction and operation of the new HEU Materials Facility and the Special Materials Complex when combined with No Action - Planning Basis Operations would not have an appreciable impact on the utility usage and resource availability at the Y-12 Site. These combined values are shown in Table 5.8.5-1 which shows that they are all within the Y-12 Site capacities shown on Table 5.8.1-1.

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*

Resource	Units	Alternative 1B No Action - Planning Basis Operations Usage	Alternative 4 Combined Usage
Electrical energy	MWh/yr	565,710	602,050
Natural gas	m^3/yr	4,000,000	4,000,000
Coal	t/yr	81,000	81,000
Steam[a]	kg/hr @ 250 psi	103,000	106,300
Raw water	L/day	17,900,000	17,900,000
Treated water	L/day	20,200,000	20,430,000
Demineralized water	L/day	16,880	22,300
Sanitary sewer	L/day	2,650,000	2,650,000
Compressed air	m^3/min	420	420
Nitrogen	m^3/yr	8,380,000	9,881,000
Oxygen	m^3/yr	116,400	116,800
Helium	m^3/yr	67,110	81,835
Hydrogen	m^3/yr	10,100	10,100

[a] Average steam load.
Source: LMES 2000a, LMES 1999b, LMES 2000c.

CHAPTER 6: CUMULATIVE IMPACTS

Consistent with NEPA, this chapter considers past, present, and reasonably foreseeable actions that could, along with the Y-12 proposed actions for the HEU Storage Mission and Special Materials Mission, result in cumulative impacts to the environment. It considers other ongoing operations at the ORR, actions that might occur in the future at ORR, and actions that are ongoing or planned within the ROI.

6.1 METHODOLOGY AND ANALYTICAL BASELINE

The CEQ regulations that implement the procedural provisions of NEPA define cumulative effects as impacts on the environment that result from the addition of the incremental impact of the action to other past, present, and reasonably foreseeable future actions. These impacts are considered regardless of what agency (Federal or non-Federal) or person undertakes the actions (40 CFR 1508.7). DOE based the cumulative impact analysis in this chapter on proposed Y-12 HEU Storage and Special Materials operations, other actions associated with the ORR, and off-site activities with the potential to contribute to the cumulative environmental impact.

Based on the analysis presented in Chapter 5, DOE has determined that the following resource areas have the greatest potential for cumulative impacts: (1) land use, (2) traffic and transportation, (3) socioeconomics, (4) water resources, (5) air resources, (6) utilities and energy consumption, (7) waste generation, and (8) public and worker health. For purposes of analysis, DOE has used the Y-12 Alternative 1B (No Action - Planning Basis Operations Alternative) as its basis for calculating cumulative impacts. The analysis has been conducted in accordance with CEQ NEPA regulations and the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997a), on the preparation of cumulative impact assessments.

Cumulative impact assessment is based on both geographic (spatial) and time (temporal) considerations. As mentioned above, past impacts are captured in the existing No Action - Status Quo Alternative. Future impacts will be analyzed for the same timeframe (2001 to 2010) as the No Action - Planning Basis Operations Alternative, as described in Section 1.5. Geographic boundaries vary by discipline depending upon the time an effect remains in the environment, the extent to which the effect can migrate, and the magnitude of the potential impact. Based on these factors, DOE has determined that for impacts to air, water, utilities, waste generation, and public and worker health, an 80-km (50-mi) radius surrounding the ORR is the potential impact zone. The impact zone for transportation and socioeconomic resources is a four-county region where over 90 percent of the ORR workforce lives: Anderson, Knox, Roane, and Blount Counties. The impact zone for land use is the ORR and adjoining properties.

The site-wide analysis presented for the Y-12 No Action - Planning Basis Operations Alternative in Chapter 5 may be considered by its scope, an analysis of cumulative impacts. To analyze the effects of continuing the Y-12 missions, ROIs were selected to identify the maximum extent of impacts while still providing a discussion of effects that can be evaluated meaningfully. The discussion that follows is not greatly influenced by the variation in impacts from the HEU Storage Mission or Special Materials Mission alternatives because the differences are not significant and/or there is little or no contribution to impacts from other sources that are in the same ROI as the Y-12 Plant.

Information was gathered from city, county, state, and other Federal organizations concerning future plans for development and to obtain information regarding regional planning efforts. CERCLA and NEPA documents including PEISs, EISs, EAs, FONSIs, and RODs were reviewed to determine if current or proposed projects could affect the cumulative impact analysis for the Y-12 SWEIS. The reasonably foreseeable future action descriptions, included in Section 6.2, were determined from planning documents through communications with ORO personnel and others to identify potential actions that may contribute to cumulative impacts on or in the vicinity of the Y-12 Plant.

6.2 POTENTIALLY CUMULATIVE ACTIONS

In addition to this SWEIS, DOE has prepared other recent NEPA documentation related to the ORR actions that could potentially contribute to the cumulative impact of Y-12 operations and modernization actions. DOE has also identified other reasonably foreseeable actions. The information was based on a review of city, county, state, and Federal information as well as any known plans in the private sector. The potential cumulative environmental impacts are quantified for each action that has available information (see Tables 6.4.4–1, 6.4.5–1, 6.4.7–1, and 6.4.8–1). For those actions which are not yet specifically defined, or are expected to have a negligible contribution to cumulative impacts, the actions are described but not included in the cumulative effects. A discussion of each potentially cumulative action is provided below.

6.2.1 TVA Plants

TVA operates three electric generating facilities within an 80-km (50-mi) radius of ORR: the Bull Run (Anderson County) and Kingston (Roane County) coal-fired steam plants, and the Watts Bar Nuclear Plant (Loudon County). Radiological impacts from the operation of the Watts Bar Plant, a two-unit commercial nuclear power plant, are minimal, but DOE has factored them into the analysis. The Watts Bar Plant is also the planned site for the generation of tritium in support of the Nation's nuclear stockpile. The potential environmental impacts of this action can be found in the *Production of Tritium in a Commercial Light Water Reactor EIS* (DOE 1999b).

6.2.2 Y-12 Site Integrated Modernization Program

As discussed in Section 3.3 of this SWEIS, DOE is considering a number of potential actions that may be implemented in the future as part of the effort to modernize the Y-12 facilities (referred to as Y-SIM). Table 3.3–1 lists the major potential actions including construction of an Enriched Uranium Manufacturing Facility, an Assembly/Disassembly/Quality Evaluation Facility, a Depleted Uranium Operations Facility, a Lithium Operations Complex, and other facilities as needed to meet Y-12 Site mission requirements. Planning and design of these modernized facilities are in the early stages and, thus, no detailed quantitative impacts have been assessed. However, modernized facilities would reduce radiation exposure to workers, incorporate pollution prevention/waste minimization measures in their operation, and reduce emissions to the environment compared to the facilities that are currently operating.

Environmental Restoration (ER) and D&D activities are currently proceeding at Y-12. To the extent that some of these activities have already occurred, some impacts from these activities are reflected within data provided for the No Action - Status Quo Alternative. Cleanup and D&D activities conducted under CERCLA are reviewed through the CERCLA process. While ER and D&D activities would continue to proceed regardless of modernization activities, the timing of some cleanup and D&D activities may, in some instances, be interrelated with the modernization program.

If modernization program actions are implemented, there would be short-term cumulative impacts due to construction activities, which may affect material resources, land use, traffic and transportation, and employment. However, once the potential modernized facilities are operating, DOE expects that through more efficient and safer processes, impacts on workers, the public, and the environment would be reduced. Therefore, implementation of the modernization program will not contribute to long-term cumulative impacts.

6.2.3 Lease of Parcel ED-1, ED-3, and Land and Facilities within the ETTP

DOE completed an EA (DOE 1996a) for the proposed lease of 387 ha (957 acres) of land (Parcel ED-1) within ORR to the East Tennessee Economic Council. The land is located on the ETTP Site about 21 km (13 mi) west of downtown Oak Ridge and Y-12. The East Tennessee Economic Council plans to develop an industrial park on the leased site to provide employment opportunities for DOE and contractor employees affected by decreased Federal funding. Plans are to create approximately 1,500 jobs over the next 10 years and to develop a total of about 202 ha (500 acres).

DOE determined that this action is not a major Federal action that would significantly affect the quality of the human environment. Since no specific industries have been announced, a quantitative assessment of impacts are not available to include in the SWEIS, with the exception of the job opportunities and total acreage described above.

DOE is also considering leasing the 182-ha (450-acre) parcel of land designated as ED-3 for development purposes. The land is located to the south and east of the ETTP. Under this action, the land would be leased through the Community Reuse Organization of East Tennessee to private companies. DOE is preparing an EA on the possible lease of this land. As with ED-1, no specific industries have been announced, and quantitative assessments are not available. Figure 6.2–1 shows the location of parcel ED-1 and ED-3 with respect to the ETTP.

DOE also has prepared an EA concerning the expansion of its leasing program at ETTP (DOE 1997d). DOE's leasing program was established to reindustrialize vacant, underutilized, and/or inactive facilities at the ETTP. The Community Reuse Organization of East Tennessee has subleased, or plans to sublease, these facilities to private sector firms or other organizations for industrial, commercial, office, R&D, manufacturing, and industrial applications.

6.2.4 Construction and Operation of the Spallation Neutron Source

DOE issued a ROD on June 30, 1999 (64 FR 35140) to proceed with the construction and operation of a SNS facility at ORNL. The SNS is an accelerator-based research facility that will provide the U.S. scientific and industrial research communities a source of pulsed neutrons. The facility will be used to conduct research in such areas as materials science, condensed matter physics, the molecular structure of biological materials, properties of polymers and complex fluids, and magnetism. Values for effluent emissions used in the cumulative impact analysis were obtained from the EIS for this action with the assumption that the source would be operating at the 4-MW power level (DOE 1999c). The SNS is currently in the early stages of site preparation and construction.

6.2.5 Surplus HEU Disposition Activities

DOE issued the *Disposition of Surplus Highly Enriched Uranium Final EIS* (DOE 1996b) on June 28, 1996. In the Final EIS, DOE considered the potential environmental impacts of alternatives for a program to reduce global nuclear proliferation risks by blending up to 200 metric tons (440,920 lb) of U.S.-origin surplus HEU down to low enriched uranium to make it nonweapons-usable. The resulting low enriched uranium could either be sold for commercial use as fuel feed for non-defense nuclear power plants, or disposed of as LLW.

Source: Tetra Tech, Inc.

FIGURE 6.2.3–1.—*Locations of Parcels ED-1 and ED*.

DOE issued a ROD to that EIS on August 5, 1996 (61 FR 40619) in which DOE decided to implement the proposed program, which involves gradually blending up to 85 percent of the surplus HEU to a ^{235}U enrichment of approximately 4 percent for eventual sale and commercial use over time as reactor fuel feed, and blending the remaining surplus HEU down to an enrichment level of about 0.9 percent for disposal as LLW. These actions would take place over a 15- to 20-year period. Because one of the sites that could be used for blending purposes was the Y-12 Facility, DOE has considered the potential effects of disposition of surplus HEU on cumulative impacts.

6.2.6 Treating Transuranic/Alpha Low-Level Waste

DOE issued the *Trasuranic Waste Treatment Facility EIS* in June 2000 and its ROD on August 9, 2000 (65 FR 48683). DOE has selected the Low- Temperature Drying Alternative (the preferred alternative in the Final EIS) and will proceed with the construction, operation, and D&D of the TRU Waste Treatment Facility at ORNL. The waste to be treated is legacy waste, i.e., waste generated from past isotope production and research/development that supported national defense and energy initiatives. TRU Waste generated from ongoing ORNL operations will also be treated at the facility. The facility is adjacent to the Melton Vally Storage Tanks, where the waste sludge and supernatant are currently stored. All treated TRU waste will be transported and disposed of at the WIPP while treated LLW transported and disposed of at NTS.

6.2.7 Oak Ridge Area Infrastructure Upgrades and Expansions

DOE Y-12 Water Plant. On May 1, 2000, DOE transferred the Y-12 Water Plant to the city of Oak Ridge. A 1997 feasibility report indicated that the transfer would assure DOE favorable water rates for its Y-12 and ORNL facilities while providing excess capacity to the city (DOE 1997e). The transfer requires approximately 11 new city employees to replace DOE employees at the plant. This transfer has no impact since there is no change in the total number of employees.

West End Utility Expansion. Partners for Progress, a group of public and private organizations, is working to extend the utility infrastructure to make industrial sites in western Oak Ridge more attractive to prospective industries. DOE-ORO has offered to transfer a 61-cm (24-in) water line to the city and to fund water and sewer lines through the Community Reuse Organization of East Tennessee. The plans for the utility expansions are not yet solidified and are not included. However, the transfer of the waterline has no additional impact.

Kerr Hollow Road. The Tennessee DOT is currently converting a section of State Highway 62 between Union Valley and Bethel Valley Roads into a four-lane highway. The work includes a fly-over to connect to Pellissippi Parkway. The section of road involved in the construction is a primary route for Y-12 traffic. Traffic congestion will occur during the 2-year construction period, but the completed project should ease congestion caused by addtional traffic from SNS and TRU Waste Treatment Projects.

I-40 Connector. Within the next decade, a four-lane highway is planned from I-40 in Roane County to downtown Oak Ridge; however, the alternative routes have not yet been identified. The conversion of TSR 58 from a two-lane to a four-lane from I-40 to its intersection with TSR 95 is estimated to be completed in the late spring of 2001. The project would improve access to the ETTP. Traffic congestion will occur during the construction period, but the completed project should ease congestion caused by addtional traffic from SNS and TRU Waste Treatment Projects.

6.3 ACTIONS CONSIDERED BUT NOT INCLUDED

The following actions were considered for inclusion in the cumulative effects analysis but were not pursued further for various reasons. Some were dropped due to the uncertainty of the action, while others due to the lack of relevant data such as resource consumption rates and effluent emission streams to evaluate. These actions are described in detail below.

6.3.1 Remediation of Contaminated Areas in the Melton Valley Watershed

Contamination in the Melton Valley Watershed originated from operations of ORNL and other ORR facilities, including Y-12, over a 50-year period. Numerous active and inactive waste management facilities used by operations at ORNL are located in Melton Valley. ORNL's historic missions of plutonium production and chemical separation during World War II and development of nuclear technology during the post-war era produced a diverse legacy of contaminated inactive facilities, research areas, and waste disposal sites throughout the Melton Valley Watershed that are potential candidates for remedial actions. Any remedial actions would be handled on a case-by-case basis with proper environmental documentation completed prior to the project initiation.

6.3.2 The Joint Institute for Neutron Sciences

The Institute for Neutron Sciences will be funded by the State of Tennessee. The facility will be collocated at the SNS site. the intersection of Bethel Valley Road and Chestnut Ridge Road on the ORR near ORNL. When completed, it will include a hotel, offices, and meeting rooms for visitors to the neutron facilities at ORNL. Impacts from this facility are a subset of the overall impacts from the SNS which have already been analyzed.

6.3.3 Receipt and Storage of Uranium Materials from the Fernald Site

DOE completed an EA and issued a FONSI for the receipt and storage of uranium materials at various DOE sites (DOE 1999e). The material has commercial market value and is currently stored at Fernald but needs to be transferred because of regulatory commitments. Y-12 and the ETTP are candidate sites for its maintenance until it can be marketed. The uranium inventory consists of approximately 6,800 metric tons (15 million lb) of which 800 metric tons (1.8 million lb) is currently in the process of being sold. Although the EA and FONSI have been issued, no decision as to the specific locations for storage have been made. Under the worst case scenario, the entire inventory is moved to the Y-12 Plant, impacts would be minimal since adequate storage facilities already exist for this option. In any event, due to the uncertainty of the action, no further analysis is warranted.

6.3.4 Alternative Strategies for the Long-term Management and Use of Depleted Uranium Hexafluoride UF_6

The long-term management and use of depleted uranium hexafluoride was assessed in a PEIS with the ROD issued on August 10, 1999 (64 FR 43358). The PEIS assessed alternatives for the management of UF_6 currently stored at three sites including ETTP (the old K-25 Site). The total inventory of depleted uranium at ETTP is stored in approximatley 4,700 cylinders. DOE has decided to convert the depleted uranium to uranium oxide, depleted uranium metal, or a combination of both. The material at ETTP would be shipped to a conversion facility, possibly at Paducah, KY or Portsmouth, OH. Any proposal to proceed with the siting, construction, and operation of a facility or facilities will involve additional NEPA review. The impact of continued storage of the material at ETTP is included in the analysis of the No Action - Status Quo Alternative. Until completion of an EIS on the conversion facility, no information is available for further assessments.

6.3.5 Management of Potentially Reusable Uranium Materials at the DOE Management Center

DOE intends to prepare an EIS that addresses the packaging, transportation, receipt, and storage of large quantities of potentially reusable uranium materials that must be moved from various DOE sites due to remediation activities. The potential Oak Ridge storage sites include Y-12, ETTP, and ORNL. However, until DOE issues an NOI defining the scope of the proposed EIS, it is not reasonable to make any assumptions regarding this action and therefore, it is not included in this cumulative analysis.

6.3.6 Disposition of Stockpiled Mercury

The Defense Logistics Agency intends to prepare an EIS on the impacts associated with the disposition of excess mercury that was stockpiled for national defense purposes. Stockpiled mercury is now warehoused at five locations in the United States, including the Y-12 Site. Approximately 675,000 kg (1.5 million lb) of Defense Logistics Agency-managed mercury is collocated with approximately 675,000 kg (1.5 million lb) of DOE-managed mercury at Y-12. DOE is a cooperating agency for the EIS. The impact of continued storage of the mercury at Y-12 is included in the analysis of the No Action - Status Quo Alternative. Until completion of an EIS on the future disposition is completed, no information is available for further assessment.

6.3.7 Environmental Impact Statement - Proposed Route 475

The Federal Highway Administration, in cooperation with the Tennessee DOT, published an NOI on October 28, 1999 (64 FR 58123) to prepare an EIS on a proposal to connect I-40 with I-75. The proposed connection would be from near the current I-40/I-75 interchange in Loudon County, near Lenoir City, Tennessee, to an area north and east in Anderson County, near the interchange of I-75 and TSR 61. The proposed project is considered necessary to improve the operation and safety of these affected interstate highways. Alternatives to be considered include taking no action and three build alternatives consisting of different alignments. Information as to this proposed action's direct impact on the ORR will not be available until completion of the EIS.

6.3.8 Commercial Ventures

A number of independent commercial development ventures are planned in and around ORR in the foreseeable future. The majority of these involve using land at or near ETTP to take advantage of the excess utilities and the highly trained technical personnel available in the area. Most all involve using land rezoned for its intended use and targeting the experienced labor pool available from the ORR community due to the reductions in work done at the DOE facilities. The major impacts of these ventures would be beneficial, with increased employment for the region. As with any commercial undertaking, there is an element of risk involved, and not all may come to fruition. Since none of them directly affect the options for Y-12, it was felt to be too speculative to include them in the current analysis. The following ventures are being considered near ORR and may have a beneficial cumulative impact, but are not specifically included in the analysis for the reasons stated above.

Horizon Center. The Horizon Center has one tenant that has leased an 8.5 ha (21-acre) parcel at ETTP with options on a contiguous 8.5-ha (21-acre) parcel. The tenant, Thermagenics, produces medical isotopes and expects to have substantial R&D efforts in Oak Ridge. Thermagenics could add approximately 140 jobs in the first 3 years of operation.

Boeing Property. Oak Ridge Properties, a limited partnership, is pursuing purchasing from Boeing, Inc. a 492-ha (1,217-acre) undeveloped site located in Roane County north of TSR 58 on the west side of the Clinch River across from ETTP at the K-25 Site. Oak Ridge Properties has proposed a $200 million mixed-use development plan. The development would include approximately 1,500 residential units including houses, apartments, and condominiums, approximately187 ha (450 acres) of industrially zoned property, and a shopping area. A full build-out of this area would pull infrastructure down TSR 58 to the Horizon Center.

The Boeing Property was rezoned from industrial to mixed-use in February 2000. The Oak Ridge Land Company is also pursuing the acquisition of a 74-ha (182-acre) floodplain strip abutting the Boeing Property for use as a buffer zone and green space. DOE controls the floodplain strip and is currently preparing an EA on the transfer of the property to the abutting landowner (86 FR 25711).

Roane Regional Business and Technology Park (Macedonia Site). The Roane Regional Business and Technology Park, also know as the Macedonia Site, consists of 265 ha (655 acres). The site is located in east Roane County, adjacent to I-40 and less than 3 miles from the I-40/I-75 interchange in Loudon County. It is directly across the Clinch River from the ORNL and the Center for Manufacturing Technology. The site's current predominant land use includes pasture and farmland, with approximately three homes scattered throughout the site. The technology park is an area proposed for medium industrial development (i.e., information technology, instrumentation, computers, and metal work). The total site area is 265 ha (655 acres), total lot area of 231 ha (570 acres), developable lot areas of 172 ha (426 acres), 41 lots, and 25 ha (61 acres) of greenbelt. Roane County officials have signed a contract with Highway Inc. of Cookeville, commencing the first of three construction phases of the technology park: Phase I includes clearing the site; widening, straightening and adding shoulders to Buttermilk Road; and installing sewer, water and gas services. Employment is speculative, but projected around 2,500-5,000 jobs with 500 - 600 as a result of the first phase.

ClientLogic. ClientLogic, a Canadian information technology company, has hired 412 people at its 1,393 m^2 (15,000 ft^2) facility in Commerce Park. ClientLogic is in the process of constructing a new building in Commerce Park to house an additional 500 employees.

Home Depot. Home Depot has purchased property off Laboratory Road for a store that will open in the first quarter of 2001 and will employ between 120 to 200 full- and part-time employees.

Bechtel Jacobs Company. As part of Bechtel Jacobs Company's investment in the local economy, a total of 1,500 jobs now exist in Anderson, Roane, Knox, and Blount counties as the result of $50 million generated in payroll. All jobs are in the private sector outside of ETTP.

6.4 CUMULATIVE IMPACTS BY RESOURCE AREA

The following sections indicate that future potentially adverse cumulative impacts contributed by the Y-12 Plant HEU Storage Mission and Special Materials Mission alternatives are minimal. Many components of the proposed actions would ultimately result in more efficient operations, resulting in potentially less air emissions, water pollution, and soil contamination due to the cleanup of contaminated sites. The population projections for the years 1990 through 2010 indicate that the surrounding counties will experience population growth from 7 percent to 31 percent (growth projection: Roane County 31 percent; Loudon County 17 percent, and Knox County 7 percent) with the exception of Anderson County, which is projected to decrease by approximately 3 percent (TEDC 1999c). Therefore, pressure will continue to be exerted on all resources and impact areas but continuing the Y-12 Plant Mission and alternatives associated with the HEU Storage Mission and Special Materials Mission would add very little to regional impacts.

6.4.1 Land Use

The ROI for cumulative effects to land use is the ORR and adjoining properties. No cumulative effects have been identified under the No Action - Planning Basis Operations Alternative since the continued operation of Y-12 do not represent a change in land use. The Y-12 Plant missions would continue to be compatible with the historical mission of industrial use and research. However, with the addition of the new Special Materials Complex, one of the sub-alternatives (Site 1) would result in a change in land use. Approximately 4 ha (10 acres) of this site is wooded and would require clearing. The change in land use will not result in an impact to cumulative effects as it would not affect land use activities outside the ORR boundary.

Construction of the SNS on ORR would require clearing a 45-ha (110-acre) greenfield site between Y-12 and ORNL and changing its use from Mixed Research/Future Initiatives to Institutional/Research. Construction of a TRU Waste Treatment facility adjacent to the Melton Valley Storage tanks at ORNL would require developing 5 acres of a brownfield site with no change in land use classification. Neither of these would impact land use on the Y-12 site or outside the ORR boundary.

6.4.2 Transportation

Transportation is not expected to be affected from the continuation of the Y-12 Plant missions. The Y-12 Plant work force is not forecasted to appreciably increase over current employment levels. Therefore, Y-12 Plant employees related traffic would increase, if any, minimally. The required construction work force tends to arrive earlier at the job site and is not expected to add notably to the number of vehicles during the workday rush-hours.

Construction of the SNS with a peak workforce of 578 will increase traffic on ORNL access roads by approximately 7 percent. Operation of the SNS at the 4-MW level with a workforce of 375 would increase traffic on the same roads by approximately 5 percent. The construction and operation of the TRU Waste Treatment facility will have less of an impact with only a peak construction workforce of 97 and operations workforce of 88. Traffic problems will arise due to the increase in construction traffic, which is unavoidable and short term, but to an extent, controllable. Increases in workers for the new facilities will cause more traffic congestion but the road improvements previously described will greatly help to alleviate this congestion.

Special shipments to and from ORR of materials such as TRU Waste, Surplus HEU, and cylinders containing depleted uranium hexafluoride can be controlled so as to avoid or minimize traffic congestion caused by the cumulative impact with other activities at ORR. Transportation problems of these shipments outside of ORR have been covered in their individual EIS's.

6.4.3 Socioeconomics

The ROI for the cumulative impact analysis is the four-county area in Tennessee consisting of Anderson, Knox, Loudon, and Roane Counties. More than 90 percent of the ORR work force resides in this area.

No adverse socioeconomic impacts, direct or indirect, have been identified from the continuation of the Y-12 Plant missions. Y-12 Plant operation and use of production, storage, and support buildings at the Y-12 Plant would not result in the hiring of substantial numbers of additional operational personnel. Therefore, there would be no cumulative impacts from continuation of the Y-12 Plant missions and operations under the No Action - Planning Basis Operations Alternative.

Under the HEU Storage Mission and Special Materials Mission Alternatives, DOE does not expect adverse cumulative impacts because the construction and operation work force associated with the missions could be supplied from within the ROI, as discussed in Section 5.3.

The separate analyses for the large projects, SNS and TRU waste treatment, have shown no adverse socioeconomic impacts from their construction and operation. Competition between these and other independent commercial developments for construction resources within the ROI could cause some project delays and perhaps a temporary influx of workers from outside of the region. Many of these developments are designed to create jobs to take advantage of the existing job pool resulting from the overall downsizing of the ORR workforce.

6.4.4 Water Resources

Table 6.4.4–1 summarizes the estimated cumulative radiological doses to human receptors from exposure to waterborne sources near ORR. Liquid effluents from Y-12 could contain small quantities of radionuclides that would be released to the UEFPC. The exposure pathways considered in this analysis included drinking water, fish ingestion, shoreline exposure, swimming, and boating. As discussed in Chapter 5, the action alternatives would not cause increased releases of radiological contaminants.

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*

Activity	MEI Dose (mrem per year)	Population Dose (person-rem per year)	Population Latent Cancer Fatalities
Oak Ridge Reservation[a]	2.7	48	0.024
Surplus HEU Disposition	0	0	0
Watts Bar Nuclear Plant[b]	0.26	1.2	0.0006
Spallation Neutron Source[c]	NR[d]	NR	NR
Cumulative Effect	NA	50	0.025

[a] Values include contributions from Y-12, ETTP, and ORNL.
[b] Includes contribution from tritium production at Watts Bar.
[c] Values are conservatively based on the 4-MW power level.
[d] NR=None reported. The Spallation Neutron Source is designed to have no releases of radioactive liquid effluents.
Source: DOE 1999k; DOE 1996b, DOE 1999c; DOE 1999b.

The estimated cumulative dose from all ORR activities to the maximally exposed member of the public from liquid releases would be 2.7 mrem per year from drinking water, fish ingestion, shoreline exposure, swimming and boating. By comparison, the DOE order 5400.5 standard for all exposure pathways is 100 mrem per year. Adding the population doses associated with current and projected ORR activities would yield a cumulative annual dose of 48 person-rem from liquid sources. This translates into 0.024 LCF for each year of exposure of the year 2000 estimated population of 880,000 living within an 80-km (50-mi) radius of the ORR. The addition of the dose from the Watts Bar Nuclear Plant cannot be directly added to the ORR MEI dose due to the spatial definition of the MEI dose. Operation of the TRU Waste Treatment Facility would eliminate the primary source of groundwater contamination in the Solid Waste Storage Area 5 North. This would reduce the overall values listed for ORR.

As discussed in Section 4.5, a number of Y-12 facilities discharge treated wastewater into EFPC via NPDES-permitted outfalls. NPDES Compliance Monitoring studies of water quality and biota downstream of these outfalls suggest that discharges from these facilities have not degraded the water quality (DOE 1999k).

6.4.5 Air Resources

DOE also evaluated the cumulative impacts of airborne radioactive releases in terms of dose to an MEI at the Y-12 Site boundary. Table 6.4.5–1 lists the results of this analysis. The cumulative dose to the maximally exposed member of the public would be 6.9 mrem per year, using the very conservative assumption that the same individual could receive the maximum dose from all activities.

The population doses from current and projected Y-12 activities, and other actions listed in Table 6.4.5–1 could yield a total annual cumulative dose of about 56 person-rem from airborne sources. The total annual cumulative dose translates into 0.03 LCF for each year of exposure for the year 2000 projected population of 537,708 living within an 80-km (50-mi) radius of the ORR.

TABLE 6.4.5–1.—*Estimated Average Annual Radiological Doses and Resulting Health Effects to Off-Site Population from Airborne Releases*

Activity	MEI Dose (mrem/yr)	Population Dose (person-rem/yr)	Population Latent Cancer Fatalities
ORNL	0.69	6.0	0.003
ETTP	0.068	2.0	0.001
Y-12	4.5	34	0.017
Surplus HEU Disposition	0.039	0.16	$8x10^{-5}$
Watts Bar Nuclear Plant[a]	0.078	0.57	0.0003
Spallation Neutron Source[b]	1.5	13	0.0065
Tru Waste Treatment Facility	0.023	0.12	$6x10^{-5}$
Cumulative Effect	6.9	56	0.03

[a] Includes contribution from tritium production at Watts Bar.
[b] Values are conservatively based on the 4-MW power level.
Source: DOE 1999k; DOE 1996b; DOE 1999c; DOE 1999b. DOE/EIS/0305.

DOE also evaluated the potential for cumulative impacts from nonradiological air emissions. As shown in Section 5.1.7, the operation of the Y-12 Steam Plant is the dominant source of nonradiological air emissions for Y-12. When the emissions from this facility are examined, the off-site concentrations are well below regulatory standards. Other facilities in the area that have the potential for nonradiological emissions have little or no spatial overlap with any emissions plume that originates from Y-12. Therefore, DOE does not expect adverse cumulative impacts due to nonradiological air emissions.

6.4.6 Utilities and Energy

As discussed in Chapter 5, the actions under any of the alternatives in this SWEIS would not cause appreciable increases in utility usage. TVA has excess electrical capacity to accommodate future uses at Y-12 and the ORR, and DOE would ensure that other site infrastructure needs were met. The installed capacity of site utilities is much greater than the current or projected usage, to include those actions considered in Section 6.2. Therefore, DOE does not expect adverse cumulative impacts to utility usage and infrastructure capacities.

6.4.7 Waste Generation

Table 6.4.7–1 lists cumulative volumes of LLW, mixed LLW, hazardous waste, and sanitary/industrial wastes that the Oak Ridge ROI would generate. The values are based on the *1998 Annual Report of Waste Generation and Pollution Prevention Progress* (DOE 1999i), the SNS EIS, and the *Production of Tritium* *in a Light Water Reactor EIS*. The Y-12 waste volumes are based on the No Action - Planning Basis Operations Alternative values presented in Section 5.11.

As stated in Chapter 5, LLW would be generated from maintenance, radiological surveys, and production activities, and mixed and hazardous waste would be generated from maintenance and production activities. The waste volumes generated by other actions shown in Table 6.4.7-1 when combined with the waste generated from proposed actions in the Y-12 SWEIS would not exceed existing ORR and offsite waste management facilities capacities and capabilities for treatment, disposal and/or storage. Therefore, DOE does not expect any adverse cumulative impacts on waste management facilities. The impact of the large increases in LLW and hazardous waste from the SNS are covered in its own EIS (DOE 1999c).

TABLE 6.4.7–1.—*Estimated Annual Volumes of Waste Generated by Actions in the Oak Ridge Area*

Activity	Low-level waste (m^3/yr)	Mixed low-level waste (m^3/yr)	Hazardous waste (m^3/yr)	Sanitary/Industrial waste (m^3/yr)
ORNL[a]	290	33	42	1,592
ETTP[a]	120	800	4	1,105
Y-12[b]	1,987	1,040	26	4,330
ORR Total (ORNL, ETTP, and Y-12)	2,397	1,873	72	7,027
Surplus HEU Disposition	825	50	90	19,800
Watts Bar Nuclear Plant[c]	41	<1	1.0	860[d]
Spallation Neutron Source[e]	34,000	18	40	1,350
TRU Waste Treatment Facility[f]	556	4.6	<1	375
Cumulative Effect	37,819	1,946	203	29,412

[a] Source: DOE 1999i.
[b] Based on estimates for the Y-12 Site No Action - Planning Basis Operations in Chapter 5 and assuming a density of 1000 kg/m^3.
[c] Includes contribution from tritium production at Watts Bar. Source: DOE 1999b.
[d] This value is expressed as kilograms instead of cubic meters in the source document. The conversion to cubic meters was done assuming a density of 1,000 kg/m^3 .
[e] Values are conservatively based on the 4-MW power level. Source: DOE 1999c
[f] Approximately 607 m^3 of treated TRU waste would result from the 5 years of operation of this facility. In addition, 5,550 m^3 of industrial waste would result from D&D of the facility after its operational life. Source: DOE/EIS/0305.

6.4.8 Public and Worker Health

Table 6.4.8–1 summarizes the cumulative radiological health effects of routine ORR operations and proposed DOE actions. The values listed in this table describe the impacts resulting from proposed DOE actions. In addition to estimated radiological doses to the hypothetical MEI and the off-site population, Table 6.4.8–1 lists potential LCFs for the public and workers due to exposure to radiation. The cumulative effect for the general population is shown as a small (less than 5 percent) increase over that from ORR alone. The worker effects are not additive, but site-specific.

TABLE 6.4.8–1.—*Estimated Annual Radiological Impacts to Off-site Population and Facility Workers*

Activity	MEI Dose (mrem/yr)	Population Dose (person-rem/year)	Population Latent Cancer Fatalities	Collective Worker Dose (person-rem/year)	Worker Latent Cancer Fatalities
ORR Total[a]	8.0	90	0.045	125[b]	0.06
Surplus HEU Disposition[c]	0.039	0.16	$8x10^{-5}$	11.3	0.005
Watts Bar Nuclear Plant[d]	0.34	1.8	0.009	110	0.045
Spallation Neutron Source[e]	1.5	1.3	0.0065	370	0.2
TRU Waste Treatment Facility [f]	0.023	0.12	$6x10^{-5}$	6.2	0.003
Cumulative Effect	NA	94	0.047	NA	NA

[a] Includes Y-12, ETTP, and ORNL. Source: DOE 1999k.
[b] Includes 106.5 person-rem for 1998 ORR Operations (40.61 person-rem attributable to Y-12) and accounts for the Y-12 Site No Action - Planning Basis Operations contribution of 59.5 person-rem (see Table D.2.3.2–1).
[c] Source: DOE 1996b.
[d] Includes contribution from tritium production at Watts Bar. Source: DOE 1999b.
[e] Values are conservatively based on the 4-MW power level. Source: DOE 1999c.
[f] Values based on the preferred alternative (Low Temperature Drying). Source: DOE/EIS/0305

CHAPTER 7: STATUTES, REGULATIONS, CONSULTATIONS, AND OTHER REQUIREMENTS

This chapter provides information concerning the environmental standards that regulate or guide proposed plans for Y-12. This section presents primary environmental compliance requirements that would result from implementation of the proposed action or alternatives. These requirements are found in Federal and state statutes, regulations, permits, approvals, and consultations and in Executive and DOE Orders, consent orders, FFCAs, and a Federal Facility Agreement. These citations identify the standards to be used for evaluating the ability of the alternative actions to meet the environmental, safety, and health requirements and for obtaining required Federal and state permits and licenses.

Y-12 was constructed during the 1940s and 1950s, when national security requirements were the dominant considerations for facilities design and operation. In the interim, emphasis on operational safety, worker heath and safety, and public and environmental health and safety has resulted in DOE shifting resources to achieve compliance with all applicable requirements. Today, both Federal and state agencies have several types of regulatory authority over Y-12 operations because of compliance agreements between DOE and regulators. These agreements detail schedules for achieving compliance with applicable environmental, health, and safety requirements.

At Y-12, the application of evolving requirements to facilities that are more than 40 years old makes achieving or maintaining compliance an expensive challenge. However, all facilities at Y-12, whether they are newly constructed or existing, must comply with the increasing number and complexity of regulations. Any action to continue operations or to change operations at Y-12 must comply with the applicable environmental, safety, and health regulations.

An overview of the roles and regulations of DOE, Federal, and state agencies is provided in the following sections. Section 7.1 presents Federal and state environmental, safety, and health regulating agencies in which DOE must cooperate in operation of Y-12 facilities. Section 7.2 presents the regulatory requirements employed by DOE and the cooperating regulators to help guide decisions and determine regulatory compliance for continued operation as well as for the SWEIS proposed action and alternatives. Section 7.3 identifies and discusses regulations requiring DOE consultations with other agencies that may also be required to be completed as part of this SWEIS.

7.1 REGULATORY FRAMEWORK

Federal and state governments mandate environmental, safety, and health requirements for operations at Y-12 through the U.S. Congress, Federal agencies, Executive Orders, the Tennessee State Legislature, and state agencies. Federal statutes establish national programs and policies, create broad legal requirements, and authorize Federal agencies to promulgate regulations that conform to the statutes. Detailed implementation of these statutes is delegated to various Federal agencies including DOE, EPA, Department of Transportation (DOT), and the U.S. Department of Labor. Executive Orders are issued by the President and establish policies and requirements for Federal Executive Branch agencies, but do not have the force of law or regulation. Many programs under the jurisdiction of the EPA, such as permitting and enforcement, go to state agencies with EPA retaining oversight of the delegated program.

State legislatures issue their own statutes to authorize and mandate promulgation of state regulations. State statutes, like Federal statutes, establish broad legal requirements. State regulations, developed by state agencies, then promulgate specific requirements to enforce state statutes. In Tennessee, statutes passed by the Tennessee State Legislature are found in the Tennessee Codes Annotated. Most state regulations for environmental requirements are in chapter 1200 of the TDEC Rules (TDEC 199a).

7.2 STATUTES AND REGULATIONS

NEPA requires that before action is taken at Y-12, the proposed action and alternatives be evaluated for their environmental impact. Regulatory environmental protection requirements are designed to protect human health and the environment, including the air, water, and land. Identification of environmental protection statutes, regulations, and orders with requirements that would be triggered by the alternatives is one means for examining actions that may harm the environment before making a decision to carry out an action. Principal requirements are identified by the applicable environmental statutes, regulations, and approval requirements. Compliance with these requirements would allow DOE to accomplish the actions being considered to at least a threshold level of safety. It does not evaluate the significance of the potential effects, but does provide a basis for relative comparison between the alternatives.

The Atomic Energy Act of 1954 (42 U.S.C. §2011 *et seq*.) makes the Federal government responsible for regulatory control of production, possession, use, and disposal of source, special nuclear, and radioactive material. Included in this responsibility is authorization for DOE to establish standards that protect health and minimize danger to life or property from activities under DOE's jurisdiction. The *Federal Compliance with Pollution Control Standards*, Executive Order 12088, requires Federal agencies, including DOE, to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the CAA, *Noise Control Act*, *Clean Water Act*, *Safe Drinking Water Act*, TSCA, and RCRA. The *General Environmental Protection Program*, DOE Order 5400.1, establishes the environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with applicable protection laws and regulations, executive orders, and internal DOE policies. It establishes formal recognition that DOE's environmental management activities are extensively, but not entirely, regulated by EPA and state and local environmental agencies, and it provides requirements for satisfying these externally imposed regulations. DOE must comply with applicable Federal and state requirements to the same extent as any other entity. Noncompliance with these requirements can lead to enforcement actions. As a result, all environmental protection and compliance activities at Y-12, with the exception of radioactive materials, are externally regulated by other Federal and state agencies.

7.2.1 Federal and State Environmental Statutes and Regulations

Applicable regulatory environmental laws and regulations can be categorized by environmental pathways: air, water, land (which includes waste management and pollution prevention), and the subsequent impact to worker safety and health, the public, and the natural environment. Table 7.2.1-1 lists Federal statutes, Executive Orders, and state statutes that pertain to control, remediation, and/or regulation of the environment and worker safety, grouped by the resources to which each requirement pertains. For most requirements identified, the statute and corresponding regulatory citations are listed. The description providing the basic environmental actions resulting from each of the Federal and state statutes and Executive Orders is also provided.

DOE is committed to fully comply with all applicable environmental statutes, regulatory requirements, and Executive and internal orders. Table 7.2.1–2 lists the most pertinent DOE Directives (orders, manuals, and notices) for implementation of ES&H regulations.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 1 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Air Resources				
Clean Air Act, as amended	42 U.S.C. § 7401 *et seq.*	40 CFR Subchapter C	EPA	Requires sources to meet standards and obtain permits to satisfy NAAQS, Tennessee State Implementation Plans, Standards of Performance for New Stationary Sources, NESHAP, and Prevention of Significant Deterioration.
Tennessee Air Quality Act	TCA, Sect. 53-3408 *et seq.*	TDEC Rules 1200-3	TDEC, Division of Air Pollution Control	Permits required to construct, modify, or operate an air contaminant source; sets fugitive dust requirements.
National Ambient Air Quality Standards/State Implementation Plans	42 U.S.C. § 7409 *et seq.* 42 U.S.C. § 7410	40 CFR 50-52	EPA	Includes requirements for compliance with primary SOx, NOx, CO, O_3, Pb and particulate matter and secondary ambient air quality standards and emission limits/reduction measures as designated in each state's implementation plan. Additional emission standards under 40 CFR 63 are also applicable.
Air Pollution Control	TCA, 68-201-105, 4-5-202	TDEC Rules 1200-3-3	TDEC, Division of Air Pollution Control	Adopts the primary NAAQS of Federal regulations for state enforcement.
Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances	Executive Order 12843		DOE/EPA	Requires Federal agencies to minimize procurement of ozone depleting substances and comply with Title VI of CAA Amendments with respect to stratospheric ozone protection and to recognize the limited availability of Class I substances until final phaseout.
Greening the Government through Efficient Energy Management	Executive Order 13123		EPA	Calls for Federal agencies to reduce greenhouse gas emissions by 30 percent and establish energy improvement goals.
Standards of Performance for New Stationary Sources	42 U.S.C. § 7411	40 CFR 60	EPA	Establishes control/emission standards and record keeping requirements for new or modified sources specifically addressed by a standard.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 2 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
National Emission Standards for Hazardous Air Pollutants	42 U.S.C. § 7412	40 CFR 61	EPA	Requires sources to comply with emission levels of radiological, carcinogenic, or mutagenic pollutants; may require a preconstruction approval, depending on the process being considered and the level of emissions that will result from the new or modified source.
Hazardous Air Contaminants	TCA, 68-201-105, 4-5-202 *et seq.*	TDEC Rules 1200-3-11	TDEC, Division of Air Pollution Control	Adopts the primary NESHAP of Federal regulations for state enforcement.
Prevention of Significant Deterioration	42 U.S.C. § 7470 *et seq.*		EPA	Applies to areas that are in compliance with NAAQS. Requires comprehensive preconstruction review and the application of Best Available Control Technology to major stationary sources (emissions $100 t/yr) and major modifications; requires a preconstruction review of air quality impacts and the issuance of a construction permit from the responsible state agency setting forth emission limitations to protect the Prevention of Significant Deterioration increments.
Noise Control Act of 1972	42 U.S.C. § 4901 *et seq.*	40 CFR Subchapter G	EPA	Requires facilities to maintain noise levels that do not jeopardize the health and safety of the public.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 3 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Water Resources				
Clean Water Act, as amended	33 U.S.C. § 1251 *et seq.*	40 CFR Subchapter D	EPA	Requires EPA or state-issued permits and compliance with provisions of permits regarding point source and nonpoint source discharge of effluents to surface water or other activities affecting water quality.
Tennessee Water Quality Control Act	TCA, 69-3-101 *et seq*., 70-324-70	TDEC Rules 1200-4	TDEC, Divisions of Groundwater Protection, Water Pollution Control, Water Supply	Establishes state authority to issue new or modify existing NPDES permits required for a water discharge source and mandates protection of water quality.
National Pollutant Discharge Elimination System (Section 402 of *Clean Water Act*)	33 U.S.C. § 1342	40 CFR 122	EPA	Requires permit to discharge effluents (pollutants) and storm waters to surface waters; permit modifications are required if discharge effluents changed.
Tennessee National Pollutant Discharge Elimination System	TCA, 69-3-108	TDEC Rules, 1200-4-10	TDEC, Division of Water Quality	In accordance with 33 U.S.C. 1342, Tennessee enforces an EPA-authorized state program that administers both Federal and state requirements for point and nonpoint source discharges to surface water.
Dredged or Fill Material (Section 404 of CWA)	33 U.S.C. § 1344	33 CFR 320, 325, 326, 329, 330, 335-338	COE	Requires permits to authorize the discharge of dredged or fill material in wetlands and to authorize certain work in or structures affecting wetlands.
Aquatic Resource Alteration		TDEC Rules, 1200-4-7 *et seq.*	TDEC, Division of Water Quality	Any activity which involves the alteration of waters of the state typically requires a state aquatic resource alteration permit, including activities in, but not limited to, wetlands, culverts, and road crossings over surface water.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 4 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Safe Drinking Water Act	42 U.S.C. § 300h-3	40 CFR 31, 34, 35, 124, 125, 143-146, 233, 270, 271	EPA	Requires permits for construction/operation of underground injection wells and subsequent discharging of effluents to ground aquifers and establishes minimum standards for drinking water at the tap.
Safe Drinking Water Act	TCA, 68-221-701	TCEC Rules, 1200-5-1	TDEC, Division of Water Supply	Adopts the Federal standards for drinking water.
Cultural Resources				
National Historic Preservation Act, as amended	16 USC 470 *et.seq.*	C7 CFR 656, 36 CFR 61, 63, 65, 68, 78, 79, 800-811	DOE, Tennessee Historical Commission (SHPO), Advisory Council on Historic Preservation (ACHP)	Requires the DOE to take into account the effect of it's actions on the historic properties present. Requires consultation with SHPO and interested parties regarding determinations of effect and in mitigations developed to avoid or minimize adverse effects to cultural resources. The ACHP may choose to participate in the consultation and any subsequent agreements.
Archaeological Resource Protection Act, as amended	16 USC 470aa *et seq.*	43 CFR 7	DOE, SHPO	Requires a permit for the removal of archaeological resources from public land. If archaeological resources are discovered during construction, provides penalties for unauthorized removal or destruction.
Native American Graves Protection and Repatriation Act	25 USC 3001	43 CFR 10	DOE, Native American tribe(s), SHPO	Describes the procedures to be followed if Native American cultural items and human remains are discovered during construction and the conditions under which these items can be removed or excavated.
American Indian Religious Freedom Act (AIRFA)	42 USC 1996		DOE, Native American tribe(s)	AIRFA affirms the right of Native Americans to have access to their sacred places. AIRFA promotes consultation with Indian religious practitioners to identify, maintain access, and avoid impacts to places of religious importance to Native Americans.
Indian Sacred Sites	Executive Order 13007	NA	DOE, Native American tribe(s)	Requires the DOE to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 5 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Curation of Federally Owned and Administered Archaeological Collections	16 U.S.C. 470 et seq.	36 CFR 79	DOE	Requires the DOE to take responsibility for the curation of archaeological collections that are recovered from lands under it's control or from DOE projects. The DOE must assure through funding agreements and inspections that archaeological collections are properly curated in an facility that meets the standards outlined in the regulations.
Tennessee Burial Law	TCA 39-17-311, TCA 39-17-312		DOE, local law enforcement and coroner	Provides for the respectful treatment of human remains that may be encountered during construction excavation.
Tennessee Native American Cemetery Removal and Reburial	TCA 11-6-116	0400-9-1	DOE, Tennessee Commission on Indian Affairs, SHPO	Provides additional guidance for the removal and reinternment of Native American human remains that may be encountered during construction excavation.
Soil/Waste Management				
Resource Conservation and Recovery Act/Hazardous and Solid Waste Amendments of 1984	42 U.S.C. § 6901 *et seq.* 42 U.S.C. § 6991	40 CFR Subchapter I	EPA	Requires notification and permits for operations involving hazardous waste treatment, storage, or disposal facilities; changes to site hazardous waste operations could require amendments to RCRA hazardous waste permits involving public hearings.
Tennessee Hazardous Waste Management Act	TCA 68-46-101 *et seq*., 68-211-101& 1001 *et seq*., 68-212-101 *et seq*., 68-215-107, 4-5-202	TDEC Rules, 1200-1-11, 14, 15	TDEC, Divisions of Solid Waste Management, Hazardous Waste Management, Underground Storage Tanks	Tennessee is authorized by EPA to administer and enforce hazardous waste standards; the Tennessee RCRA requirements mirror the Federal RCRA requirements.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 6 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Toxic Substances Control Act	15 U.S.C. § 2601 *et seq.*	40 CFR Subchapter R	EPA	Provisions of TSCA require inventory reporting and chemical control provisions to protect the public from the risks of exposures to chemicals; strict limitations on use and disposal imposed on polychlorinated biphenyl, lead-based paint, and asbestos-contaminated equipment and material.
Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act of 1986	42 U.S.C. § 9601 *et seq.*	40 CFR Subchapter J	EPA	Requires cleanup and notification if there is a release or threatened release of a hazardous substance; requires DOE to enter into Interagency Agreements with EPA and state to control the cleanup of each DOE site on the National Priorities List.
Superfund Implementation	Executive Order 12580	3 CFR 33 CFR 1, 138, 153 40 CFR 35, 300, 303-305, 307 44 CFR 220-222	DOE/EPA	DOE shall comply with the National Contingency Plan in addition to the other requirements of the Order, as amended.
Worker Safety and Health				
Occupational Safety and Health Act	29 U.S.C. 651 *et seq.*, 655	29 CFR Chap. XVII	OSHA	Employers shall comply with all applicable worker safety and health standards including, but limited to, requirements for protection from physical and chemical hazards, training, medical monitoring as needed, and information available such as Material Safety Data Sheets.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 7 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Chronic Beryllium Disease Prevention Program Final Rule December 8, 1999	42 U.S.C. § 2011 (i)(3), 29 U.S.C. 688	10 CFR Part 850	DOE	Establishes a chronic beryllium disease prevention program (BDPP) that supplements and is integrated into existing worker protection programs that are established for DOE employees and contractor employees.
Radiological				
Atomic Energy Act of 1954	42 U.S.C. § 2011 *et seq*.	10 CFR 835, 830, 120, 820	DOE	DOE shall develop and follow its own standards and procedures, particularly with respect to radioactive substances, to ensure the safe operation of its facilities.
Nuclear Waste Policy Act of 1982	42 U.S.C. § 10101 *et seq.*	40 CFR 191, 194	DOE	DOE shall complete all required permits and dispose of spent nuclear fuel, high level, and TRU radioactive waste; certification and compliance of Waste Isolation Pilot Plant.
Low Level Radioactive Waste Policy Act	42 U.S.C. § 2021b - 2021d	NA	DOE/TDEC	DOE shall dispose of low-level radiological waste off-site in accordance with State of Tennessee rules.
Occupational Radiation Protection	42 U.S.C. § 2201; 7191	10 CFR 835	DOE	Establishes limits for worker exposure to radioactivity.
Other				
National Environmental Policy Act of 1969, as Amended/Council on Environmental Quality Regulations Implementing the Procedural Provisions of NEPA	42 U.S.C. § 4321 *et seq.*	10 CFR 1021 40 CFR 6 40 CFR Subchapter V	CEQ	DOE shall implement NEPA and comply with the Council on Environmental Quality procedures.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 8 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Hazardous Material Transportation Act	49 U.S.C. § 5101 *et seq.*	49 CFR Chapter 1 Subchapters A & C 40 CFR 263	DOT	DOE shall comply with the requirements governing hazardous materials and waste transportation.
Hazardous Materials Transportation Uniform Safety Act of 1990	49 U.S.C. § 5105	10 CFR 71 49 CFR 173, 174, 397	DOT	Restricts shippers of overland route-controlled quantities of radioactive materials to use-only permitted carriers.
Emergency Planning and Community Right-to-Know Act of 1986 (SARA Title III)	42 U.S.C. § 11001 *et seq.*	40 CFR 350-374	EPA	Requires the development of emergency response plans and reporting requirements for chemical spills and other emergency requirements covering storage and use of chemicals which are reported in toxic chemical release forms.
Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements	Executive Order 12856	NA	DOE/EPA	Requires Federal agencies to achieve 50 percent reduction of agency's total releases of toxic chemicals to the environment and offsite transfers, to publicly report toxic chemicals entering any waste stream from Federal facilities, including any releases to the environment, and to improve local emergency planning, response, and accident notification.
Pollution Prevention Act of 1990	42 U.S.C. 13101 & 13102	NA	EPA	Establishes a national policy that pollution should be reduced at the source; requires DOE to submit a toxic chemical source reduction and recycling report for Y-12, a facility required to file an annual toxic chemical release form under section 313 of SARA.
Federal Facility Compliance Act of 1992	42 U.S.C. § 6961	40 CFR 255	TDEC	Waives sovereign immunity for Federal facilities under RCRA and requires DOE to develop plans and enter into agreements with states as to specific management actions.

TABLE 7.2.1–1.—*Major Federal and State Requirements Regulating Environmental Control Remediation and Worker Safety Arranged by Topic* [Page 9 of 9]

Statute/Regulation/ Order	Statute Citation	Regulatory Citation	Responsible Agency	SWEIS-Level Potential Applicability; Permits, Approvals, and Notifications
Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition	Executive Order 13101	NA	DOE	States a national policy preference for pollution prevention (reducing the generation of waste at its source) over waste recycling, treatment, and disposal. If pollution prevention is not feasible, waste should be recycled or treated in an environmentally safe manner. Disposal should be used only as a last resort. The Secretary of Energy is required to incorporate waste prevention and recycling into daily operations. In addition, DOE must implement cost-effective procurement programs that favor the purchase of environmentally preferable products and services. There are products or services with a lesser or reduced effect on human health and the environment compared to competing products and services used for the same purposes. This EO would require the incorporation of waste prevention and recycling into construction and operation of the proposed HEU Materials Facility or Upgrade Expansion of Building 9215, and the Special Materials Complex, consistent with the demands of efficiency and cost-effectiveness.
Federal Compliance with Pollution Control Standards	Executive Order 12088		Office of Management and Budget/DOE/ EPA	Requires Federal agency landlords to submit to the Office of Management and Budget an annual plan for the control of environmental pollution and to consult with EPA and state agencies regarding the best techniques and methods.

TABLE 7.2.1–2.—*Selected Department of Energy Directives*

DOE Directive	Directive Title
5400.1	General Environmental Protection Program
5400.5	Radiation Protection of the Public and the Environment
5480.4	Environmental Protection, Safety, and Health Protection Standards
5480.19	Conduct of Operations
5480.21	Unreviewed Safety Questions
5480.22	Technical Safety Requirements
5480.23	Nuclear Safety Analysis Reports
5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements
5530.1A	Accident Response Group
5530.4	Aerial Measuring System
470.2A	Security and Emergency Management Independent Oversight and Performance Assurance Program
5632.1C	Protection and Control of Safeguards and Security Interests
M 231.1 Chg 2	Environment, Safety, and Health Reporting Manual
N 441.1	Radiological Protection for DOE Activities
O 151.1 Chg 2	Comprehensive Emergency Management
O 232.1A	Occurrence Reporting and Processing of Operations Information
O 414.1A	Quality Assurance
O 420.1 Chg 2	Facility Safety
O 430.1A	Life Cycle Asset Management
O 435.1	Radioactive Waste Management
O 440.1A	Worker Protection Management for DOE Federal and Contractor Employees
O 450.5	Line Environment, Safety and Health Oversight
O 451.1A	*National Environmental Policy Act Compliance Program*
O 460.1A	Packaging and Transportation Safety
O 460.2 Chg 1	Departmental Materials Transportation and Packaging Management
O 470.1 Chg 1	Safeguards and Security Program

7.2.2 Other Pertinent Laws and Requirements

DOE has entered into agreements with Federal and state regulatory agencies that have substantive provisions in effect for Y-12. These agreements establish a schedule, the means, interim conditions or actions for achieving full compliance at the DOE facility. Table 7.2.2-1 lists environmental agreements with Federal and state regulatory agencies that have substantial provisions in effect for Y-12.

7.3 CONSULTATION

Some environmental laws and Executive Orders are integrated into the NEPA process and establish guidelines for review. Pursuant to NEPA and DOE Regulations (10 CFR 1021), consultations are conducted with outside Federal and state agencies having jurisdiction or special expertise. Agencies involved include those responsible for protecting significant resources, such as, endangered species, critical habitats, or historic resources. Federal and state agencies with jurisdiction or expertise in these areas have been, and will be, consulted during the development of the Y-12 SWEIS. Representatives of Federal and state agencies were involved in scoping activities for this SWEIS and will be consulted in the preparation of the Final Y-12 SWEIS. Copies of letters from DOE inviting the participation of consulting agencies and response letters received by DOE are included in Appendix C.

Table 7.3-1 provides laws and Executive Orders that involve consultation for this SWEIS and that are applicable to the Y-12 proposed actions and alternatives. Accompanying each law or Executive Order is a brief description of the purpose of the cited statutes and the consultation occurring for the current Y-12 proposed actions and alternatives.

TABLE 7.2.2–1.—*Agreements Between DOE-ORO and Other Regulatory Agencies*

Areas of Agreement	Regulation for Which Agreement Reached	Regulatory Agency	Explanation and Summary of Agreement
TSCA Storage Requirements for PCBs	40 CFR 761.65	EPA and TDEC	PCBs and PCB-contaminated items with concentration above 50 ppm must be disposed of within 1 year. Agreement set milestones for disposal of various PCB-contaminated materials, providing wastes could be stored for more than 1 year provided milestones met and complete disposal of all PCB wastes be achieved before the year 2016.
Programmatic Agreement on Historic Preservation	16 U.S.C. 470	TSHPO	A Programmatic Agreement for the Management of Historical and Cultural Properties at the ORR, Memorandum of Agreement, was executed on May 6, 1994. The three-party agreement was among DOE/ORO, the Tennessee State Historic Preservation Officer (TSHPO) and the National Advisory Council on Historic Preservation to fulfill DOE's responsibilities under Section 106 and 110 of the *National Historic Preservation Act*.
Mixed Waste	40 CFR 268.50	EPA and TDEC	Storage of RCRA LDR waste for other than accumulation of sufficient quantities to facilitate proper recovery, treatment, or disposal is prohibited. Storage of mixed LDR wastes pending development of treatment capacity is not an approved reason for accumulation. EPA granted a national capacity variance for mixed LDR wastes; however, the variance expired on May 8, 1992. In June 1992, an agreement to make past, present, and future LDR waste generation and storage facilities on the ORR in compliance with environmental laws. Mixed waste covered in this agreement includes flammable and corrosive liquids, solvents, paint waste, waste oils and organics, and solid mixed wastes.
DOE-ORO Placed on the National Priorities List on November 21, 1989, and effective December 21, 1989	NA	EPA and TDEC	As a result of the listing, DOE entered into an agreement (effective date January 1, 1992). Agreement coordinates RCRA corrective actions underway with response action under CERCLA to ensure comprehensive remediation at ORR. Environmental media and inactive facilities known or suspected to contain hazardous material would be addressed under this agreement pursuant to CERCLA or RCRA.
National Historic Preservation Act, as amended	36 CFR 800	DOE, Tennessee Historical Commission (SHPO), Advisory Council on Historic Preservation (ACHP)	Programmatic Agreement (1994). Allows an alternative compliance procedure for NHPA requirements for certain routine and/or repetitive activities defined in the agreement. Commits DOE-ORO to the preparation of a Cultural Resource Management Plan to address compliance with the full range of cultural resource requirements.

TABLE 7.3–1.—*Applicable Laws and Executive Orders Y-12 Proposed Action and Alternatives* [Page 1 of 5]

Statute/Executive Order	Statute Citation	Regulatory Citation	Consulting Agency	SWEIS- Applicability; Consultations, and DOE involvement
Endangered Species Act	16 U.S.C. 1531 *et seq.*	19 CFR 10, 12 30 CFR 773 32 CFR 190 43 CFR 8340 50 CFR 17, 23, 81, 225, 230, 402, 424, 450-453	USFWS	Ensures that actions authorized, funded, or carried out by DOE are not likely to jeopardize the continued existence of any federally listed threatened or endangered species or destroy or adversely modify their critical habitat. A biological assessment and a Section 7 Endangered Species Consultation for proposed activities included in the SWEIS shall be conducted by DOE in consultation with the U.S. Fish and Wildlife Service.
Endangered and Threatened Wildlife and Plant/Interagency Cooperation		50 CFR 17 50 CFR 402	USFWS	Describes interagency implementation regulations for the *Endangered Species Act*.
Migratory Bird Treaty Act, as amended	16 U.S.C. 703 *et seq.*	30 CFR 773 50 CFR 14, 20	Department of the Interior, USFWS	Federal statute mandates protection of sensitive or otherwise regulated wildlife species making it unlawful to pursue, hunt, take, capture, or kill (or attempt any of the preceding) any migratory bird, nest, or eggs of such birds.
Taking Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants/Migratory Bird Hunting		50 CFR 10 50 CFR 20	USFWS	Implementation regulations for the *Migratory Bird Treaty Act*.

TABLE 7.3–1.—*Applicable Laws and Executive Orders Y-12 Proposed Action and Alternatives* [Page 2 of 5]

Statute/Executive Order	Statute Citation	Regulatory Citation	Consulting Agency	SWEIS- Applicability; Consultations, and DOE involvement
National Historic Preservation Act, as amended	16 U.S.C. 470	7 CFR 656 36 CFR 61,63, 65, 68, 78, 79, 800-811	SHPO	Protects sites with significant national historic value, placing them on the National Register of Historic Places (NRHP). DOE, as a governmental agency, must locate and inventory historic properties and cultural resources under their jurisdiction prior to undertaking an activity that might remove or alter their appearance. As required by Section 106 of the *National Historic Preservation Act* and per DOE's Memorandum of Agreement with the TSHPO, proposed Y-12 activities shall be evaluated in consultation with the SHPO.
National Historic Preservation	Executive Order 11593	NA	DOE	DOE, in consultation with the Advisory Council on Historic Preservation (16 U.S.C. 470i), is to institute procedures to assure Federal plans and programs that contribute to historic preservation and to proactively interact with the SHPO to identify structures, buildings, and properties to nominate for listing in the NRHP.
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. 3001	43 CFR 10	CIN	Tribal descendants shall own American Indian human remains and cultural items discovered on Federal lands after November 16, 1990. Notification of tribal governments by DOE is required if and when items are discovered during an activity at Y-12 or elsewhere on the DOE ORR.
Protection of Wetlands	Executive Order 11990	NA	USACE	Federal activities are required to avoid short- and long-term adverse impacts to wetlands whenever a practicable alternative exists.
Floodplains Management	Executive Order 11988	NA	USACE	DOE is directed to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken. Impacts to floodplains are to be avoided to the extent practicable.

TABLE 7.3–1.—*Applicable Laws and Executive Orders Y-12 Proposed Action and Alternatives* [Page 3 of 5]

Statute/Executive Order	Statute Citation	Regulatory Citation	Consulting Agency	SWEIS- Applicability; Consultations, and DOE involvement
Wetland Protection and Floodplain Management		10 CFR 1022	DOE	Regulations establish requirements for compliance with Executive Orders 11990 and 11988. No floodplain impacts are identified for the SWEIS; wetland impacts are under consultation.
Right-to-Know Laws and Pollution Prevention Requirements	Executive Order 12856	NA	DOE	Expands the 33/50 Pollution Prevention Program (*Superfund Amendments and Deauthorization Act*, Section 313). Under the expanded program, DOE is requiring each of its sites to establish site-specific goals to reduce the generation of all waste types. This order also requires DOE to (1) report toxic chemicals entering waste streams; (2) improve emergency planning, response, and accident notification; and (3) encourage clean technologies and the testing of innovative pollution prevention technologies.
Environmental Justice	Executive Order 12898	NA	DOE	Federal entities are directed to identify and address disproportionately high adverse human health or environmental impacts on minority and low-income populations resulting from an agency's program, policies, or activities. Data must be collected, analyzed, and made publicly available on race, national origin, and income level of populations in areas surrounding the Federal facility expected to have a substantial environmental, human health, or economic effect. Environmental justice issues for Y-12 have been identified and addressed prior to preparation of this SWEIS, are further addressed through this SWEIS; the policies requirements of this Executive Order remain applicable to future actions at Y-12.

TABLE 7.3–1.—*Applicable Laws and Executive Orders Y-12 Proposed Action and Alternatives* [Page 4 of 5]

Statute/Executive Order	Statute Citation	Regulatory Citation	Consulting Agency	SWEIS- Applicability; Consultations, and DOE involvement
Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition	Executive Order 13101	NA	DOE	States a national policy preference for pollution prevention (reducing the generation of waste at its source) over waste recycling, treatment, and disposal. If pollution prevention is not feasible, waste should be recycled or treated in an environmentally safe manner. Disposal should be used only as a last resort. The Secretary of Energy is required to incorporate waste prevention and recycling into daily operations. In addition, DOE must implement cost-effective procurement programs that favor the purchase of environmentally preferable products and services. There are products or services with a lesser or reduced effect on human health and the environment compared to competing products and services used for the same purposes. This EO would require the incorporation of waste prevention and recycling into construction and operation of the proposed HEU Materials Facility or Upgrade Expansion of Building 9215, and the Special Materials Complex, consistent with the demands of efficiency and cost-effectiveness.
Greening the Government Through Leadership in Environmental Management	Executive Order 13148	NA	EPA	Gives responsibility to each Federal agency for ensuring that all necessary actions are taken to integrate environmental accountability into agency day-to-day decisionmaking and longterm planning processes, across all agency missions, activities, and functions. Environmental management must be considered in all Federal Government policy making, operations, planning, and management. The goals set forth by this EO focus on pollution prevention through the development of effective environmental management systems; establishment of environmental compliance audit programs and policies; implementation of Community Right-To-Know; reductions in both the use of release of toxic chemicals, hazardous substances, and other pollutants; reductions in the use of ozone-depleating substances; and promotion of environmentally and economically beneficial landscaping. Under this EO, DOE is required to implement these goals through effective pollution prevention practices and the introduction of new technologies that will reduce waste and toxic chemicals for both current and future operations at the Y-12 Plant to the extent practical.

TABLE 7.3–1.—*Applicable Laws and Executive Orders Y-12 Proposed Action and Alternatives* [Page 5 of 5]

Statute/Executive Order	Statute Citation	Regulatory Citation	Consulting Agency	SWEIS- Applicability; Consultations, and DOE involvement
Greening the Government through Federal Fleet and Transportation Efficiency	Executive Order 13149	NA	EPA/DOE/OMB/GSA	The purpose of this EO is to ensure that the Federal Government exercises leadership in the reduction of petroleum consumption through improvements in fleet fuel efficiency and the use of alternative fuel vehicles (AFVs) and alternative fuels. Each agency operating 20 or more motor vehicles within the U.S. shall reduce it's entire fleets annual petroleum consumption by at least 20 percent by the end of FY 2005 (compared to FY 1999 levels). This EO lists a number of strategies to achieve this reduction and requires Federal agencies to use alternative fuels to meet fuel requirements of AFVs (established by section 303 of *Energy Act of 1992*) by the end of FY 2005. This EO also calls for an increase in the average EPA fuel economy rating of passenger cars and light trucks acquired by at least 1 mile per gallon (mpg) by the end of FY 2002 and at least 3 mpg by the end of FY 2005 (compared to FY 1999 acquisitions).
Federal Workforce Transportation	Executive Order 13150	NA	EPA/DOT/Treasury Dept/OMB/GSA	Directs DOT, EPA, and DOE to implement a "transit pass" transportation fringe benefit program as part of a three-year Nationwide Pilot Program no later than October 1, 2000. Before extending the program to other Federal agencies and their employees nationwide, results from the pilot program will be analyzed by an entity to be determined by the consulting agencies to determine if it is effective in reducing single occupancy vehicle travel and local area traffic congestion. Federal agencies are encouraged to use any nonmonetary incentive that the agencies may otherwise offer under any other provision of law or other authority to encourage mass transportation and vanpool use. Under this EO, DOE is required to implement a carpool program for all Federal employees working at ORR facilities, including the Y-12 Plant.

Notes: EO - Executive Ord

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CHAPTER 11: GLOSSARY

Absorbed dose: The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. Expressed in units of radiation absorbed dose or grays, where one radiation absorbed dose equals 0.01 gray. Also, see "radiation absorbed dose."

Acute exposure: The exposure incurred during and shortly after a radiological release. Generally, the period of acute exposure ends when long-term interdiction is established, as necessary. For convenience, the period of acute exposure is normally assumed to end 1 week after the inception of a radiological accident.

Air pollutant: Any substance in air which could, if in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne.

Air Quality Control Region (AQCR): Geographic subdivisions of the United States, designed to deal with pollution on a regional or local level. Some regions span more than one state.

Air quality standards: The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area.

Alpha activity: The emission of alpha particles by fissionable materials (uranium or plutonium).

Alpha particle: A positively charged particle, consisting of two protons and two neutrons, that is emitted during radioactive decay from the nucleus of certain nuclides. It is the least penetrating of the three common types of radiation (alpha, beta, and gamma).

Ambient air: The surrounding atmosphere as it exists around people, plants, and structures. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

Aquifer: A saturated geologic unit through which significant quantities of water can migrate under natural hydraulic gradients.

Archaeological sites (resources): Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

Artifact: An object produced or shaped by human workmanship of archaeological or historical interest.

As low as reasonably achievable (ALARA): A concept applied to the quantity of radioactivity released in routine operation of a nuclear system or facility, including "anticipated operational occurrences." It takes into account the state of technology, economics of improvements in relation to benefits to public health and safety, and other societal and economic considerations in relation to the use of nuclear energy in the public interest.

Atmospheric dispersion: The process of air pollutants being dispersed in the atmosphere. This occurs by the wind that carries the pollutants away from their source and by turbulent air motion that results from solar heating of the Earth's surface and air movement over rough terrain and surfaces.

***Atomic Energy Act* of 1954:** This act was originally enacted in 1946 and amended in 1954. For the purpose of this Programmatic Environmental Impact Statement "...a program for Government control of the possession, use, and production of atomic energy and special nuclear material whether owned by the Government or others, so directed as to make the maximum contribution to the common defense and security and the national welfare, and to provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear materials and atomic weapons..." (Section 3(c)).

Atomic Energy Commission: A five-member commission, established by the *Atomic Energy Act* of 1946, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the Atomic Energy Commission was abolished and all functions were transferred to the Nuclear Regulatory Commission and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated and its functions vested by law in the Administrator were transferred to the Secretary of Energy.

Background radiation: Ionizing radiation present in the environment from cosmic rays and natural sources in the Earth; background radiation varies considerably with location. Also, see "natural radiation."

Badged worker: A worker equipped with an individual dosimeter who has the potential to be exposed to radiation.

Baseline: A quantitative expression of conditions, costs, schedule, or technical progress to serve as a base or standard for measurement during the performance of an effort; the established plan against which the status of resources and the progress of a project can be measured.

BEIR V: Biological Effects of Ionizing Radiation; referring to the fifth in a series of committee reports from the National Research Council.

Beryllium: An extremely lightweight, strong metal used in weapons systems.

Benthic: Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

Best Available Control Technology: A term used in the Federal *Clean Air Act* that means the most stringent level of air pollutant control considering economics for a specific type of source based on demonstrated technology.

Beta particle: A charged particle emitted from the nucleus of an atom during radioactive decay. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron.

Beyond Evaluation Basis Accident: An accident, generally with more severe impacts to on-site personnel and the public than a Evaluation Basis Accident or Design Basis Accident (DBA), initiated by operational or external causes with an estimated probability of occurrence less than 10^{-6} per year and used for estimating the impacts of a planned new or modified facility and/or process. For those cases where a DBA is defined, these accidents are often referred to as Beyond Design Basis Accidents or Severe Accidents.

Cask (radioactive materials): A container that meets all applicable regulatory requirements for shipping spent nuclear fuel or high-level waste.

Category I, II, III, IV: Designated categories of nuclear material used in the implementation of Department of Energy's graded safeguards program. The material category of a Special Nuclear Materials location (e.g., material balance area, material access area, protested area, facility) is used to determine and establish the required protection level. Determination of category involves grouping materials by Special Nuclear Material type, attractiveness level, and quantity. Material quantities are element weights for plutonium and ^{233}U and isotope weights for ^{235}U. The table shows category levels for ^{235}U and attractiveness level.

	Attractiveness Level	Contained U-235 Category (quantities in kgs)			
		I	II	III	IV[a]
WEAPONS Assembled weapons and test devices	**A**	**All**	**N/A**	**N/A**	**N/A**
PURE PRODUCTS Pits, major components, button ingots, recastable metal, directly convertible materials	**B**	**$5**	**$1<5**	**$0.4<1**	**<0.4**
HIGH-GRADE MATERIALS	**C**	**$20**	**$6<20**	**$2<6**	**<2**
LOW-GRADE MATERIALS	**D**	**N/A**	**$50**	**$8<50**	**<8**

[a.] The lower limit for Category IV is equal to reportable quantities.

Chemical oxygen demand: A measure of the quantity of chemically oxidizable components present in water.

Chronic exposure: Low-level radiation exposure incurred over a long period of time.

***Clean Air Act*:** This Act mandates and enforces air pollutant emissions standards for stationary sources and motor vehicles.

***Clean Air Act* Amendments of 1990:** Expands the Environmental Protection Agency's enforcement powers and adds restrictions on air toxics, ozone depleting chemicals, stationary and mobile emissions sources, and emissions implicated in rain and global warming.

***Clean Water Act* of 1972, 1987:** This Act regulates the discharge of pollutants from a point source into navigable waters of the United States in compliance with an National Pollution Discharge Elimination System permit as well as regulates discharges to or dredging of wetlands.

Climatology: The science that deals with climates and investigates their phenomena and causes.

***Code of Federal Regulations* (CFR):** All Federal regulations in force are published in codified form in the *Code of Federal Regulations*.

Collective committed effective dose equivalent (CEDE): The CEDE of radiation for a population.

Committed dose equivalent: The predicted total dose equivalent to a tissue or organ over a 50-year period after an intake of radionuclide into the body. It does not include external dose contributions. Committed dose equivalent is expressed in units of rem or Sievert. The committed effective dose equivalent is the sum of the committed dose equivalents to various tissues of the body, each multiplied by the appropriate weighting factor.

***Comprehensive Environmental Response, Compensation, and Liability Act* of 1980 (CERCLA or Superfund):** This act provides regulatory framework for remediation of past contamination from hazardous waste. If a site meets the act's requirements for designation, it is ranked along with other "Superfund" sites and is listed on the National Priorities List. This ranking is the Environmental Protection Agency's way of determining which sites have the highest priority for cleanup.

Comprehensive Test Ban Treaty (CTBT): A proposed treaty prohibiting nuclear tests of all magnitudes.

Conceptual design: Efforts to develop a project scope that will satisfy program needs; ensure project feasibility and attainable performance levels of the project for congressional consideration; develop project criteria and design parameters for all engineering disciplines; and identify applicable codes and standards, quality assurance requirements, environmental studies, construction materials, space allowances, energy conservation features, health, safety, safeguards, and security requirements and any other features or requirements necessary to describe the project.

Credible accident: An accident that has a probability of occurrence greater than or equal to one in a million years.

Criteria pollutants: Six air pollutants for which national ambient air quality standards are established by the Environmental Protection Agency under Title I of the Federal *Clean Air Act*: sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, particulate matter (smaller than 10 microns in diameter), and lead.

Critical habitat: Defined in the *Endangered Species Act* of 1973 as "specific areas within the geographical area occupied by [an endangered or threatened] species..., essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species... that are essential for the conservation of the species."

Criticality: The condition in which nuclear fuel sustains a chain reaction. It occurs when the number of neutrons present in one generation cycle equals the number generated in the previous cycle.

Cultural resources: Archaeological sites, architectural features, traditional use areas, and Native American sacred sites or special use areas.

Cumulative impacts: In an EIS, the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal), private industry, or individuals undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Decommissioning: The process of withdrawing a building, equipment, or a facility from active service.

Decontamination: The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

Depleted uranium: Uranium whose content of the isotope uranium-235 is less than 0.7 percent, which is the uranium-235 content of naturally occurring uranium.

Direct economic effects: The initial increases in output from different sectors of the economy resulting from some new activity within a predefined geographic region.

Direct Effect Multiplier: The total change in regional earnings and employment in all related industries as a result of a one-dollar change in earnings and a one-job change in a given industry.

Direct jobs: The number of workers required at a site to implement an alternative.

Disposition: The ultimate "fate" or end use of a surplus Department of Energy facility following the transfer of the facility to the Office of the Assistant Secretary for Environmental Waste Management.

Dose: The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad.

Dose commitment: The dose an organ or tissue would receive during a specified period of time (e.g., 50 to 100 years) as a result of intake (as by ingestion or inhalation) of one or more radionuclides from a defined release, frequently over a year's time.

Dose equivalent: The product of absorbed dose in rad (or gray) and the effect of this type of radiation in tissue, and a quality factor. Dose equivalent is expressed in units of rem or Sievert, where 1 rem equals 0.01 Sievert. The dose equivalent to an organ, tissue, or the whole body will be that received from the direct exposure plus the 50-year committed dose equivalent received from the radionuclides taken into the body during the year.

Dosimeter: A small device (instrument) carried by a radiation worker that measures cumulative radiation dose (e.g., TLD - thermoluminescent badge or ionization chamber).

Drinking-water standards: The prescribed level of constituents or characteristics in a drinking water supply that cannot be exceeded legally.

Dual use/dual benefit: Projects that have uses in or benefits for the defense sector and the private industry or civilian sector.

Effective dose equivalent (EDE): The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value and can be used to estimate the health effects risk of the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The EDE includes the CEDE from internal deposition of radionuclides, and the effective dose equivalent due to penetrating radiation from sources external to the body. EDE is expressed in units of rem (or Sievert).

Effluent: A gas or fluid discharged into the environment.

Emission standards: Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

Endangered species: Defined in the *Endangered Species Act* of 1973 as "any species which is in danger of extinction throughout all or a significant portion of its range."

***Endangered Species Act* of 1973:** This act requires Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions will not likely jeopardize the continued existence of any endangered or threatened species or adversely affect the habitat of such species.

Enduring stockpile: Weapons types expected to be retained in the smaller stockpile for the foreseeable future.

Environment, safety, and health (ES&H) program: In the context of the Department of Energy, encompasses those Department of Energy requirements, activities, and functions in the conduct of all Department of Energy and Department of Energy-controlled operations that are concerned with: impacts to the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both operating personnel and the general public to acceptably low levels; and protecting property adequately against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, and process and facilities safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

Environmental assessment (EA): A written environmental analysis that is prepared pursuant to the *National Environmental Policy Act* to determine whether a Federal action would significantly affect the environment and thus require preparation of a more detailed environmental impact statement. If the action would not significantly affect the environment, then a finding of no significant impact is prepared.

Environmental impact statement (EIS): A document required of Federal agencies by the *National Environmental Policy Act* for major proposals significantly affecting the environment. A tool for decision-making, it describes the positive and negative effects of the undertaking and alternative actions.

Environmental justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

Environmental survey: A documented, multidisciplined assessment (with sampling and analysis) of a facility to determine environmental conditions and to identify environmental problems requiring corrective action.

Epicenter: The point on the Earth's surface directly above the focus of an earthquake.

Epidemiology: The science concerned with the study of events that determine and influence the frequency and distribution of disease, injury, and other health-related events and their causes in a defined human population.

ES&H vulnerabilities: Conditions or weaknesses at facilities that could lead to unnecessary or increased exposure of workers or the public to radiation or to HEU associated chemical hazards, or to the release of radioactive materials to the environment.

Evaluation Basis Accident: An accident, generally with small impacts to the public, initiated by operational or external causes with an estimated probability of occurrence greater than 10^{-6} per year and used for estimating the impacts of a planned new or modified facility and/or process when a Safety Analysis Report, that would define a DBA, has not been prepared. A DBA is used to establish the performance requirements of structures, systems, and components that are necessary to maintain them in a safe shutdown condition indefinitely or to prevent or mitigate the consequences of the DBA so that the public and onsite personnel are not exposed to radiation in excess of appropriate guideline values.

Exposure limit: The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur:

- Reference dose is the chronic exposure dose (mg or kg per day) for a given hazardous chemical at which or below which adverse human non-cancer health effects are not expected to occur.

- Reference concentration is the chronic exposure concentration (mg/M^3) for a given hazardous chemical at which or below which adverse human non-cancer health effects are not expected to occur.

Fault: A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall.

Finding of No Significant Impact (FONSI): A document by a Federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and will not require an environmental impact statement.

Fissile material: Any material capable of supporting a self-sustaining neutron chain reaction to include uranium-233, enriched uranium, plutonium-239, plutonium-241, americium-242, curium-243, curium-245,-247, californium-249,-251.

Floodplain: The lowlands adjoining inland and coastal waters and relatively flat areas including at a minimum that area inundated by a 1-percent or greater chance flood in any given year. The base floodplain is defined as the 100-year (1.0 percent) floodplain. The critical action floodplain is defined as the 500-year (0.2 percent) floodplain.

Formation: In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

Fugitive emissions: Emissions to the atmosphere from pumps, valves, flanges, seals, and other process points not vented through a stack. Also includes emissions from area sources such as ponds, lagoons, landfills, and piles of stored material.

Gamma rays: High-energy, short-wavelength, electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating and can be stopped only by dense materials (such as lead) or a thick layer of shielding materials.

Gaussian plume: The distribution of material (a plume) in the atmosphere resulting from the release of pollutants from a stack or other source. The distribution of concentrations about the centerline of the plume, which is assumed to decrease as a function of its distance from the source and centerline (Gaussian distribution), depends on the mean wind speed and atmospheric stability.

Genetic effects: The outcome resulting from exposure to mutagenic chemicals or radiation which results in genetic changes in germ line or somatic cells.

- Effects on genetic material in germ line (sex cells) cause trait modifications that can be passed from parents to offspring.
- Effects on genetic material in somatic cells result in tissue or organ modifications (e.g. liver tumors) that do not pass from parents to offspring.

Glove box: An airtight box used to work with hazardous material, vented to a closed filtering system, having gloves attached inside of the box to protect the worker.

Hazard chemical: Under 29 CFR 1910, Subpart Z, "hazardous chemicals" are defined as "any chemical which is a physical hazard or a health hazard." Physical hazards include combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and reactives. A health hazard is any chemical for which there is good evidence that acute or chronic health effects occur in exposed employees. Hazardous chemicals include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes or mucous membranes.

Hazard Index (HI): A summation of the hazard quotient for all chemicals now being used at a site and those proposed to be added to yield cumulative levels for a site. A HI value of 1.0 or less means that no adverse human health effects (non-cancer) are expected to occur.

Hazard quotient (HQ): The ratio of the estimated exposure (e.g., daily intake rate) to be expected to have no adverse effects. It is independent of a cancer risk, which is calculated only for those chemicals identified as carcinogens.

Hazardous material: A material, including a hazardous substance, as defined by 49 CFR 171.8 which poses a risk to health, safety, and property when transported or handled.

Hazardous/toxic waste: Any solid waste (can also be semisolid or liquid, or contain gaseous material) having the characteristics of ignitability, corrosivity, toxicity, or reactivity, defined by the *Resource Conservation and Recovery Act* and identified or listed in 40 CFR 261 or by the *Toxic Substances Control Act.*

Heavy metals: Metallic or semimetallic elements of high molecular weight, such as mercury, chromium, cadmium, lead, and arsenic, that are toxic to plants and animals at known concentrations.

High-efficiency particulate air (HEPA) filter: A filter used to remove particulates from dry gaseous effluent streams.

High-level waste: The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid.

High-level waste contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Highly enriched uranium (HEU): Uranium in which the abundance of the isotope ^{235}U is increased well above normal (naturally occurring) levels.

Historic resources: Archaeological sites, architectural structures, and objects produced after the advent of written history dating to the time of the first Euro-American contact in an area.

Hydrology: The science dealing with the properties, distribution, and circulation of natural water systems.

Incident-free risk: The radiological or chemical impacts resulting from packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups such as crew, passengers, and bystanders.

Indirect economic effects: Indirect effects result from the need to supply industries experiencing direct economic effects with additional outputs to allow them to increase their production. The additional output from each directly affected industry requires inputs from other industries within a region (i.e., purchases of goods and services). This results in a multiplier effect to show the change in total economic activity resulting from a new activity in a region.

Induced economic effects: The spending of households resulting from direct and indirect economic effects. Increases in output from a new economic activity lead to an increase in household spending throughout the economy as firms increase their labor inputs.

Indirect jobs: Within a regional economic area, jobs generated or lost in related industries as a result of a change in direct employment.

Interim (permit) status: Period during which treatment, storage, and disposal facilities coming under the *Resource Conservation and Recovery Act* of 1980 are temporarily permitted to operate while awaiting denial or issuance of a permanent permit.

Ionizing radiation: Alpha particles, beta particles, gamma rays, x rays, neutrons, high speed electrons, high speed protons, and other particles or electromagnetic radiation that can displace electrons from atoms or molecules, thereby producing ions.

Isotope: An atom of a chemical element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons but different numbers of neutrons and different atomic masses.

Lacustrine wetland: Lakes, ponds, and other enclosed open waters at least 8 ha (20 acres) in extent and not dominated by trees, shrubs, and emergent vegetation.

Large release: A release of radioactive material that would result in doses greater than 25 rem to the whole body or 300 rem to the thyroid at 1.6 km from the control perimeter (security fence) of a reactor facility.

Laser: A device that produces a beam of monochromatic (single-color) “light” in which the waves of light are all in phase. This condition creates a beam that has relatively little scattering and has a high concentration of energy per unit area.

Latent fatalities: Fatalities associated with acute and chronic environmental exposures to chemicals or radiation.

Low-level waste: Waste that contains radioactivity but is not classified as high-level waste, transuranic waste, spent nuclear fuel, or "11e(2) by-product material" as defined by DOE Order 5820.2A, *Radioactive Waste Management.* Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram. Some low-level waste is considered classified because (1) the nature of the generating process and/or constituents, and (2) the waste would reveal too much about the generating process.

Manufacturing: see "production."

Maximum contaminant level: The maximum permissible level of a contaminant in water delivered to any user of a public water system. Maximum contaminant levels are enforceable standards.

Maximally exposed individual (MEI): A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

Meteorology: The science dealing with the atmosphere and its phenomena, especially as relating to weather.

Migration: The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

Mixed waste: Waste that contains both "hazardous waste" and "radioactive waste" as defined in this glossary.

Modified Mercalli intensity: A level on the modified Mercalli scale. A measure of the perceived intensity of earthquake ground shaking with 12 divisions, from I (not felt by people) to XII (damage nearly total).

National Ambient Air Quality Standards (NAAQS): Air quality standards established by the *Clean Air Act,* as amended. The primary NAAQS are intended to protect the public health with an adequate margin of safety, and the secondary NAAQS are intended to protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Emission Standards for Hazardous Air Pollutants (NESHAP): A set of NESHAP emitted from specific classes or categories of new and existing sources. These were implemented in the *Clean Air Act* Amendments of 1977.

***National Environmental Policy Act* of 1969 (NEPA):** This Act is the basic national charter for the protection of the environment. It requires the preparation of an environmental impact statement for every major Federal action that may significantly affect the quality of the human or natural environment. Its main purpose is to provide environmental information to decision makers and the public so that actions are based on an understanding of the potential environmental consequences of a proposed action and its reasonable alternatives.

National Environmental Research Park (NERP): An outdoor laboratory set aside for ecological research to study the environmental impacts of energy developments. NERPs were established by the Department of Energy to provide protected land areas for research and education in the environmental sciences and to demonstrate the environmental compatibility of energy technology development and use.

***National Historic Preservation Act* of 1966, as amended (NHPA):** This Act provides that property resources with significant national historic value be placed on the National Register of Historic Places. It does not require any permits but, pursuant to Federal code, if a proposed action might impact an historic property resource, it mandates consultation with the proper agencies.

National Pollutant Discharge Elimination System (NPDES): Federal permitting system required for hazardous effluents regulated through the *Clean Water Act*, as amended.

National Register of Historic Places (NRHP): A list maintained by the Secretary of the Interior of districts, sites, buildings, structures, and objects of prehistoric or historic local, state, or national significance. The list is expanded as authorized by Section 2(b) of the *Historic Sites Act* of 1935 (16 U.S.C. 462) and Section 101(a)(1)(A) of the NHPA of 1966, as amended.

Nitrogen oxides (NOX): Refers to the oxides of nitrogen, primarily NO (nitrogen oxide) and NO_2 (nitrogen dioxide). These are produced in the combustion of fossil fuels and can constitute an air pollution problem. When nitrogen dioxide combines with volatile organic compounds, such as ammonia or carbon monoxide, ozone is produced.

Nonattainment area: An air quality control region (or portion thereof) in which the Environmental Protection Agency has determined that ambient air concentrations exceed NAAQS for one or more criteria pollutants.

Nonproliferation Treaty: A treaty with the aim of controlling the spread of nuclear weapons technologies, limiting the number of nuclear weapons states and pursuing, in good faith, effective measures relating to the cessation of the nuclear arms race. The treaty does not invoke stockpile reductions by nuclear states, and it does not address actions of nuclear states in maintaining their stockpiles.

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

Nuclear grade: Material of a quality adequate for use in a nuclear application.

Nuclear production: Production operations for components of nuclear weapons that are fabricated from nuclear materials, including plutonium and uranium.

Nuclear weapon: The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

Nuclear Weapons Complex: The sites supporting the research, development, design, manufacture, testing, assessment, certification and maintenance of the Nation's nuclear weapons and the subsequent dismantlement of retired weapons.

Occupational Safety and Health Administration (OSHA): Oversees and regulates workplace health and safety, created by the *Occupational Safety and Health Act* of 1970.

Off-site: As used in this EIS, the term denotes a location, facility, or activity occurring outside the boundary of the entire Oak Ridge Reservation site.

On-site: As used in this EIS, the term denotes a location or activity occurring somewhere within the boundary of the Oak Ridge Reservation.

On-site population: Department of Energy and contractor employees who are on duty, and badged on-site visitors.

Operable unit: A discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration or eliminates or mitigates a release, threat of release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units.

Outfall: The discharge point of a drain, sewer, or pipe as it empties into a body of water.

Ozone: The triatomic form of oxygen; in the stratosphere, ozone protects the Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere ozone is considered an air pollutant.

Packaging: The assembly of components necessary to ensure compliance with Federal regulations. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle tie-down system and auxiliary equipment may be designated as part of the packaging.

Palustrine wetland: Nontidal wetlands dominated by trees, shrubs, and emergent vegetation.

Perched groundwater: A body of groundwater of small lateral dimensions lying above a more extensive aquifer.

Performance Categories (PC): Defined in DOE O 420.1, performance categories classify the performance goals of a facility in terms of facility's structural ability to withstand natural phenomena hazards (i.e., earthquakes, winds, and floods). Ranging from 0 to 4, each PC has a qualitative and quantitative description of the performance goal for its category. Both the qualitative description of acceptable performance and the quantitative probability for each PC are equally significant in establishing the design and evaluation criteria. In general, facilities that are classified as (1) PC 0 do not consider safety, mission, or cost considerations, (2) PC 1 must maintain occupant safety, (3) PC 2 must maintain occupant safety and continued operations with minimum interruption, (4) PC 3 must maintain occupant safety, continued operations, and hazard materials confinement, and (5) PC 4 must meet occupant safety, continued operations, and confidence of hazard confinement**.**

Person-rem: The unit of collective radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

Physical setting: The land and water form, vegetation, and structures that compose the landscape.

Plume: The elongated pattern of contaminated air or water originating at a point source, such as a smokestack or a hazardous waste disposal site.

Plutonium: A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially in a reactor by bombardment of uranium with neutrons and is used in the production of nuclear weapons.

Prehistoric: Predating written history, in North America, also predating contact with Europeans.

Prevention of Significant Deterioration: Regulations established by the 1977 *Clean Air Act* Amendments to limit increases in criteria air pollutant concentrations above baseline.

Prime farmland: Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor without intolerable soil erosion, as determined by the Secretary of Agriculture (*Farmland Protection Policy Act* of 1981, 7 CFR 7, paragraph 658).

Probable maximum flood: Flood levels predicted for a scenario having hydrological conditions that maximize the flow of surface waters.

Production: Encompasses the fabrication, processing, assembly, and acceptance testing of nuclear weapons and nuclear weapon components, and is interchangeable with the term manufacturing.

Programmatic Environmental Impact Statement (PEIS): A legal document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of proposed Federal actions that involve multiple decisions potentially affecting the environment at one or more sites.

Project-specific EIS: A legal document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of a single action at a single site.

Proliferation: The spread of nuclear weapons and the materials and technologies used to produce them.

Protectedarea: An area encompassed by physical barriers, subject to access controls, surrounding material access areas, and meeting the standards of DOE Order 5632.1C, *Protection and Control of Safeguards and Security Interests*.

Quality factor: The principal modifying factor that is employed to derive dose equivalent from absorbed dose.

Rad: See "radiation absorbed dose."

Radiation: The particles or electromagnetic energy emitted from the nuclei of radioactive atoms. Some elements are naturally radioactive; others are induced to become radioactive by bombardment in a reactor. Naturally occurring radiation is indistinguishable from induced radiation.

Radiation absorbed dose: The basic unit of absorbed dose equal to the absorption of 0.01 joule per kilogram of absorbing material.

Radioactive waste: Materials from nuclear operations that are radioactive or are contaminated with radioactive materials, and for which use, reuse, or recovery are impractical.

Radioactivity: The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

Radioisotopes: Radioactive nuclides of the same element (same number of protons in their nuclei) that differ in the number of neutrons.

Radionuclide: A radioactive element characterized according to its atomic mass and atomic number which can be man-made or naturally occurring. Radionuclides can have a long life as soil or water pollutants, and are believed to have potentially mutagenic or carcinogenic effects on the human body.

RADTRAN: A computer code combining user-determined meteorological, demographic, transportation, packaging, and material factors with health physics data to calculate the expected radiological consequences and accident risk of transporting radioactive material.

Reasonably Available Control Technology : The lowest emissions limit that a particular source is capable of meeting by the application of control technology that is reasonably available as well as technologically and economically feasible.

Receiving waters: Rivers, lakes, oceans, or other bodies of water into which wastewaters are discharged.

Recharge: Replenishment of water to an aquifer.

Record of Decision (ROD): A document prepared in accordance with the requirements of 40 CFR 1505.2 that provides a concise public record of Department of Energy's decision on a proposed action for which an EIS was prepared. A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced by Department of Energy in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

Regional economic area: A geographic area consisting of an economic node and the surrounding counties that are economically related and include the places of work and residences of the labor force. Each regional economic area is defined by the U.S. Bureau of Economic Analysis.

Region of influence (ROI): A site-specific geographic area that includes the counties where approximately 90 percent of the current Department of Energy and/or contractor employees reside.

Rem: See "roentgen equivalent man."

Remediation: The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Replacement Secondary Fabrication: This function includes the fabrication, surveillance, and storage of the secondary uranium and lithium portion of a nuclear weapon.

***Resource Conservation and Recovery Act* (RCRA), as amended:** This Act provides "cradle to grave" regulatory program for hazardous waste which established, among other things, a system for managing hazardous waste from its generation until its ultimate disposal.

Riparian wetlands: Wetlands on or around rivers and streams.

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

Risk assessment (chemical or radiological): The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

Roentgen: A unit of exposure to ionizing X- or gamma radiation equal to or producing 1 electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad.

Roentgen equivalent man (REM): The unit of radiation dose for biological absorption equal to the product of the absorbed dose, in rads, a quality factor which accounts for the variation in biological effectiveness of different types of radiation. Also known as "rem".

Runoff: The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

***Safe Drinking Water Act*, as amended:** This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

Safe secure trailer (SST): A specially designed semitrailer, pulled by an armored tractor, which is used for the safe, secure transportation of cargo containing nuclear weapons or special nuclear material.

Safety Analysis Report: A safety document providing a concise but complete description and safety evaluation of a site, design, normal and emergency operation, potential accidents, predicted consequences of such accidents, and the means proposed to prevent such accidents or mitigate their consequences. A safety analysis report is designated as final when it is based on final design information. Otherwise, it is designated as preliminary.

Sanitary wastes: Wastes generated by normal housekeeping activities, liquid or solid (includes sludge), which are not hazardous or radioactive.

Scope: In a document prepared pursuant to the NEPA of 1969, the range of actions, alternatives, and impacts to be considered.

Scoping: Involves the solicitation of comments from interested persons, groups, and agencies at public meetings, public workshops, in writing, electronically, or via fax to assist Department of Energy in defining the proposed action, identifying alternatives, and developing preliminary issues to be addressed in an EIS.

Secondary: See "weapon secondary."

Security: Minimizing the likelihood of unauthorized access to or loss of custody of a nuclear weapon or weapon system, and ensuring that the weapon can be recovered should unauthorized access or loss of custody occur.

Seismic: Pertaining to any earth vibration, especially an earthquake.

Seismic zone: An area defined by the Uniform Building Code (1991), designating the amount of damage to be expected as the result of earthquakes. The United States is divided into six zones: (1) Zone 0 - no damage; (2) Zone 1 - minor damage; corresponds to intensities V and VI of the modified Mercalli intensity scale; (3) Zone 2A - moderate damage; corresponds to intensity VII of the modified Mercalli intensity scale (eastern U.S.); (4) Zone 2B - slightly more damage than 2A (western U.S.); (5) Zone 3 - major damage;

corresponds to intensity VII and higher of the modified Mercalli intensity scale; and (6) Zone 4 - areas within Zone 3 determined by proximity to certain major fault systems.

Seismicity: The tendency for the occurrence of earthquakes.

Severe accident: An accident with a frequency rate of less than 10^{-6} per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, offsite consequences, or both.

Shielding: Any material of obstruction (bulkheads, walls, or other constructions) that absorbs radiation in order to protect personnel or equipment.

Short-lived nuclides: Radioactive isotopes with half-lives no greater than about 30 years (e.g., cesium^{137} and strontium^{90}).

Shrink-swell potential: Refers to the potential for soils to contract while drying and expand after wetting.

Silt: A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Siltstone: A sedimentary rock composed of fine textured minerals.

Site-Wide EIS (SWEIS): A legal document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of many actions at one large, multiple-facility Department of Energy site. Site-wide EISs are used to support programmatic and specific decisions.

Source term: The estimated quantities of radionuclides or chemical pollutants released to the environment.

Special nuclear materials (SNM): As defined in Section 11 of the *Atomic Energy Act* of 1954, special nuclear material means (1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Nuclear Regulatory Commission determines to be special nuclear material, or (2) any material artificially enriched by any of the foregoing.

Standardization (Epidemiology): Techniques used to control the effects of differences (e.g., age) between populations when comparing disease experience. The two main methods are:

- Direct method, in which specific disease rates in the study population are averaged, using as weights the distribution of the comparison population.
- Indirect method, in which the specific disease rates in the comparison population are averaged, using as weights the distribution of the study population.

Strategic Arms Reduction Talks (START) I and II: Terms which refer to negotiations between the U.S. and Russia (the former Soviet Union during START I negotiations) aimed at limiting and reducing nuclear arms. START I discussions began in 1982 and eventually led to a ratified treaty in 1988. The START II protocol, which has not been fully ratified, will attempt to further reduce the acceptable levels of nuclear weapons ratified in START I.

Strategic reserve: That quantity of plutonium and highly enriched uranium reserved for future weapons use. For the purposes of this SWEIS, strategic reserves of plutonium will be in the form of pits, and strategic reserves of highly enriched uranium will be in the form of canned secondary assemblies. Strategic reserves also include limited quantities of plutonium and highly enriched uranium metal maintained as working inventory at Department of Energy laboratories.

***Superfund Amendments and Reauthorization Act* (SARA) of 1986:** Public Law 99-499 passed in 1986 which amends the CERCLA of 1980. SARA more stringently defines hazardous waste cleanup standards and emphasizes remedies that permanently and significantly reduce the mobility, toxicity, or volume of wastes. Title III of SARA, the Emergency Planning and Community Right-to-Know Act, mandates establishment of community emergency planning programs, emergency notification, reporting of chemicals, and emission inventories.

Surface water: Water on the Earth's surface, as distinguished from water in the ground (groundwater).

Threatened species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Threshold limit values: The recommended concentrations of contaminants workers may be exposed to according to the American Council of Governmental Industrial Hygienists.

***Toxic Substances Control Act* of 1976 (TSCA):** This act authorizes the Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the Environmental Protection Agency before they are manufactured for commercial purposes.

Transuranic waste: Waste contaminated with alpha-emitting radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries/gram at time of assay.

Unclassified Controlled Nuclear Information (UCNI): Certain unclassified but sensitive Government information concerning nuclear material, weapons, and components whose dissemination is controlled under section 148 of the *Atomic Energy Act.*

Unusual occurrence: Any unusual or unplanned event that adversely affects or potentially affects the performance, reliability, or safety of a facility.

Uranium: A naturally occurring heavy, silvery-white metallic element (atomic number 92) with many radioactive isotopes. Uranium-235 is most commonly used as a fuel for nuclear fission. Another isotope, uranium-238, can be transformed into fissionable plutonium-239 following its capture of a neutron in a nuclear reactor.

Volatile organic compound: A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol.

Visual Resource Management (VRM) Class: Port of BLM's visual resource inventory process that provides a means for determining visual values, consisting of scenic quality evaluation, sensitivity level analysis, and delineation of distance zones. Classes are established through a resource management planning (RMP) process and are ultimately based on management decisions made in the RMPs. Classes range from VRM Class I (highly scenic) to VRM Class IV (industrialized, low scenic quality). Management objectives for these classes are: Class I, preserve existing character of landscape; Class II, retain existing character of landscape with little change that respects basic elements of landscape; Class III, partially retain existing character of landscape with moderate changes that do not dominate view of casual observer; and Class IV, major modifications of existing character of landscape that dominate viewer's attention.

War Reserve: Operational weapons and materials designated as essential for national security needs.

Waste Isolation Pilot Plant (WIPP): A facility in southeastern New Mexico developed as the disposal site for transuranic waste.

Waste minimization and pollution prevention: An action that economically avoids or reduces the generation of waste and pollution by source reduction, reducing the toxicity of hazardous waste and pollution, improving energy use, or recycling. These actions will be consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

Weapon secondary: Provides additional explosive energy release; composed of lithium deuteride and other materials. As the secondary implodes, the lithium in the isotope form lithium-6 is converted to tritium by neutron interactions, and the tritium product in turn undergoes fusion with the deuterium to create the thermonuclear explosion.

Weapons-grade: Fissionable material in which the abundance of fissionable isotopes is high enough that the material is suitable for use in thermonuclear weapons.

Weighting factor: Represents the fraction of the total health risk resulting from uniform whole-body irradiation that could be contributed to that particular tissue.

Wetland: Land or areas exhibiting hydric soil conditions, saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions.

Whole-body dose: Dose resulting from the uniform exposure of all organs and tissues in a human body. (Also, see "effective dose equivalent.")

Wind rose: A depiction of wind speed and direction frequency for a given period of time.

Worker year: Measurement of labor requirement equal to 1 full-time worker employed for 1 year.

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

This chapter lists agencies, organizations, and persons who requested the Summary, Volume I, and Volume II or the Summary of the *Draft Site-Wide Environmental Impact Statement for the Oak Ridge Y-12 Plant.*

Federal Elected Officials
U.S. Representative John J. Duncan, Jr.
U.S. Senator Bill Frist, MD
U.S Representative Bart Gordon
U.S. Representative Van Hilleary
U.S. Senator Fred Thompson
U.S. Representative Zach Wamp

State Elected Officials
The Honorable Don Sundquist
Governor of Tennessee
Ben Atchley
State Senator
William Baird
State Representative - District 36
H.E. Bittle
State Representative - District 14
Tim Burchett
State Senator
Gene Caldwell, MD
State Representative - District 33
Lincoln Davis
State Senator
Dennis Ferguson
State Representative - District 32
Douglas Gunnels
State Representative - District 21
Joe McCord
State Representative - District 8
Jeff Miller
State Senator
Harry Tindell
State Representative - District 13

Local Officials
Mayor, City of Harriman
Mayor, City of Clinton
Mayor, City of Rockwood
Mayor, City of Oak Ridge
Mayor, City of Kingston
Mayor, City of Oliver Springs
City Manager, City of Oak Ridge
City Manager, City of Clinton
Vice Mayor, City of Oak Ridge
Anderson County Executive
Loudon County Executive
Knox County Executive
Roane County Executive
Oak Ridge City Council
Environmental Quality Advisory Board, City of Oak Ridge

Federal Agencies
Tennessee Valley Authority
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Defense Logistics Agency

State Agencies
North Carolina Department of Administration
Tennessee Department of Economic and Community Development
Tennessee Department of Health
Tennessee Division of Radiation Protection
Tennessee Commission on Indian Affairs
Tennessee Department of Environment and Conservation

Native American Tribes
Eastern Band of Cherokee Tribal Council
Cherokee Nation of Oklahoma - Muskogee Area Office
United Keetoowah Band Tribal Council

Organizations
EUCHEE
SCORE
EASI
Earth First!
Anderson Co. Development Corp.
PACE Intl. Union
Nuclear Control Institute

Community Reuse Org. of East Tennessee
League of Women Voters
East Tennessee Economic Council
Southeast Center for Ecological Awareness
East Tennessee Development District
Friends of ORNL
Oak Ridge Reservation Local Oversight Committee
Roane County Industrial Development Board
EUO
Presbytery of East Tennessee
Knox Area Chamber Partnership
The University of Tennessee
Advocates for ORR
SOCM
Oak Ridge Site Specific Advisory Board
Katuah Earth First!
Intl Guards Union of America, Local 3
OREPA/JPIC
LOC/CAP
Roane County Industrial Development Board
Association For Women in Science
United Plant Guard Workers of America, Local 109
Knoxville News-Sentinel
Anderson County Chamber of Commerce
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Atomic Trades and Labor Council
Roane County Environmental Review Board
TN Nature Conservancy
Oak Ridge Committees Allied
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William Fulkerson
Tommy Fuller
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Paloma Galindo
David Garcia
Michael Garrett
Susan Gawarecki
Fey Geal
Louis Goenflo
Bill Gorz
Jim Goss
Shawn Grady
Ralph Grantham
Carol Green
Donna Griffith
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Christopher Griffy
Roland Grizzle
Rod Grubb
Fred "Gus" Gustavson
James Hall
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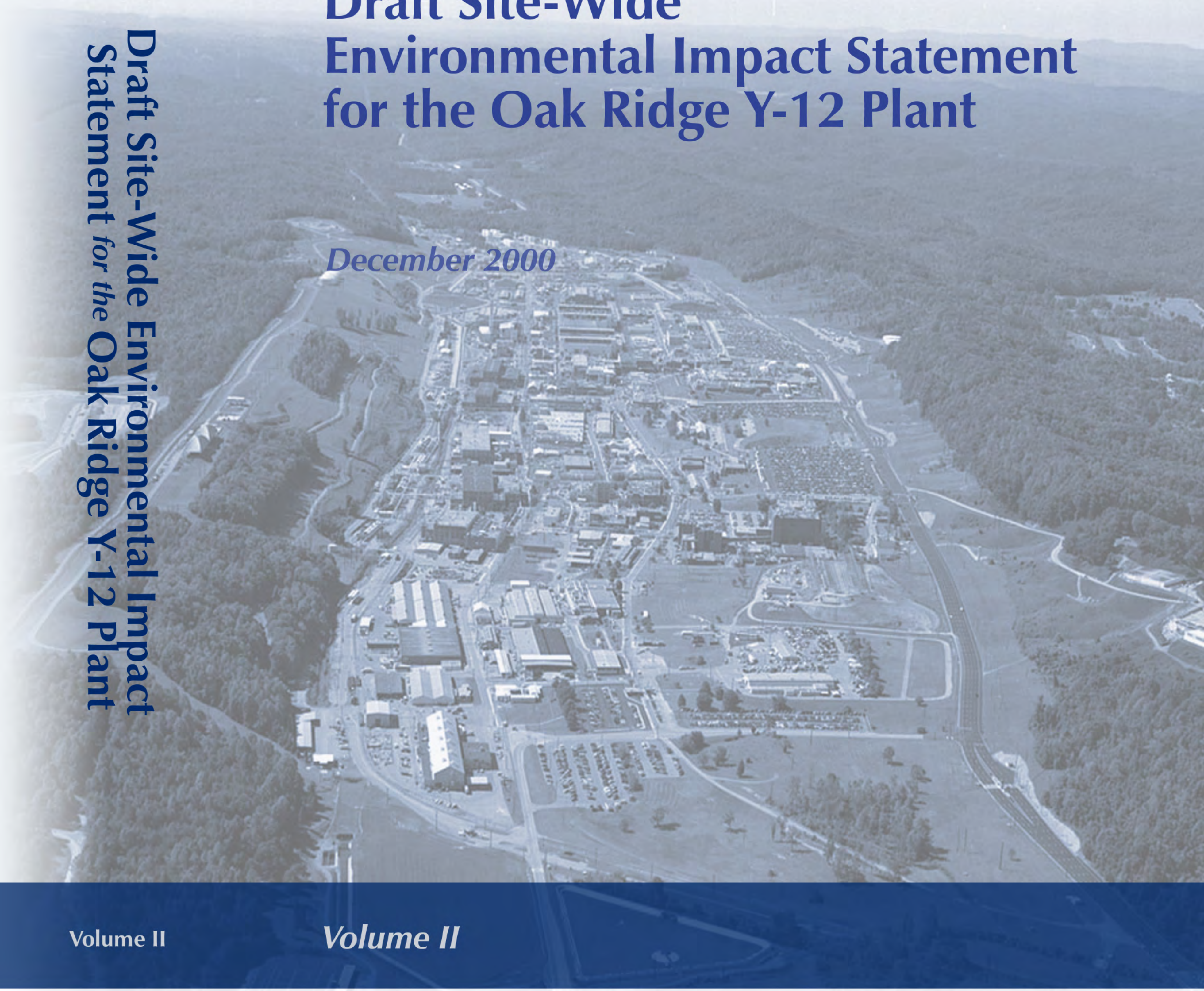
DOE/EIS-0309

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

December 2000



Volume II

U.S. Department of Energy
Oak Ridge Operations Office

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

Volume II

U.S. Department of Energy

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

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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

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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 October 30, 2000.

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ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ACO	Analytical Chemistry Laboratory
AIHA	American Industrial Hygiene Association
ALARA	as low as reasonably achievable
ASER	Annual Site Environmental Report
ATSDR	Agency for Toxic Substances and Disease Registry
CAP-88	*Clean Air Act* Assessment Package 1988
CATV	Cable Television Network
CDC	Center for Disease Control
CDI	chronic daily intake
CEDE	committed effective dose equivalent
CEDR	Comprehensive Epidemiologic Data Resource
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CI	confidence interval
CIND	Computing, Information, and Networking Division
CMTS	Central Mercury Treatment System
CSA	criticality safety analysis
CSE	criticality safety evaluation
CSF	cancer slope factors
CSN	Classified Services Network
D&D	decontamination and decommissioning
DARA	Disposal Area Remedial Action
DCG	Derived Concentration Guidelines
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DP	Defense Program
DRS	Dosimetry Record System
DSWM	Division of Solid Waste Management
ECR	excess cancer risk
EDE	effective dose equivalent
EEMTS	East End Mercury Treatment System
EFPC	East Fork Poplar Creek
EIS	Environmental Impact Statement
EM	Environmental Management
EM-60	DOE Office of Nuclear Material and Facility Stabilization
EPA	Environmental Protection Agency
ERPG	Emergency Response Planning Guide
ES&H	environmental, safety and health
ETTP	East Tennessee Technology Park (formerly the Oak Ridge K-25 Site)
FDDI	fiber-distributed data interface
HAP	hazardous air pollutant
HEPA	high-efficiency particulate air
HEU	Highly Enriched Uranium
HI	hazard index
HMIS	Hazardous Material Information System
HQ	hazard quotient

HVAC	heating, ventilation, and air conditioning
IAEA	International Atomic Energy Agency
ICRP	International Commission Radiological Protection
IP	Internet protocol
IRIS	Integrated Risk Information System
ISC3	Industrial Source Complex
LCF	latent cancer fatality
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LMES	Lockheed Martin Energy Systems
LOAEL	lowest observed adverse effect level
LOS	level of service
MACCS	MELCOR Accident Consequence Code System
MAR	material at risk
MEI	maximally exposed individual
NAAQS	National Ambient Air Quality Standards
NDA	nondestructive assay
NDT	nondestructive testing
NESHAP	National Emission Standards for Hazardous Air Pollutants
NEPA	*National Environmental Policy Act*
NIOSH	National Institute for Occupational Safety and Health
NN	Nuclear Nonproliferation and National Securities
NOAEL	no observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
O&M	operation and maintenance
OEL	occupational exposure limit
ORFICN	Oak Ridge Federal Integrated Communications Network
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyls
PEL	permissible exposure limits
PHA	preliminary hazards analysis
PIDAS	Perimeter Intrusion Detection and Assessment System
POTW	publicly owned treatment works
R&D	research and development
Rad-NESHAP	Radionuclide National Emission Standards for Hazardous Air Pollutants
RCRA	*Resource Conservation and Recovery Act*
REL	recommended exposure limits
RfC	Reference Concentration
RfD	Reference Dose
S&M	surveillance and maintenance
SARA	*Superfund Amendments and Reauthorization Act*
SMR	Standardized Mortality Ratio
SNM	special nuclear material
SWEIS	Site-Wide Environmental Impact Statement
TDEC	Tennessee Department of Environment and Conservation

TDHE	Tennessee Department of Health and Environment
TEDE	total effective dose equivalent
TEEL	temporary emergency exposure limit
TEV	threshold emission value
TI	Transport Index
TLV	threshold limit value
TSCA	*Toxic Substances Control Act*
TVA	Tennessee Valley Authority
TWA	time-weighted average
UEFPC	Upper East Fork Poplar Creek
UTM	Universal Transverse Mercator
VAC	alternating current volt
VOC	volatile organic compounds
WETF	West End Treatment Facility
Y-12	The Oak Ridge Y-12 Plant
Y-12DPNet	Y-12 Defense Programs Network

CHEMICALS AND UNITS OF MEASURE

Bq	Becquerel
C	Celsius
Ci	curie
CCl_4	carbon tetrachloride
cm	centimeter
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	gram
G	acceleration due to gravity
gal	gallons
GPD	gallons per day
gpm	gallons per minute
GPY	gallons per year
ha	hectares
HCl	hydrochloric acid
HF	hydrogen fluoride
hr	hour
in.	inch
kg	kilogram
km	kilometer
km^2	square kilometer
KOH	potassium hydroxide
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt hour
L	liter
lb	pound
Li	lithium
LiD	lithium deuteride
LiH	lithium hydride
LiO	lithium oxide
m	meter
m^2	square meter
m^3	cubic meter
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	mile
mi^2	square mile
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 oxide
Np	neptunium
O_3	ozone
Pa	protactinium
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
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 inch gage
Ra	radium
rem	roentgen equivalent man
s	second
scf	standard cubic feet
scfd	standard cubic feet per day
scfm	standard cubic feet per minute
SO_2	sulfur dioxide
Sv	sievert
t	metric ton
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 yard
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
$\mu g/m_3$	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 inche	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	l00 = 10^{2}
deka-	da	l0 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	F	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}

APPENDIX A: Y-12 PLANNING, PROCESS AND FACILITY INFORMATION

This appendix to the Y-12 Site-Wide Environmental Impact Statement (SWEIS) presents information on the principal planning, processes, and facilities associated with the Y-12 Plant. This includes a description of the facility planning and transition process; a summary of major Y-12 Plant configurations and infrastructure; a description of the Y-12 Plant production processes; a description of Defense Programs (DP) major facilities (designated by building complex or specific buildings); a summary of principal Waste Management activities (designated by unit names since these are usually located in larger buildings); and information dealing with traffic and transportation. Tables and figures related to these discussions are included in order to conveniently summarize selected facility information.

A.1 FACILITY PLANNING PROCESS AND FACILITY TRANSITION PROGRAM

This section summarizes information dealing with facility planning processes at Y-12. In addition, information on facility transition programs and the decontamination and decommissioning (D&D) of facilities is also summarized.

A.1.1 Y-12 Facility Planning

The Y-12 Weapons Programs Organization, in which the Required Technical Base and Facilities Program resides, has the overall responsibility for formulating the DP capital investment and workforce strategy for the Y-12 Site. The Weapons Program is integrally linked with the Modernization Program and the Utilities and Infrastructure Management Program. Together, this triad works to accomplish the following objectives:

- Convey program requirements to the Site organizations to ensure that Y-12 plans for the capacity and capability commensurate with directive schedules and funding (Weapons Programs/Required Technical Base and Facilities Program)
- Migration (planning, project development, and execution) of current state to future state with respect to facilities and infrastructure (Modernization Program)
- Maintenance of all utilities and distribution systems, development of their requirements, and prioritization of resources (Utilities and Infrastructure Management Program)
- Development and prioritization of maintenance, upgrades, and replacement of site-wide infrastructure buildings, roads, parking lots, etc. (Utilities and Infrastructure Management Program/Modernization Program)

Planning at the Y-12 Plant begins with an understanding of current and proposed missions, coupled with a vision of the future role of the facility in meeting overall DP requirements. A strategic plan is prepared for the Y-12 Plant that provides guidance on its objectives and long-range plans, including site and facilities considerations relating to the manufacturing footprint. The site and facilities planning process uses the strategic plan as a starting point for developing long-range alternatives, prioritizing proposed projects, and generally setting the direction for infrastructure investment.

At a detailed level, the site and facilities planning process at the Y-12 Plant involves three major steps: (1) identification of needs, (2) packaging of proposed solutions into projects or activities, and (3) prioritization of those projects and activities to meet budget constraints. These steps are iterative and ongoing, as needs and budget projections change.

In the past, Y-12 has used the Condition Assessment Survey tools and procedures developed by the U.S. Department of Energy (DOE) Headquarters to systematically assess and document the physical condition of its facilities. Condition Assessment Survey data have provided information to identify maintenance needs. Other needs, particularly for operational improvements, acquisition, and disposition, have been identified by program managers and facility managers in response to facility conditions, workload requirements, and programmatic guidance from DOE.

These needs and proposed solutions are then formalized into requests for funding of capital projects, expense-funded projects, or work authorization packages. Processes for setting priorities differ, depending on the proposed funding source, but generally involve formal or informal committees of middle managers passing initial recommendations to senior management for modification and approval.

A.1.2 Y-12 Facility Transition Program

Facility Transition, which is part of the Modernization and Facilities Transition Program, involves preparing surplus facilities for disposition with their safe, compliant, and cost-effective management until disposition. Disposition could include reuse by another entity, transfer to the DOE Office of Nuclear Material and Facility Stabilization (EM-60), or demolition by DP. Any of these disposition alternatives may be preceded by an extended period of surveillance and maintenance (S&M): the program has developed a systematic approach for placing surplus facilities in a safe and compliant condition and minimizing S&M costs in a framework that protects workers, the public, and the environment.

Figure A.1.2**S**1 is a top-level flow diagram of the decision and planning process. While the flow diagram represents a linear sequence of events, many of the steps in the process can be done in parallel. S&M is not final disposition, and facilities in long-term S&M will be periodically reevaluated to determine if the time is right for a more permanent disposition. The level of activity required at each step in the process will depend on the size and complexity of the facilities.

A.1.2.1 *Surplus Facilities Identification*

Identification of surplus facilities is obtained through the Y-12 Ten-Year Plan and the downsizing activities described in the Activity Implementation Plan. The surplus facilities identified in these documents constitute the baseline for surplus facilities to be managed by the program.

A.1.2.2 *Disposition Strategy*

The disposition options for surplus facilities are to reuse the facility, transfer it to EM-60, demolish it, or place it in long-term S&M. The preferred option is to find a reuse (new owner) for the facility. If reuse is not feasible, transfer to EM-60 or demolition by DP are the next preferences. For process-contaminated facilities, Environmental Management (EM) is the departmental organization designated to deactivate and decontaminate as necessary and take the facility to its final disposition.

The final disposition could be demolition or a reuse option that was not available in its former contaminated state. The uncontaminated facilities that EM will take will be demolished with DP funding whenever justified on the basis of cost savings or other programmatic imperatives, such as need for the land. Demolition is subject to funding constraints. Long-term S&M is not a final disposition alternative, although it may be used while waiting for a reuse opportunity, demolition funding, or EM's readiness to accept a contaminated facility. The final selection of a disposition option for a facility will involve the approval of Y-12 Site management and DOE.

FIGURE A.1.2–1.—*Facility Disposition Approach.*

A.1.2.3 *Scheduling and Budgeting*

After the disposition strategy for a facility is selected, a baseline schedule and cost estimate for the disposition of the facility would be developed and incorporated into the budget planning process. Developing the budget submission requires a team effort involving numerous Y-12 organizations: Weapons Programs Management; Operations; Engineering; Environment, Safety and Health; Maintenance; Waste Management; Facility Safety; Fire Protection; and others as required.

A.1.2.4 *Walkdown Assessments*

Walkdown assessments identify actions required to place facilities in a safe and compliant condition, taking into account the status of the facility and a necessary and sufficient approach to requirements. The assessment process is used to determine what actions need to be performed in a facility prior to reuse, transfer to EM, demolition, or long-term S&M. Figure A.1.2–2 shows the process flow for the stabilization actions required to place a surplus facility in a safe and compliant condition.

A.1.2.5 *Reuse*

The stabilization approach is tailored to the disposition strategy for the facility. If the facility is a candidate for reuse, then it is anticipated that some actions will need to be completed prior to transfer to a new owner. These actions typically will address removal of potential *Resource Conservation and Recovery Act* (RCRA) wastes, equipment, materials, etc., that are not needed by the new owner.

A.1.3 Transfer to EM

If reuse is not an option, process-contaminated facilities are candidates for transfer to EM-60. Process contamination is defined as contamination of systems or structural components by radioactivity or hazardous chemicals. The definition excludes contamination from conventional building materials, such as asbestos and lead-based paint, and from polychlorinated biphenyl (PCB) oils. It also excludes facilities in which bulk or containerized hazardous materials have been used or managed if no residual contamination remains after the hazardous materials are removed.

Transfer to EM will be done as prescribed by DOE O 430.1A, *Life Cycle Asset Management.* Because a facility's budget for S&M is transferred along with the facility, notification of intent to transfer is required two budget-years in advance of the proposed transfer. This time will allow EM-60 to incorporate the S&M costs into its budget planning and to complete a pre-transfer agreement. The pre-transfer agreement documents the actions that will be required by Y-12 prior to EM's accepting the facility.

A.1.4 Demolition

If a facility is targeted for demolition, a demolition plan is prepared. Consideration will be given to options that could range from having a subcontractor remove the facility and salvage the materials with no cost to DOE, destruction of the facility by fire with fire protection personnel using this fire as a training exercise, a low-bid subcontractor award contract, or other options. The intent is to minimize the costs to DOE while maintaining a safe and compliant process.

FIGURE A.1.2–2.—*Stabilization Action Process.*

A.1.4.1 *Long-Term S&M*

If near-term disposition by reuse, transfer, or demolition is not feasible, the facility will be placed into long-term S&M. The basic difference in the process at this time is the implementation of an S&M plan. The facility will be stabilized to a safe and compliant condition as determined by analysis of the walkdown assessments (based on necessary and sufficient principles). After stabilization, personnel access to the facility will be limited, and an S&M plan will be implemented. The objective is to minimize the S&M costs, consistent with risk management concepts. Reduction of S&M costs will potentially involve things such as shutting off utility services (e.g., electrical, water, steam), decontaminating radiation-contaminated areas, removing materials, and eliminating inspections on equipment no longer in service. Systems such as the Criticality Accident Alarm System, Fire Protection, Emergency Notification System, and Emergency Lighting/Egress will remain in service as necessary to ensure the health and safety of workers, the public, and the environment.

A.1.5 Y-12 Decontamination and Decommissioning of Facilities

It is important to recognize that the decisions to conduct near-term cleanup and D&D activities at Y-12 do not depend on whether the proposals for the Y-12 SWEIS alternatives are implemented. Regardless of proposed actions, substantial cleanup of both soil and groundwater contamination and substantial D&D of buildings already determined to be necessary for future operations are either occurring or planned. When specific proposals are completed for the D&D of facilities that would be phased out as a result of the implementation of the proposed Y-12 SWEIS actions, the appropriate *National Environmental Policy Act* (NEPA) process would be followed.

The required level of effort to complete the D&D of Y-12 facilities would be a function of the types of chemical and radiological materials used when the facility was operational, and the extent to which radioactive and hazardous/toxic materials have been deposited on the internal and external surfaces of components, systems, and structures.

Because the specific number and types of Y-12 facilities that may be proposed for transition to EM have not been identified for the future schedule of D&D, it is not possible to quantitatively analyze potential impacts at this time. However, radiological impacts from D&D activities to the general population are expected to remain below the negligible level for a maximally exposed individual (1 mrem/yr) based on the off-site releases reported in previous annual environmental reports for the ORR published by DOE. All D&D activities are regulated by DOE Orders, and exposure limits to the general population would be similar to exposure limits for facility operations.

A.2 Y-12 SITE CONFIGURATION AND INFRASTRUCTURE

This section summarizes information dealing with the Y-12 Site configuration and infrastructure.

A.2.1 Site Configuration

The Y-12 Area of Responsibility in the Oak Ridge Reservation (ORR) covers a total of 2,136 ha (5,279 acres). The main area of Y-12 is largely developed and encompasses 328 ha (811 acres), with 255 ha (630 acres) fenced (4 by 2 km [3 by 1 mi]). Approximately 580 buildings, trailers, and other structures house about 714,317 m^2 (7.6 million ft^2) of laboratory, machining, dismantlement, storage, and research and development (R&D) areas. Because of the Site's defense support manufacturing and storage facilities, the land in the Y-12 area is classified in DOE's industrial category.

Many of the buildings used for Y-12 production processes were built during the 1940s for the Plant's original mission of electromagnetically separating isotopes of uranium. These buildings have been modified over the years to accommodate changing missions. The separation of lithium isotopes using column exchange technology was performed at one time in some of the buildings, but that process was discontinued in the 1960s.

The Building 9212 Complex was built in the early 1940s with several buildings added in the 1950s. The most recent production facility additions were made in the late 1960s and early 1970s as part of the Production Facilities Modifications Program. The major facilities added at that time were Buildings 9204-2E, 9201-5W, and 9201-5N. The current beryllium operations are located in Buildings 9202, 9201-5, 9201-5N, and 9995; these buildings range from 27 to more than 50 years old.

Generally speaking, the Y-12 Plant can be divided into three areas: (1) the East End mission support area; (2) the West End manufacturing areas; and (3) the West End environmental area. East End facilities are generally technical, administrative, and Y-12 Plant support functions. The West End manufacturing area is generally considered an area inside the Perimeter Intrusion Detection and Assessment System (PIDAS) fence. The area inside the PIDAS boundaries contains manufacturing and nuclear material storage facilities as well as technical and Y-12 Plant support operations and program management, product certification, quality control, product engineering and scheduling, maintenance, and utilities. The West End environmental area is managed by EM and contains tank farms, waste management treatment facilities, and storage areas; included are such facilities or areas as the Bear Creek Road Debris Burial Area, Rust Spoil Area, Liquid Organic Waste Storage Facility, Hazardous Chemical Disposal Area, Oil Landfarm, Oil Landfarm Contaminant Area, and Sanitary Landfill 1.

A.2.2 Site Infrastructure

An extensive network of existing infrastructure provides services to Y-12 activities and facilities. The Y-12 area contains 104 km (65 mi) of roads ranging from well-maintained paved roads to remote, seldom-used roads that provide occasional access.

Electric power is supplied by the Tennessee Valley Authority (TVA) and is distributed throughout the Y-12 Site via three 161-kV overhead radial feeders. In addition, there is one 161-kV interconnecting overhead feeder. Some sections of the three lines are supported from suspension insulators on self-supporting steel towers; most sections, however, are supported on wooden-pole H-frame structures. Thirteen 13.8-kV distribution systems ranging in size from 20 MVA to 50 MVA are located within such buildings as 9201-1, 9201-2, 9201-3, 9204-4, 9201-4, 9201-5, 9204-1, and 9204-3. Each system consists of a high-voltage outdoor transformer with indoor switchgear, 15-kV feeder cables, power distribution transformers, and auxiliary substation equipment.

The electrical distribution loads outside major buildings are carried out through 13.8-kV overhead circuits, primarily radial-feed type. Two 13.8-kV tie lines are capable of transferring large blocks of power between the distribution substations. These tie lines are used as alternate power feeds to sections of the Plant when part of the 161-kV transmission system is out of service. The total installed transformer capacity is approximately 400 MVA. According to the draft report, *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999), the Y-12 Plant load during the 1990s averaged approximately 44 MVA.

Natural gas is used for furnaces, the Steam Plant, and laboratories and is supplied via a pipeline from the East Tennessee Natural Gas Company at "C" Station located south of Bethel Valley Road near the eastern end of the Y-12 Plant. A 36-cm (14-in) 125-psig line is routed from "C" Station to the southwest corner of the

Y-12 Plant perimeter fence. From this point, a 20-cm (8-in) line feeds the Steam Plant and a 15-cm (6-in) branch line serves the process buildings and laboratories in the east end of the Plant. The western end of the Y-12 Plant, other than the Steam Plant, is served by 10-cm (4-in) and 5-cm (2-in) headers that are fed from the Steam Plant line. Two other pressure reducing stations, one at the Steam Plant and the other at Building 9202, reduce the gas pressure from 125 psig to 25 psig and 35 psig, respectively. The gas pressure is further reduced and the flow metered at each use point.

Steam used in heating and processing is supplied from a central Y-12 Steam Plant which was originally built in 1955 and upgraded and modernized several times to date. The Plant operates 24 hr/day, 365 days/year. It includes four coal-fired boilers, each of which is rated at 200,000 lb/hr at 500EF and 235 psig. Each boiler is capable of firing on either pulverized coal or natural gas, and includes two coal pulverizers and four burners. Coal for the Steam Plant is purchased regionally, delivered by truck, and stored in a bermed area near the Steam Plant. Runoff from the coal pile is collected and treated in the Steam Plant Wastewater Treatment Facility prior to discharge to the sanitary sewer system. Natural gas is supplied from the Y-12 Plant system through an 8-in-diameter, and a 125-psig underground main; a pressure reducing station reduces the pressure to 25 psig for use in the burners.

Steam is distributed throughout the Y-12 Plant at 235 psig through main headers ranging in size from 5 cm (2 in) to 46 cm (18 in) in diameter. Condensate is collected and returned to the Steam Plant using a similar network of pipes; a majority of the returned condensate is used as feed to the demineralized water system.

The source of raw water for the Y-12 Plant and a city of Oak Ridge filtration plant is the Melton Hill Reservoir section of the Clinch River. Raw water is pumped approximately 9,000 ft from the reservoir to a 1.5 million gal storage tank and pumping station east of the Plant. From the pumping station, raw water is pumped to a 91 MLD (24 MGD) filtration plant water system that also serves Oak Ridge National Laboratory (ORNL) and the city of Oak Ridge. Separate underground piping systems provide distribution of raw and treated water within the Y-12 Plant. Raw water is routed to the Y-12 Plant by two lines: a 41-cm (16-in) main from the booster station, installed in 1943; and a 46-cm (18-in) main from the 61-cm (24-in) filtration plant feed line. The raw water system has approximately 8 km (5 mi) of pipes with diameters ranging from 10-cm (4-in) to 46-cm (18-in). The primary use of the raw water is to maintain a monthly average minimum flow of 7 MGD in the East Fork Poplar Creek (EFPC).

Treated water is routed from the city of Oak Ridge filtration plant to Y-12 facilities by three lines: one 61 cm (24 in) main and two 41 cm (16 in) mains; the total treated water system contains approximately 31 km (19 mi) of pipe ranging in size from 3 cm (1 in) to 61 cm (24 in) in diameter. The treated water system supplies water for fire protection, process operations, sanitary sewage requirements, and boiler feed at the Steam Plant. Treated water usage at the Y-12 Plant averages 5 to 6 MGD, or 160 to 200 million gal/month. The ownership and operation of the treated water system were transferred from DOE to the city of Oak Ridge in May 2000.

Demineralized water is used to support various processes at the Y-12 Plant that require high-purity water. A central system located in and adjacent to Building 9404-18 serves the entire Y-12 Plant through a distribution piping system. This system consists of feedwater storage, carbon filters, demineralizers, a deaerator, and demineralized water storage tanks. The primary source of feedwater is condensate return which is cooled and stored in two storage tanks (13,000 gal and 30,000 gal). The secondary source of feedwater is softened water from the Steam Plant; feedwater from the storage tanks is filtered, demineralized, deaerated, and stored until needed.

The demineralization system includes four mixed-bed-type demineralizer units, each capable of delivering 100 gpm of water. These units, which use commercial resins, operate alternately—one unit is online while the other three are on standby. The system also includes three storage tanks: one with a 30,000-gal capacity and two with a 20,000-gal capacity each. Demineralized water is distributed in 8m cm (3 in) and 15-cm (6 in) mains constructed mostly of stainless steel. The mains run above and below the ground in approximately equal proportions. The *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report indicates that the existing system is in good mechanical condition.

The Y-12 Site's sanitary sewer system was first installed in 1943 and expanded as the Y-12 Plant grew. Sanitary sewage from the Y-12 Plant flows by gravity to a 46-cm (18-in) sewer main that leaves the west end of the Plant near Lake Realty and connects to the city main near the intersection of Bear Creek and Scarboro roads. The current system capacity is approximately 1.5 MGD.

According to the *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report, the sanitary sewer system has been upgraded over the past couple of years and is judged to be in good shape. The storm drainage system, however, is judged to be in need of repair; some lines are collapsed, most lines have sediment buildup, and some mains are undersized because of changes in the Y-12 Plant layout over the years.

The chilled water systems were renovated and upgraded during the mid-1990s. Most chillers that were more than 20 years old were replaced, and the new chillers were inspected and renovated to eliminate the use of chlorofluorocarbons and to restore the chillers to optimal mechanical condition.

Industrial gases include compressed air, liquid nitrogen, liquid oxygen, liquid argon, helium, and hydrogen. Compressed air is supplied by three different systems that use compressors and associated air-drying equipment located throughout the Y-12 Plant. The high-pressure (110 psig) instrument air system serves specific production buildings in the west end of the Y-12 Plant. The low-pressure (100 psig) system also serves the production facilities in addition to serving the production support buildings and ORNL facilities located at Y-12. The Plant air system (90 psig) serves those areas where air quality is not a concern. All three systems are supplied from the same set of compressors and are different only in the operating pressure and the cleanliness of the piping systems (i.e., the Plant air piping system contains legacy oil and moisture from previous operations).

Both the high- and low-pressure instrument air systems provide dry, clean, oil-free air for air operated valves, instruments, gages, air-spindle bearings, and breathing air (for both respirators and suits). The Y-12 Plant air system is supplied from the low-pressure system; however, since the piping system is not the same quality as the parent system, the Y-12 Plant air system is operated at a lower pressure to prevent backflow and cross contamination of the low-pressure system. Air compressors and dryer systems have been installed throughout the Y-12 Plant. Twelve compressors are located in Buildings 9976, 9767-1, 9767-13, 9401-3, 9727-4, 9404-2, 9767-5, and 9767-10.

Liquid nitrogen is normally delivered to the Y-12 Plant by trailer truck. The Y-12 nitrogen supply system consists of five liquid-nitrogen storage tanks, a bank of atmospheric vaporizers, a steam-to-nitrogen vaporizer, and hot-water vaporizers. Nitrogen is delivered to all production facilities and laboratories at 90 psig through a network of 5-cm (2 in), 8 cm (3 in) and 10 cm (4 in) pipes. The five storage tanks have a combined capacity of 241,084 L (63,688 gal), or approximately 5.9 Mscf. A bank of 12 atmospheric vaporizers, each with a capacity of 4500 scf/hr at 0EF, is capable of producing 38.8 Mscf/month. In Building 9727-3, four standby hot water vaporizers with a combined capacity of approximately 300,000 scf/hr can provide an additional 100 Mscf/month. The *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report indicates that usage in 1998 at the Y-12 Plant was 192 Mscf.

Liquid oxygen is delivered to the Y-12 Plant by truck. The oxygen supply system consists of one 914,460 scf vacuum-insulated storage tank for liquid oxygen. Oxygen is generated by passing the liquid oxygen through two banks of atmospheric vaporizers that have a capacity of 5800 scf/hr, or 4.1 MScf/month. The gas pressure is reduced to 90 psig, metered, and distributed to production facilities through a 5-cm (2 in) overhead pipeline. According to the *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report, oxygen consumption between 1994 and 1998 ranged from 3 to 4 Mscf per year.

Liquid argon is delivered to the Y-12 Plant by trailer truck. The Plant's argon system consists of five vacuum-insulated liquid storage tanks and 12 atmospheric fin-type vaporizers. The storage tanks have a combined capacity of 116,351 L (30,737 gal) equivalent to approximately 3.4 Mscf of gas. The argon distribution system operates at 75 psig and includes a system of filters, dryers, regulators and meters. Gas is distributed to production areas and laboratories through a network of 5-cm (2 in) and 8 cm (3 in) pipes. Argon is also piped to the cylinder-filling station at Building 9977.

The Y-12 Plant receives and stores high-purity helium at 3,000 psig in a jumbo tube trailer. The helium facility at Building 9977-1 includes a jumbo tube trailer with a capacity of 160,000 scf. In addition, 36,000 scf of helium at 1800 psig is stored in a tube trailer and serves as emergency standby. The Building 9977-1 cylinder filing facility also houses the high pressure reducing station. Helium gas is distributed throughout the Y-12 Plant at 90 psig through a 5 cm (2 in) overhead pipeline. The *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report indicates that the condition of the current system is adequate to serve the long-term needs of the Y-12 Plant.

The hydrogen supply at the Y-12 Plant is stored in Building 9977-2 in multi-cylinder tube trailers in open concrete block stalls. Four trailers are used on a rotating basis: one is in service, one is in ready standby, one is in emergency standby, and one is being refilled. Each trailer has a capacity of approximately 30,000 scf, providing a total capacity of 90,000 scf. Stored gas is pressurized at 2,000 psig. A two-stage pressure-reducing station delivers 50 psig gas through a meter. The gas is then distributed through a 5-cm (2 in) overhead pipeline to Plant and laboratory facilities. The draft report, *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999), indicates that current usage is approximately 1,000 scfd.

According to the *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report, systems supplying industrial gases are generally oversized and do not operate at optimum efficiency. For example, the nitrogen system has an installed capacity of over 140 Mscf/min while current usage is averaging approximately 14 Mscf/min. The oxygen system has a capacity of over 4 Mscf/min compared to an average consumption in FY 1998 of approximately 300,000 scf/min. These oversized conditions results in excessive losses and increase the cost to users.

The four basic telecommunications systems within the Y-12 Plant are the Oak Ridge Federal Integrated Communications Network (ORFICN), the Cable Television (CATV) Network, the unclassified Y-12 Intrasite Network, and the Y-12 Defense Programs Network (Y-12DPNet). ORFICN consists of copper cable distributed throughout the Y-12 Plant and within all its buildings. This network is used for telephone, fax, and special data and alarm circuits and is operated by U.S. West.

The CATV Network consists of coaxial cable that is run to selected sites within the Y-12 Plant. This network has the ability to send and/or receive video among the Oak Ridge Plant's buildings at a given site and some off-site locations. Broadcasts originating at one plant can be seen at the other two as well as off-site locations and the DOE Federal Building. The CATV Network is managed and operated by ORNL's Computing, Information, and Networking Division (CIND).

The unclassified Y-12 Intrasite Network consists of a fiber-optic backbone network with fiber-optic connectivity to most buildings within the Y-12 Plant. The unclassified network uses a 100-Mbps fiber-distributed data interface (FDDI) Ring for the backbone network. This network uses a routed Ethernet service to separate Internet protocol (IP) sub-nets for each building. Within these buildings, desktop connectivity consists of mostly Category V data wiring. Most desktops presently have shared 10 Mbps connectivity, although some locations have switched 10 and 100 Mbps connectivity. External connections to the Internet are made through the ORNL Network that is managed and operated by CIND.

The Y-12DPNet is the Classified Services Network (CSN) and presently consists of a coaxial broadband network and a fiber-optic backbone network with fiber-optic connectivity to most buildings within the protected areas of the Y-12 Plant. The coaxial broadband network is still used for terminal-to-host connectivity and some Ethernet service in areas not connected by fiber optics. A fiber-optic backbone network, consisting of a 100 Mbps FDDI Ring, is used for 100 Mbps Ethernet service to buildings with fiber-optic connectivity. Within these buildings, desktop connectivity consists mostly of old, nonstandard cabling with shared 10 Mbps service. This network is connected to other nuclear weapons complex sites through DOE's SecureNet.

As part of the ORR system, telephone services for the Y-12 Plant are provided by U.S. West; approximately 7,000 voice and data lines are provided. In addition, a Plant-wide public address and emergency notification system is provided. Finally, a classified computer network supports the DP mission.

A.3 Major Y-12 Production Processes

The Y-12 mission activities required to support the production and maintenance of the secondaries and case components of the nuclear weapons physics package include:

- Providing secondary materials
- Processing materials
- Fabricating parts and components
- Assembling and disassembling secondary components
- Performing quality evaluations of secondary assemblies
- Providing safe, secure storage of secondary material and products
- Packaging and shipping materials, components, and assemblies

Functional capabilities required to perform these activities include operations to physically and chemically process, machine, inspect, assemble, certify, disassemble, and store secondary materials. Management of wastes generated from these operations is also required. The fabrication of secondaries and cases can be subdivided into the following major material production processes: uranium, lithium, and nonnuclear/special materials. The following typical process descriptions are provided to illustrate the functional activities and operations associated with each of the major production processes. These processes are based on traditional secondary and case fabrication methods and represent upper bounds to the types and number of processes that would be continued in the downsized and modernized Y-12.

A.3.1 Process Descriptions

Processes described in this section include those dealing with uranium, lithium, special materials, and nonnuclear.

A.3.1.1 *Uranium*

The uranium process provides finished enriched and depleted uranium parts and products. The operations are capable of all uranium handling and processing functions, from raw materials handling to finished parts manufacturing. In addition, uranium storage areas are provided for storage of in-process uranium materials and for the highly enriched uranium (HEU) strategic reserve.

The production of uranium parts and products involves casting or wrought processing; metal-working; machining, inspection, and certification; chemical recovery; assembly/disassembly/quality evaluation; and in-process storage. The products from casting or wrought processing are billets and cast parts that feed directly to machining and metal-working. Billets are cropped and cast parts are deluged before they are sent to the next operation. The input to casting consists of retired weapons parts, metal buttons from storage, and recycled scrap metal from metal-working and machining. A casting charge is made up and processed in a criticality-safe configuration in a vacuum induction furnace. Scrap metal and machine turnings are degreased, cleaned, and briquetted before direct recycle.

Metal-working prepares a wrought product as feed for machining. Cropped billets from casting are preheated in a salt bath, rolled into a sheet, annealed in a salt bath, blanked, and pressed. The blanking operations are a major source of recycled metal for casting. Formed parts are cleaned, debrimmed, and machined.

Both formed and cast blanks are machined to finished dimensions and inspected. Scrap metal and machine turnings are returned to casting for cleanup and reuse. Miscellaneous solids are sent to the chemical recovery systems for treatment to recycle the material back to metal buttons. Product inspections and certification are accomplished with coordinate measuring machines, optical gauging, high-energy x-ray radiography, ultrasonic and dye penetrant flaw-inspection methodology, plating thickness gaging, and mechanical properties testing.

Enriched uranium chemical recovery receives feed from virtually all areas in the process. The major feeds are residuals from casting, impure metal chips from machining, and a miscellaneous array of combustibles from all areas. The feeds are incinerated and processed in a head-end treatment consisting of acid dissolution, leaching, and feed preparation for solvent extraction. The feed solution is processed through primary extraction by which it is purified, concentrated by evaporation, and purified further by secondary extraction. The resulting solution is converted to oxide, then to UF_4, and then to uranium metal buttons. Secondary residues are returned to the head-end treatment. Finished metal is returned to casting for reuse.

Assembly operations assemble parts into subassemblies using joining techniques such as welding, adhesive bonding, and mechanical joining. Disassembly takes retired weapons apart and recycles all materials of value. The quality evaluation function receives weapons from the stockpile for disassembly, evaluation, and life cycle testing. Shipping containers for weapons parts and subassemblies are certified and refurbished as part of the assembly and disassembly process.

Uranium storage includes storage vaults for in-process uranium materials, which include buttons and other scrap materials directly recycled, as well as semifinished and finished components. The vaults at Y-12 are also used for the strategic reserve, which includes assembled secondaries and HEU metal castings and surplus HEU awaiting final disposition.

A.3.1.2 *Lithium*

The lithium process provides finished lithium hydride and lithium deuteride parts. Primary functional elements of this process include powder production and forming, finishing and inspection, and deuterium production. These systems are briefly described below.

The lithium hydride and lithium deuteride from storage, recycled weapons parts, and manufacturing scrap are broken, crushed, and ground to produce powder. The powder is loaded into molds and cold isostatically pressed to form solid blanks.

The blanks are unloaded from the molds and placed into vacuum furnaces where they are outgassed by heating under vacuum. After cooling, the outgassed blanks are loaded into form-fitting bags, heated, and then warm pressed. After being warm pressed, the blanks are cooled to room temperature and removed from the bags. The fully dense machining blanks that result from forming operations are radiographed to detect any high-density inclusions. Powder production, mold loading, and radiography are all performed in dry gloveboxes to minimize reaction of the lithium hydride and lithium deuteride with moisture in the atmosphere. Mold unloading, furnace loading and unloading, and bag loading and unloading are all conducted in an inert glovebox. The lithium hydride or lithium deuteride is handled outside inert-atmosphere gloveboxes only when it is sealed in a mold or bag.

The blanks from forming operations are machined to final shapes and dimensions on lathes using single-point machining methods in finishing operations. Most machine dust is collected for direct recycle salvage operations. The finished part weight and dimensions are inspected using certified balances and contour measuring machines. All machining and inspection activities are conducted in dry gloveboxes to minimize any reaction with moisture in the atmosphere. Certified parts receive a final vacuum outgassing treatment before final assembly.

Deuterium is required for many of the products and is stored for future use. Deuterium oxide, or heavy water, is electrolytically reduced. The resulting deuterium is compressed and stored for use. If necessary, the compressed deuterium gas is used to reconvert the lithium metal to deuteride in the final step of wet chemistry.

Lithium wet chemistry can be used to pre-produce lithium hydride and lithium deuteride to meet production requirements for many decades. The principal function of wet chemistry is to purify lithium hydride and lithium deuteride by removing oxygen and other trace elements. The principal feeds to this system are retired weapons components from the disassembly operation, machine dust, powder, and killed parts from other operations. Purification is accomplished by transforming the lithium hydride and lithium deuteride through a chemical dissolution process, then the solution is evaporated and crystallized. The crystals are then reduced to lithium metal and impurities are removed. The lithium metal is reconverted to lithium hydride and lithium deuteride by combining it with hydrogen or deuterium gas. The resulting lithium hydride and lithium deuteride billet, sealed in a thin stainless-steel can, is transferred to lithium storage.

The production of lithium hydride and lithium deuteride components creates a considerable amount of scrap that must be recycled to recover the lithium and deuterium. Much of the machine dust, unacceptable formed parts, machined parts that fail inspection, and stockpile returned parts are directly recycled. Salvage operations typically process material that is too impure to be recycled. Salvage operations primarily involve washing and chemical recovery. Items that require washing include machining tools and fixtures, filters used throughout the processes, and sample bottles. Oil-soaked lithium hydride and lithium deuteride blanks from the powder-forming operations are also prepared for storage. Solutions from the purification and wash operations, including mop and dike water streams, are neutralized, filtered, crystallized, and sent to storage or waste disposal.

Long-term storage is required for chemicals and pre-produced lithium hydride and lithium deuteride billets. Interim storage is provided for lithium hydride and deuteride components from disassembly or retired weapons and rejected components from forming and finishing operations.

A.3.1.3 *Special Materials*

Special materials such as diallyl-phthalate are required to support DP. Diallyl-phthalate based molding compound is formed into near-net-shape blanks that are later machined to finished parts. The primary forming operation is compression or transfer molding, which is followed by a drying and final curing step. Current beryllium operations are located in Buildings 9202, 9201-5, 9201-5N, and 9995. Beryllium machining, final dimensional inspection, and beryllium part certification currently provide worker protection through the use of vent hoods and personal protective equipment. All of these operations rely heavily on administrative controls for worker protection. The existing buildings in which beryllium operations are located range from 27 to more than 50 years old.

A.3.1.4 *Nonnuclear*

The nonnuclear process is responsible for producing certain weapons components composed of nonnuclear materials and for providing the uranium and lithium processes with specialized material and support services. Many types of materials are processed to provide a diverse product line consisting of both nonnuclear metal components and tooling and a variety of polymer-based items. The principal manufacturing technologies employed are hydroforming, hydrostatic forming, rolling, forging, heat treating, welding, machining, cold/hot isostatic pressing, grinding, winding, casting, plating, molding, and coating.

The nonnuclear process handles several product streams, which are described briefly in the following paragraphs.

Several types of urethane foams are required to be produced. The urethane components and blowing agents are pumped into molds and allowed to expand to fill the mold. After curing, the foam moldings are ejected and trimmed to final shape.

Steel and aluminum are construction materials for both components and support tooling, making this a relatively high throughput product line. The usual fabrication route for both materials is rough machining, heat treatment, and finish machining.

Operations to produce stainless-steel cans consist of blanking, followed by hydroforming and hydrostatic forming with subsequent machining and heat treatment. Ultrasonic cleaning is required before heat treatment to ensure cleanliness for welding, which completes the assembly.

Ceramic finished parts are finished from blanks or procured. Procured parts are inspected and certified prior to final assembly.

Polyvinyl chloride is formed into bags and castings and is also applied as a coating. Items to be coated are dipped into a tank of curable, plasticized polyvinyl chloride formulation, whereas castings are produced by transferring the polyvinyl chloride liquid into a mold. All items are heat cured.

Figures A.3.1–1 through A.3.1–3 depict the waste management system associated with the Y-12 production missions. Waste management facilities for treatment and storage are described in Section A.5.

FIGURE A.3.1–1.—*Waste Management Process - Solid Waste Treatment.*

FIGURE A.3.1–2.—*Waste Management Process - Declassification*.

FIGURE A.3.1–3.—*Waste Management Process - Process Wastewater Treatment and Waste Thermal Treatment.*

A.4 Y-12 DEFENSE PROGRAMS MAJOR FACILITIES DESCRIPTION

Of the approximately 714,317 m^2 (7.6 million ft^2) of total floor space at the Y-12 Plant, DP occupies roughly 427,350 m^2 (4.6 million ft^2); approximately 223,000 m^2 (2.4 million ft^2) are in major manufacturing facilities, and approximately 195,100 m^2 (2.1 million ft^2) are in support facilities (LMER 1999, SPAS 1999, DOE 1999). According to the *Oak Ridge Y-12 Plant Site Facility Plan, FY 1999-FY 2008* (SPAS 1999), 49 DP buildings are in surplus; most of these are small support structures that are not process-contaminated. The long-term objective is to plan for the removal of these facilities when it becomes cost-effective or a compliance requirement mandates action. Another 11 facilities are planned to be surplus within 10 years, assuming the availability of funding for downsizing. The remainder of the DP buildings are anticipated to have a continuing mission.

All Y-12 facilities used in processing and storage of HEU are located in the protected area of Y-12 surrounded by the PIDAS (except Buildings 9983 and 9710-3, which house only calibration sources managed by Radiological Control and the Protective Services Organization). Figure A.4–1 shows the locations of major DP facilities. Table A.4-1 provides an overview of the DP facilities. Table A.4–2 (located at the end of this appendix) lists all facilities at the Y-12 Plant. The following provides information on the major DP facilities located at the Y-12 Plant.

A.4.1 Building 9212 Complex

The Building 9212 Complex includes Buildings 9212, 9818, 9815, and 9980. Over 100 operations or processes have been or are capable of being performed within the Building 9212 Complex. The primary missions performed in this Complex include the following:

- Casting of HEU metal (for weapons, reactor fuels, storage, and other purposes)
- Accountability of HEU from Y-12 Plant activities (quality evaluations, casting, storage)
- Recovery and processing of HEU to a form suitable for storage and/or future designation (from Y-12 Plant activities and commercial scrap)
- International Atomic Energy Agency (IAEA) sampling of surplus enriched uranium
- Packaging HEU for off-site shipment
- Preparation of special uranium compounds and metal for research reactor fuel

The largest building, Building 9212, is a multistory facility constructed in the early 1940s of structural steel frame infilled at the perimeter with thick hollow clay tiles. It was built in stages over a period of years. The substructure basement is constructed of reinforced concrete. The original structure consisted of a headhouse 22 by 94 m (72 by 308 ft) (N–S direction) and four wings projecting from the east side of the headhouse, each 11 by 80 m (36 by 264 ft) (A, B, C, and D Wings).

In 1948, new structures were added in the space between the A, B, and C Wings (A-1, B-1, and C-1 Wings) and adjoining D-Wing (D-1 Wing). Finally, a single-story 34 by 122 m (113 by 400 ft) long steel frame structure was added in 1951 (E-Wing). Other less extensive modifications or additions have been added subsequently.

TABLE A.4–1.—*Y-12 Defense Program Major Facility Overview* [Page 1 of 2]

Facility Designation	Function	Mission	Current Status
Building 9212 *Includes Buildings 9818, 9815, 9980, 9981*	• Uranium Recovery Operations • Metallurgical Operations • In-Process Storage • X-ray density	• Recovery of HEU to a form suitable for storage • Casting HEU metal (for weapons, storage, reactors, or other uses) • HEU down-blending • Accountability of HEU from Y-12 Plant activities • Nondestructive evaluation of parts	Not Operating except for limited special operations. Operations expected to resume after stand-down
Building 9206 *Includes Building 9720-17*	• Chemical recovery of intermediate enrichments of HEU (20% to 85% ^{235}U) • In-Process Storage	• Recovery of HEU to a form suitable for storage	Not Operating-HEU materials will be transferred to Building 9212 for processing or to a storage location. Operations in Building 9206 will not resume
Building 9720-12 *Includes a small storage area in Building 9201-5*	• Storage of combustibles, residues and other solid waste material contaminated by HEU	• Storage of combustibles, residues, and other solid wastes awaiting chemical recovery of HEU	In use as a storage facility
Building 9215 *Includes Building 9998*	• Storage • Dismantling • Fabrication (rolling, heat treating, forming, shearing, machining, inspection, etc.) of parts	• Storage and handling of HEU • Dismantling of weapons • Fabrication and inspection of metal parts • HEU down-blending	Partial operations. Full operations expected to resume after stand-down
Building 9720-5 *Includes bonded storage area in 9204-4*	• Storage of HEU • Receiving • Shipping • SNM vehicle material transfers	• Warehouse for shipping and receiving HEU from other sites • Transient, interim, and long-term storage of HEU • In-Plant material transfers in SNM vehicle	Operating
Buildings 9204-2 and 9204-2E	• Assembly • Product Certification • Disassembly • Storage	• Assembly of new or replacement weapons • Quality operations for certification • Disassembly of retired weapons • Storage of retired weapons assemblies, subassemblies, and components • LiH/LiO production	Operating

TABLE A.4–1.—*Y-12 Defense Program Major Facility Overview* [Page 2 of 2]

Facility Designation	Function	Mission	Current Status
Building 9204-4	• Quality Evaluation/Disassembly • Metalworking • Testing • Plating	• Currently, only Quality Evaluation/Disassembly is conducted	Operating
Building 9995	• Analytical Chemistry Organization	• Provides analytical support services for Y-12 and LMES regulatory compliance	Operating
Building 9201-5W	• Metal machining	• Machining of metal parts	Not operating. In standby awaiting refurbishment
Building 9201-5N	• Machining • Dimensional Inspection • Electroplating • X-ray density	• Depleted uranium and stainless-steel machining • Dimensional inspection of parts • Electroplating of parts • Nondestructive evaluation of parts	Operating
Buildings 9202 and 9203	• Process Development • Beryllium Operations	• Development and refinement of manufacturing processes employed at Y-12 • Technology transfer support	Operating
Building 9996	• Storage	• Tooling and material storage	Active
Building 9201-1	• Metal and graphite machining	• General machine shop • Machining and tooling • Work for others • Technology transfer	Operating
Building 9201-5	• Machining • Dimensional Inspection • Nondestructive Evaluation (x-ray density)	• Machining of beryllium • Dimensional inspection of parts • Nondestructive evaluation of parts	Operating

Note: SNM - special nuclear material.
Source: DOE 1996.

FIGURE A.4.–1.—*Major Defense Program Facilities at Y-12*.

The Building 9212 Complex houses two major process areas: (1) the Building 9212 Uranium Recovery Operations (also called Chemical Recovery Operations), which occur primarily in the Headhouse, Wings B-1, C, and C-1, and Buildings 9818 and 9815; and (2) the Metallurgical Operations which occur in the E-Wing. Buildings 9818, 9815, 9880, and 9981 are small structures adjacent to Building 9212, which contain services for operations in Building 9212.

The HEU materials located in the Building 9212 Complex are in various chemical forms, both liquids and solids, and are in more than 6,000 separate containers. All this material is considered "in process." Material awaiting processing, including solid process residues, fluorides, low-equity residues, and aqueous and organic solutions of many kinds, is stored throughout the building. Solids are typically stored in cans made from ordinary carbon steel or stainless steel, depending on the material. Liquids are stored in plastic criticality-safe bottles.

There are no floor areas where solutions may collect to greater than 4 inches in depth. Nearly all vessels in the solvent extractions operation are of safe geometry. Solid oxides and residues are stored in cans of limited volume and controlled mass. The foundry operation, which involves the use of large amounts of uranium metal, is closely controlled, and each operation is subjected to criticality safety analysis and control.

Large quantities of combustible organics can be in-process in the B-1 Wing. In the past, there have been some minor explosions in the chemical recovery operations involving Nitric Acid Dissolvers, Muffle Furnaces, and Destructive Distillation Unit Operations. The *Highly Enriched Uranium Vulnerability*

Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant (LMES 1997) report identifies interim corrections associated with Building 9212. These include manual fire fighting capability that is provided on-site 24 hours/day; the three active extraction systems are segregated from each other; and the dissolution processes are performed in well-ventilated chemical fume hoods or dissolvers. The E-Wing baghouse is equipped with flame-resistant bag filters that reduce the predicted likelihood of a major fire with significant release of HEU to very low (i.e., not expected to occur in the life of the facility). Finally, every inventory period the E-Wing bag filter is shaken down and the residue is collected; the material is removed to minimize the accumulation of HEU.

The Building 9212 Complex is currently not operating except for limited special operations. It is expected that operations will resume after stand-down.

The following summarizes Building 9212 Uranium Recovery Operations and Metallurgical Operations.

A.4.1.1 Uranium Recovery Operations

Uranium recovery operations include recovery/purification of HEU-bearing scrap into forms suitable for reuse and accountability of the HEU contained therein. The majority of this scrap and waste was generated by Y-12's weapon production or disassembly operations and by the recovery processes themselves. Some scrap and waste were generated through nuclear materials production; additional scrap is received from other sites for recovery or for accountability of the HEU it contains. The nature of these HEU-bearing materials varies from combustible and noncombustible solids to aqueous and organic solutions. Concentrations of HEU vary in these materials from pure uranium compounds and alloys to trace quantities (parts per million levels) in combustibles and solutions.

The recovery and purification process can be divided into the following general groupings:

- Headend Operations (Headhouse, B-1, C, and C-1 Wings)
  - Bulk reduction of scrap (mostly burning)
  - Dissolution of scrap into uranyl nitrate solution
  - Separation of uranyl nitrate from nonuranium materials
  - Continuous Recovery and Purification Operations (B-1 and C-1 Wings)
  - Organic solvent extraction
  - Evaporation
  - Conversion of uranyl nitrate to UO_3
  - Conversion of UO_3 to UF_4

- Reduction
  - Blending of UF_4
  - Calcium reduction of UF_4 powder to uranium metal

- Special Processing
  - Special materials production
  - Accountability of scrap
  - Scrap dissolution
  - Packaging of materials for shipment

- Waste Streams and Materials Recovery (Buildings 9818 and 9815)
  - Nitrate recycle
  - Biodenitrification
  - Materials storage and handling
  - Chemical makeup

The Biodenitrification Unit, located in Building 9818, utilizes such treatment methods as neutralization, pH adjustment, and nitrate removal to treat liquid mixed low-level waste (LLW) (e.g., nitrate solutions from enriched uranium recovery). The Phaseout/Deactivation Program Management Plan has been approved by DOE for Building 9206 (see Section A.4.2); waste that was generated and transported to Building 9818 will no longer be generated.

A.4.1.2 *E-Wing Metallurgical Operations*

Casting of enriched uranium metal and alloys occurs in vacuum induction furnaces located in E-Wing. Cast components are shipped to M-Wing in Building 9215 via the intrasite Special Nuclear Materials (SNM) Vehicle for machining. Machine turnings are washed in water and freon to remove machine coolant and boron, dried, and pressed into briquettes for reuse in the casting operation. A number of presses and shears are used to condition recycled weapons components and other metal parts for casting. Recycled metal may be washed with nitric acid to remove surface oxide prior to casting. Waste from the casting operations is sent to the chemical recovery operations for accountability and recovery.

Metallurgical Operations can be described in the following general groupings of activities:

- E-Wing Casting
  - Preparation of metal feed
  - Casting metal into parts or cylinders
  - Packaging of materials for shipment
  - Machine turning recycle

A.4.2 Building 9206 Complex

The Building 9206 Complex includes the primary Building 9206 and an immediately adjacent Building 9720-17. The Complex is centrally located in Y-12 near the east end of the protected area. Building 9720-17, adjacent to the south side of Building 9206, is constructed of prefabricated metal and occupies approximately 297 m^2 (3,200 ft^2). Building 9720-17 was constructed in the 1950s. This metal-frame building has transit siding and a concrete slab on grade.

Building 9206 is a multi-story facility constructed in the early 1940s of structural steel infilled at the perimeter with thick, hollow clay tile. It is approximately 50 by 79 m (165 by 260 ft). The building consists of a second floor in its center portion and two sections elevated to two stories. The two one-story sections are approximately 18 by 50 m (60 by 165 ft) and 24 m (80 ft) in plan with a height of 6 m (18 ft). The center section measures approximately 37 by 50 m (120 by 165 ft) with a height of 10 m (32 ft). Also contained in Building 9206 is an incinerator, which is currently permitted for burning combustible waste containing uranium.

Building 9206 has generally been reserved for intermediate enrichments (20 to 85 percent) of HEU. Its original design mission was to recover HEU from the electromagnetic separation process. After World War II, Building 9206 received intermediate enrichments of uranium from the gaseous diffusion plants as uranium hexafluoride. An ammonia gas reduction and hydrofluorination was used to convert the uranium hexafluoride (UF_6) to uranium tetrafluoride (UF_4). In the mid-1950s, a UF_6 to UF_4 conversion facility using fluorine and hydrogen gas was installed to perform the same function. In either case, the UF_4 was reduced with calcium metal to purified uranium metal. Supporting the conversion processes, recovery processes were installed to recover and purify uranium contained in the increasing waste processes. Many of these processes were patterned after the recovery process equipment that was installed in Building 9212.

In the late 1960s, Building 9206 underwent modifications to install denitration and fluid bed systems for the conversion of uranyl nitrate to UF_4. The mission of converting recovered uranyl nitrate from the Savannah River back into metal was transferred to Building 9206 in 1973. The machining-turning-cleaning process was installed in the mid-1980s for recycling intermediate enrichments of uranium turnings. In 1988, shipments of uranyl nitrate from the Savannah River were stopped. A year later the weapon production rate was severely decreased. In 1993, decommissioning of Building 9206 began. Since that time, most of the processes have been shut down and some processes have been removed from the facility.

The *Building 9206 Complex Phaseout/Deactivation Program Management Plan* (LMES 1999) describes the activities to transition the existing chemical recovery capabilities from Building 9206 to Building 9212 and deactivation of the 9206 Complex. The project is expected to last 6 to 10 years. The phaseout and deactivation will reduce the risk of existing hazards and place the building in a positive, safe, and environmentally secure configuration. Some in-process holdup still remains in the facility tanks and process lines.

There are no plans to resume operations in Building 9206. At the present time, Building 9206 is designated as an in-process HEU storage area; this will be its function until the stored material can be transferred to Building 9212 for processing, or to another storage location. Building 9206 has five permitted RCRA waste storage locations. The locations are used for storage of both hazardous waste, as defined by RCRA, and nonhazardous waste mixed with HEU awaiting recovery or disposal. The hazardous wastes include characteristic and listed wastes. Hazardous materials include a number of strong and weak acids as well as various organic materials.

Material transfers occurring within the Building 9206 Complex are performed by a number of different methods. Dollies designed to provide safe spacing of fissile material containers are used to perform the majority of the container transfers. Personnel are also permitted to transfer single fissile material containers by carrying them. Process material transfers are accomplished with pumps and airlifts.

The *Highly Enriched Uranium Working Group Report* (DOE 1996a) identified that the storage of pyrophoric material and flammable gases for the furnaces in Building 9206 under certain conditions can result in explosions. The report also noted that Building 9720-17 is not protected by an automatic sprinkler system to detect and suppress a fire; however, sprinklers are not necessary if the combustible level is kept low.

The *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report identified interim corrections associated with Building 9206: manual fire fighting capability is provided on-site 24 hours/day; materials are stored in taped cans; much of the uranium is in the form of oxides that do not burn; reactor vessels are inspected daily as a part of the operator's round; and natural gas supply to the building has been shut off and tagged outside the building.

A.4.3 Building 9720-12

Building 9720-12 is a warehouse facility located in the western portion of Y-12. The building is a single-story, steel structure with sheet metal exterior walls. It is 15 by 91 m (50 by 300 ft) with a pitched roof 5 m (15 ft) high at the eaves. The mission of Building 9720-12 is to provide storage for items and materials that have been removed from the Material Access Areas. The western portion of the facility is used for storage of combustibles that contain recoverable amounts of enriched uranium. The storage area is also used for other hazardous materials including RCRA storage, PCBs, and drums of beryllium. Combustible material storage containers include cans, plastic bags, and carbon-steel (208-L) 55-gal drums. Drums containing combustible materials are stored on wooden pallets and are collocated with other combustible materials that are also in drums on wooden pallets.

The *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report identified interim corrections associated with Building 9720-12: sprinkler systems are provided in storage areas; a manual fire fighting capability is provided on-site 24 hours/day; and materials are stored in sealed drums.

A.4.4 Building 9201-5

Building 9201-5 is a multi-story, steel frame and concrete structure that was constructed in the early 1940s. The building is a large production/processing facility previously used for depleted uranium and nonuranium processing. Three small storage areas for enriched uranium combustibles have been established on the third floor of the building. The building has several collocated operations, including lithium hydride storage and arc melt operations. The third floor storage area also includes miscellaneous parts, combustibles, and depleted uranium. Combustible materials storage containers include cans, plastic bags, and carbon-steel 208-L (55-gal) drums.

The *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report, identified interim corrections associated with Building 9201-5: sprinkler systems are provided in storage areas; a manual fire fighting capability is provided on-site 24 hours/day; and materials are stored in sealed drums.

A.4.5 Building 9215 Complex

The Building 9215 Complex consists of Buildings 9215 and 9998. Building 9998 is physically attached to the northeast corner of Building 9215. Both are multi-story steel buildings with hollow clay tile walls. Building 9215 was constructed in the early 1940s, and Building 9998 was added shortly thereafter. Both buildings have been expanded and modified over the years. Included in Building 9215 is a Blister Area in the northwest corner of the building where HEU parts and scraps are packaged and shipped. The Blister Area was constructed in the 1970s and is configured as an "L" shaped steel-frame structure with cement block shear walls.

The mission of the Building 9215 Complex is to provide for storage and handling of HEU inventories, to aid in the dismantlement of nuclear weapons, to provide fabricated metal shapes as needed for the nuclear weapons stockpile maintenance, and to support nuclear programs at other U.S. and foreign facilities. Materials stored in Building 9215 are considered to be part of the backlog awaiting processing. Not all of the materials will be processed in Building 9215.

Operations performed in the Building 9215 Complex are rolling and forming in O-Wing and machining of HEU parts in M-Wing. Additionally, the basement contains an HEU storage vault. Third Mill operations include salt-bath heat treating, rolling, shearing, and plate cutting of depleted uranium, depleted uranium alloys, and nonradiological materials. Arc melt operations include sawing, skull casting, and vacuum arc remelting of depleted uranium and depleted uranium alloys. P-Wing operations include forming, heat treating, and rolling of depleted uranium, depleted uranium alloys, and nonradiological materials.

Building 9998 contains H-2 inspection, machining, and storage areas, H-1 foundry (casting of depleted uranium, depleted uranium alloys, and nonradiological materials using induced melting and arc melting processes), and an R&D area. Operations in both areas include the handling, packaging, and transporting of HEU materials and parts. The Blister Area allows collection, packaging, receipt, and shipment of outgoing HEU metal parts, chips, metal scrap, and contaminated combustibles. F-Area/A-Wing operations include metal forming, heat treating, and arc melting of depleted uranium, depleted uranium alloys, and nonradiological materials.

The *Highly Enriched Uranium Working Group Report* (DOE 1996a) noted that there have been 16 reportable occurrences for the Building 9215 Complex partition area. These occurrences include 15 off-normal occurrences and 1 unusual occurrence. The off-normal occurrences include person/clothing contamination (11 cases), inventory difference (1 case), loss of ventilation (1 case), injury (1 case), and loss of facility power (1 case). The unusual occurrence occurred on April 30, 1996, and involved an operator safety requirement violation.

According to the *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report, interim corrections associated with Building 9215 include the packing of machine turnings in coolant to prevent dry out and spontaneous combustion, and the use of vented ship dollies to prevent pressurization due to hydrogen generation.

Except for limited special operations, the Building 9215 Complex is currently not operating. It is expected that operations will resume after stand-down.

A.4.6 Building 9720-5

Building 9720-5 historically has been used as a warehouse for weapons-related materials and reactor fuel. The facility was built in 1944 and has since been renovated. The current mission is an operating warehouse used for short- and long-term storage of materials, including high-equity uranium, weapons assemblies, reactor fuel, and low-equity materials awaiting recycle.

The facility is a single-story building with a concrete floor elevated about 1 m (4 ft) above local grade; air is exhausted unfiltered through roof-mounted fans. The main warehouse dimensions are approximately 46 by 91 m (150 by 300 ft). Five dock areas serve the transfer of SNM and non-SNM materials to and from approved transport vehicles.

The *Highly Enriched Uranium Working Group Report* (DOE 1996a) raised several concerns about Building 9720-5. These included concerns about potential flooding by a 5,000- or 10,000-year flood, and collapse of the Brookhaven fuel storage vault walls and storage racks during an earthquake. While the potential for fires of sufficient intensity to threaten materials in the vaults is low, the potential for a wide-scale facility fire that would then involve the drums storage in cages was judged to be higher. Differences in construction, operating practices, amount of combustibles, design of the specific storage arrays, and specific locations of the arrays within the buildings means that fire risks are expected to vary among the Building 9720-5 storage arrays.

The *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report identified interim corrections associated with Building 9720-5. The partitioned area is covered by wet-pipe sprinkler systems, portable fire extinguishers, and fire alarms; forklift trucks are required to be electrically operated; all wooden surfaces comprising the building frame are periodically painted with fire retardant paint; and all hot work operations (i.e., cutting, welding, etc.) are controlled by special permit. Use of combustible/flammable liquids in the facility is very limited.

A.4.7 Buildings 9204-2 and 9204-2E

Building 9204-2 was built in 1943 and has been used to support nuclear weapons production since that time. The main structure of the building is structural steel and concrete with freestanding hollow clay tile exterior and interior walls. As a result of a major upgrade program, Lithium Process replacement, some of the major processes and equipment were upgraded in the early 1990s. In addition, a portion of Building 9204-2 is being modified for storage of HEU materials.

Building 9204-2E, which comprises the major portion of the building partition, is a multi-story facility, reinforced concrete slab structure built in 1971 to house weapon assemblies. Exterior walls on the first floor are reinforced concrete, but are clay tile and concrete block with brick veneer on the second and third floors. Interior walls are also clay tile and concrete block. Major assembly and disassembly facilities are located in Building 9204-2E. According to the *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) report, the building is generally in good condition except for a structural problem with the west wall and deterioration of the third floor from Kathene leakage.

Four current HEU activities at 9204-2E include:

- Assembly of new or replacement weapons

- Quality certification of components and assemblies
- Disassembly of retired weapons assemblies
- Storage of retired assemblies, subassemblies, and components

Assembly and disassembly operations areas, five vault-type rooms, and one vault are located in Building 9204-2E. Most of the HEU is composed of metal pieces or weapons components. According to the *Highly Enriched Uranium Working Group Report* (DOE 1996a), significant quantities of various hazardous materials are collocated with HEU in the operations areas.

Barriers to exposure of workers or the public to radiation or chemical hazards or to releases of radioactive materials to the environment include packages and containers, and vault and/or room walls; and for some operations, gloveboxes, hoods, and ventilation systems with high-efficiency particulate air (HEPA) filters. Both Buildings 9204-2 and 9204-2E are protected by smoke and heat detectors, sprinklers, and alarm systems. Operations and storage activities are conducted by procedure in accordance with criticality safety approvals that incorporate double contingency. At least two independent criticality alarm systems cover each HEU area to annunciate a criticality accident.

According to the *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report, interim corrections associated with these buildings includes fixed fire suppression systems and smoke alarms; ventilation, both for recirculating and exhausting, is HEPA filtered; the ventilation system includes a smoke removal system; uranium chips are packed in coolant to prevent dry out and spontaneous combustion; machining and work with lithium hydride, lithium deuteride, and uranium are conducted in controlled atmospheres to prevent ignition; and machining is conducted under exhaust hoods in conjunction with respirator use to prevent internal contamination.

A.4.8 Building 9204-4

Building 9204-4 was built in 1943 and is a three-story structure (including the basement level) 73 by 112 by 27 m (240 by 368 by 87 ft). The main structure is steel and concrete. The roof is constructed with precast concrete roof planks over structural steel beams. The exterior and original interior walls are constructed of 30 cm (12 in) of hollow clay tile with no attachment between the walls and structural slabs or beams. Building 9204-4 has complete fire detection and fire suppression coverage.

Areas within Building 9204-4 can be functionally classified as follows: (1) quality evaluation of current weapons production programs and disassembly of obsolete weapons; (2) metal-working operations (forging, forming, heat treating) and grit blast cleaning of depleted uranium, depleted uranium alloys, and metals such as steel and aluminum; (3) a Bonded Storage Area (occupying approximately 929 m^2 [10,000 ft^2]) and vault-type room for storage of SNM (occupying approximately 557 m^2 [6,000 ft^2]); (4) radiography, ultrasonic, and other nondestructive testing (NDT); and (5) a plating area. The only active operational areas involving HEU within Building 9204-4 are quality evaluation, assembly, and storage in the vault-type room and the Bonded Storage Area. The plating area, while shut down, contains residual materials. The Bonded Storage Area and the vault-type room are set aside for storage of HEU in drums.

Key safety features of Building 9204-4 include a criticality alarm system and detectors. Two criticality detectors are located in Building 9204-4: one in the quality evaluation area (on the second floor) and the other adjacent to the Bonded Storage Area (on the first floor). The building is equipped with a fire detection and fire suppression system consisting of wet-pipe sprinklers. The ventilation exhaust system is HEPA-filtered. Additionally, the quality evaluation and disassembly areas are equipped with HEPA-filtered gloveboxes for use in performing a limited number of operations.

HEU is normally stored within specially designed packages and containers except when quality evaluations or disassembly operations are being performed. A variety of packaging configurations for HEU-bearing materials is used. For relatively pure metal and weapons components, packaging configurations include (1) 114 208-L (30 55-gal) drums and overpacks designed to U.S. Department of Transportation (DOT) requirements with weapons components or canned subassemblies, (2) metal stored in cans with birdcages, (3) metal components or canned subassemblies with special metal vessels designed for use in quality evaluation operations, and (4) metal in slip-lid cans. Sealed and unsealed polypropylene bottles are used for low concentration HEU solutions or mop water, respectively. Polyethylene bags contain paper, plastic, mop heads, and other miscellaneous combustible materials used in the process areas. The total number of HEU storage containers within the quality evaluation and disassembly partition is approximately 100, with the majority (>60 percent) being 208-L (55-gal) drums and polyethylene bags of combustibles. Storage of HEU in the process areas is minimal due to criticality safety approval limitations.

Storage configurations range from drum arrays in vaults to cans and bottles stored on transport carts and dollies within vault-type cages. Polyethylene bags are stored within the process areas or consolidated into 208-L (55-gal) drums prior to shipment from the facility.

Building 9204-4 press operations include the forming of depleted uranium, depleted uranium alloys, and non-radiological materials using 7,500-ton, 1,500-ton, and 1,000-ton presses.

The *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report identified interim corrections associated with this building to include fixed fire suppression systems and smoke alarms which alarm locally and to remote continuously monitored locations; ventilation, both recirculating and exhausting, is HEPA filtered; uranium chips are packed in coolant to prevent dry out and spontaneous combustion; machining and work with lithium hydride, lithium deuteride, and uranium are conducted in controlled atmospheres to prevent ignition; and machining is conducted under exhaust hoods in conjunction with respirator use to prevent internal contamination.

A.4.9 Building 9995

Building 9995, the Analytical Chemistry Organization (ACO), is a multistory 37 by 10 m (123 by 361 ft) facility that was constructed in 1952. It is a steel frame structure with hollow clay tile and concrete block walls on reinforced concrete foundation. A 2-inch-thick gypsum roof deck covers the majority of the building with concrete on the remainder. The building is within the Y-12 PIDAS area. Building 9995 has had two major expansions since it was originally constructed. A south addition was added in 1969 that is currently used for analytical development. An annex office area was added in 1981. The roof on the main structure was replaced in the early 1970s. The primary operations area is divided between first-floor and basement levels. Two service elevators connect the various floors of the building; the elevators are original equipment and according to the draft report, *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999), they are not code compliant.

Building 9995 is equipped with approximately 150 chemical fuming hoods with supporting heating, ventilation, and air conditioning (HVAC) systems that form the primary engineered safety feature. Most chemical fume hoods in the building are original equipment; limited hood upgrades have been performed and approximately 20 hoods were replaced in the mid-1980s with additional units having been added or replaced at various times during laboratory alteration projects. There are 52 separate supply and exhaust systems; however, most air is supplied by seven major air handling units that provide conditioned, filtered air to the various rooms in Building 9995. Five major exhaust fans support hoods, and each hood is fitted with a continuous flow monitor to allow convenient confirmation of hood flow before use. The ventilation system in Building 9995 is a zoned, once-through system that provides more than six air exchanges per hour.

The facility was designed for, and is currently used as, an analytical chemistry laboratory, providing analytical support for DP, Work-for-Others, and operation and maintenance (O&M) contractor, regulatory compliance programs. The total facility is restricted to a maximum of 5 kg (11 lb) of HEU for criticality safety. Analyses associated with HEU include impurities by emission spectroscopy, x-ray fluorescence spectrometry or Davies-Gray titration, carbon analysis by LECO carbon analyzer, and isotopic analysis by thermal oxidation mass spectrometry. Control of enriched uranium is facilitated by bar coding of samples and by a computer system for recording the location of materials within the facility. Most work is done in hoods. The area is provided with sprinklers in the event of a fire.

The *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report indicates that special facilities located in Building 9995 include the Lithium Preparation Room, Argon-purged gloveboxes, and a gas-mixing laboratory. The Lithium Preparation Room has its own roof-mounted HVAC system, independent of the rest of the building; the room atmosphere is humidity controlled at 10 percent relative humidity in the winter and 15 percent in the summer to limit hydrolysis of reactive lithium or lithium compounds. Agron-purged gloveboxes are provided in several laboratories for handling materials that require dry inert atmospheres; these are self-contained systems, and mostly include filters and desiccant systems to maintain and dry the recirculating argon while others are once-through argon-purge types. A gas-mixing laboratory is located in the room off Dock 11 in Building 9995; ACO personnel mix gases in cylinders for use by various Y-12 Plant operations.

Fire protection for Building 9995 is provided by the Y-12 Plant Fire Department. The building is also protected by a sprinkler system, an alarm system, and by departmental procedures. An alarm system located on the first floor of Building 9995 responds to the sprinkler trip alarm, glovebox heat detectors, pull boxes, and other heat detectors located in the building. In the event of a fire, it is expected to be restricted to a limited area and, because of the small amount of enriched uranium present, is not expected to have large radiological consequences. Chemical reactions resulting from the mixing of incompatible chemicals are expected to be minimal because the sample sizes are limited and operations are performed according to procedures. Safety showers are readily available throughout the laboratory.

The *Highly Enriched Uranium Vulnerability Assessment Corrective Action Plan for the Oak Ridge Y-12 Plant* (LMES 1997) report identified interim corrections associated with Building 9995 to include the location of sprinkler systems throughout the process and storage areas; flammable liquids are stored in approved flammable storage cabinets; limited quantities of gases and solvents are maintained in inventory; and portable fire extinguishers are found throughout the areas, as are cans of fire suppressant carbon in areas where chip fires are possible.

A.4.10 Buildings 9119, 9983, and 9710-3

The HEU calibration standards and test facilities are in Buildings 9119, 9983, and 9710-3. Building 9119 is an office building built of noncombustible materials and located in the western end of Y-12. The current mission of the building supports a variety of DP-related organizations. HEU sources are stored in this building in a Nuclear Materials Control and Accountability Vault. The sources are used for the calibration of nondestructive assay (NDA) equipment. Building 9983 is a small wooden frame storage building located next to Building 9711-1 in the eastern half of Y-12. Radiological control instrument calibrations are performed in Building 9983. Y-12 personnel use these sources for calibration purposes and to store sources awaiting disposal. Building 9710-3 is an office building constructed of noncombustible materials and is located in the eastern section of Y-12. This building houses the Protective Services Force which uses these sources to test the portal monitors at the Plant.

According to the *Highly Enriched Uranium Working Group Report* (DOE 1996a), HEU sources in Building 9119 are stored in fireproof safes with combination locks. The Y-12 personnel store the sources in a cabinet in Building 9983. Both buildings are protected with automatic sprinkler systems. Protective Service personnel lock the sources in Building 9710-3 in a file cabinet; the building is also protected by an automatic sprinkler.

A.4.11 Building 9201-5W

Building 9201-5W is a single-story structure 79 by 80 m (258 by 263 ft) built in 1967. The main structure is steel and concrete with brick veneer. The major portion of Building 9201-5W is a large machine shop area containing machining equipment and controls with nominal storage for in-process parts and materials. Offices for shop supervision are provided on a mezzanine. The building is used as a machine shop and performs machining, plating, and support operations (including NDT and dimensional inspections) of depleted uranium, depleted uranium alloys, and nonradiological materials. Currently, the facility is on standby awaiting refurbishment.

A.4.12 Building 9201-5N

Building 9201-5N is a one-story steel and concrete building 55 by 101 m (182 by 331 ft) with a basement that was built in 1972. It is connected to Building 9201-5W via an underground tunnel for transport of materials and parts. The building is protected by smoke and heat detectors, sprinklers, and an alarm system.

Activities conducted in Building 9201-5N include:

- Electroplating of parts
- Machining of depleted uranium and stainless steel parts
- Dimensional inspection of parts
- Nondestructive evaluation (x-ray and density) of parts
- Beryllium machining

Barriers to exposure of workers or the public to radiation or chemical hazards or to releases of radioactive or toxic materials to the environment include gloveboxes, hoods, and ventilation systems with HEPA filters. Ventilation exhaust stacks are monitored for radiological and hazardous materials as appropriate.

A.4.13 Buildings 9202 and 9203

Building 9202 was built in 1954 and is a two-story building 55 by 110 m (182 by 360 ft) with a basement and a four-story laboratory wing. The structure is steel and concrete with a brick veneer over the office at the front of the building. An addition, which houses a welding laboratory, was added in 1972. According to the *Y-12 Site Integrated Modernization Deployment Study* (Y-12 1999) draft report, a small beryllium blank forming area is operated in Building 9202. Activities conducted in Building 9202 include development of material and metallurgical synthesis, forming, and evaluation techniques and processes.

Building 9203 was built in 1944 and is a two-story building 166 ft wide by 176 ft long with a basement. The structure is steel and concrete with a brick veneer over the office at the front of the building. Activities conducted in Building 9203 include development of processes for material characterization as well as measurements, and instrumentation and control.

A.4.14 Building 9996

Building 9996 is a three-story structure 25 by 78 m (82 by 256 ft) that was built in 1955. The main structure is steel and concrete with brick veneer. Building 9996 is used as a tooling and material storage facility to support operations in immediately adjacent portions of Building 9212.

A.4.15 Building 9201-1

Building 9201-1 is a two-story structure 84 by 162 m (276 by 530 ft) built in 1955. The main structure is steel and concrete with brick veneer. Building 9201-1 is a large, general machine shop with several areas containing machining equipment and controls. Nominal storage for in-process parts and materials and offices for supervision are also provided. The building is used as a general machine shop for nonuranium metal and graphite parts.

A.5 WASTE MANAGEMENT ACTIVITIES

This section summarizes information for facilities used to manage the various waste streams generated at the Y-12 Plant; including LLW, mixed LLW, RCRA-hazardous waste, TSCA-regulated waste, and nonhazardous waste. Some inactive facilities that were closed recently and facilities that are expected to operate in the near future (within 3 years) are included here as well.

The majority of waste management facilities at Y-12 are operated under the EM Program, but some are managed by DP. Waste management facilities are located in buildings, or on sites, dedicated to their individual functions, or are collocated with other waste management facilities or operations. Many of the facilities are used for more than one waste stream (see Figure A.5–1).

DOE is authorized to manage radioactive waste that it generates under the *Atomic Energy Act of 1954*. LLW is generated during many plant operations including, machining operations that use stock materials such as steel, stainless steel, aluminum, depleted uranium, and other materials. DOE stores, treats, and repackages, but does not dispose of, LLW at Y-12. The majority of the LLW generated at Y-12 is otherwise uncontaminated scrap metal and machine turnings and fines. Waste treatment provides controlled conversion of waste streams generated from operations to an environmentally acceptable, or to a more efficiently handled or stored, form. This activity includes continuing O&M of facilities that treat wastewater and solid waste generated from production and production support activities. LLW at Y-12 is managed in accordance with DOE Orders (e.g., DOE O 435.1), policy, and guidance related to management of radioactive waste. Management of this waste is not directly regulated by EPA or TDEC. Waste minimization and planned treatment facilities are expected to continue reducing the magnitude of these wastes.

The TDEC Division of Solid Waste Management (DSWM) regulates management of both hazardous and non-hazardous waste streams under RCRA. The major sources of hazardous waste are plating rinsewaters, waste oil, and solvents from machining and cleaning operations; contaminated soil, soil solutions, and soil materials from RCRA closure activities; and waste contaminated with hazardous constituents from construction/demolition activities. Facilities used to store or treat RCRA-hazardous waste at Y-12 are regulated by the DSWM as authorized by the EPA. These facilities may also be used to manage mixed waste (waste that is RCRA-hazardous and radioactive). Mixed waste is generated from site development, sampling, metal preparation, fabrication, enriched and depleted uranium operations, assembly, and industrial engineering functions at Y-12. Mixed waste is put in storage awaiting treatment or disposal, treated at Y-12, or sent to another ORR facility for treatment and disposal. There are no facilities for the disposal of RCRA-hazardous or mixed waste currently in operation at Y-12. Some disposal of RCRA-hazardous and mixed wastes is done at a permitted off-site commercial facility.

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FIGURE A.5–1.—*Major Environmental Management Facilities at Y-12.*

Major activities that generate nonhazardous waste include construction and demolition activities that produce large volumes of non-contaminated wastes, including lumber, concrete, metal objects, and soil and roofing materials. Industrial trash is generated by daily operations throughout the Plant. These operations include janitorial services, floor sweepings in production areas, and production activities. Storage and physical treatment (e.g., shredding, compaction) of non-hazardous waste does not generally require a permit under RCRA. There are three landfills in operation for disposal of non-hazardous waste at Y-12. These disposal facilities are regulated by the TDEC DSWM.

PCB-containing waste is generated at the Y-12 Plant during spill cleanup and stabilization activities as part of ongoing O&M actions. TSCA-regulated waste that contains PCBs is managed at Y-12 in accordance with EPA regulations (40 CFR 761) and with a Federal Facilities Compliance Agreement (FFCA) for managing PCBs on the ORR (EPA, August 19, 1997). Per the FFCA between the EPA and DOE, ORR waste containing PCBs may be stored in TSCA-compliant facilities. Provisions in 40 CFR 761.65 allow storage of PCB-contaminated materials in RCRA-compliant storage facilities under certain circumstances. Therefore, TSCA-regulated waste is often collocated with RCRA-hazardous waste at Y-12.

Waste management functions are generally identified as storage, treatment, or disposal. Facilities, or waste management units, may be permitted or designated for one or more waste stream and function. The following description of waste management facilities at Y-12 are grouped by functional program area and focus on facilities currently available for waste management at Y-12.

A.5.1 Waste Storage at Y-12

The following text and Table A.5.1-1 (located at the end of Section A.5.1) summarize waste storage capabilities at Y-12 and are ordered by ascending building number. Information on these facilities is based on the following references: Bechtel Jacobs 2000, LMES 2000, and PAI 1996.

A.5.1.1 *Cyanide Treatment Unit*

The Cyanide Treatment Facility in Building 9201-5N has a small (8 m^3) storage area associated with it. This facility is described in Section 5.2.7.

A.5.1.2 *Storage for Mixed Waste Residue/Ash*

Buildings 9212 and 9206 provide container storage areas for mixed waste residue or ash. A RCRA operating permit was issued on September 28, 1995 for these two units. The ash resulted from the burning of solvent- and uranium-contaminated solid wastes. The ash does not contain free liquids. Uranium-bearing solutions generated during the uranium recovery process (Building 9818) and laboratory analyses are also stored in these areas. These solutions, as well as the residue, are mixed (hazardous and radioactive) wastes and are being stored prior to further uranium recovery. Occasionally, uranium-bearing materials generated off-site may be stored in Buildings 9212 and 9206, prior to uranium recovery at Building 9212. Although a Phaseout/Deactivation Program Management Plan has been approved by DOE for Building 9206, and the recovery operations within this facility will no longer be operated, this building will continue to store hazardous and mixed waste for several years into the future.

A.5.1.3 *Building 9212 Tank Farm*

Building 9212 Tank Farm, a RCRA permit-by-rule facility, has never been placed in operation, but there are future plans to do so when Enriched Uranium Operations are restarted. The facility consists of three dikes containing four 37,854 L (10,000 gal) stainless-steel tanks that will eventually be used to collect nitrate waste from Building 9818 operations before being transferred to the West End Tank Farm (WETF).

A.5.1.4 *Liquid Storage Facility*

The Liquid Storage Facility (Building 9416-35) of the Disposal Area Remedial Actions (DARA) Liquid Storage Treatment Unit is a hazardous and mixed waste storage and pretreatment facility built during the Bear Creek Burial Ground closure activities. It is located in Bear Creek Valley approximately 3 km (2 mi) west of Y-12, and operates under RCRA permit-by-rule. It collects, stores, and pre-treats groundwater and other wastewater received from the seep collection lift station, the DARA Solid Storage Facility, tankers, polytanks, and the diked area rainfall accumulation. Feed streams may contain oil contaminated with PCBs, VOCs, non-VOCs, and heavy metals. Most equipment is in an outdoor, containment area and includes: two 284,000 L (75,000 gal) bulk water storage tanks; a 22,700 L (6,000 gal) oil storage tank; gravity separator; two filtering units; composite monitoring station; and tanker transfer station. Collected liquids are pre-treated by traveling through the gravity separator, filters, and composite monitoring station prior to entering bulk storage tanks. The wastewater is then transferred by tanker to the Groundwater Treatment Facility for further treatment.

A.5.1.5 *Containerized Waste Storage Area*

The Containerized Waste Storage Area (Buildings 9500-120, 9500-121, and 9500-149) consists of three concrete pads covering approximately 2,320 m^2 (24,800 ft^2). An impermeable dike for spill containment surrounds each pad. The area was previously RCRA-permitted and closed. It is currently being used for LLW storage.

A.5.1.6 *PCB and RCRA Hazardous Drum Storage Facility*

Building 9720-9 is a 1161 m^2 (12,500 ft^2), single-story, prefabricated metal building with slab on grade built in 1955. The facility provides a drum storage area for mixed and PCB waste, including an area for flammable waste. The building is used to store both RCRA and PCB mixed waste.

A.5.1.7 *Container Storage Facility*

Building 9720-12, a Container Storage Facility, also called the LLW Storage Areas, provides storage for mixed (hazardous and radioactive) waste residue, ash, and combustibles. It also contains some classified waste. A RCRA operating permit was issued on September 28, 1995. The ash is produced from burning solvent- and uranium-contaminated wastes. Unburned solvent- and uranium-contaminated solid wastes are also stored in Building 9720-12. The waste at Building 9720-12 contains no free liquids and is typically generated during the uranium recovery process. Some of this waste is also stored in Buildings 9212 and 9206, as described above.

A.5.1.8 *Classified Waste Storage Facility*

The Classified Waste Storage Facility (Building 9720-25) is a 1635 m^2 (17,600 ft^2), single-story building with masonry-bearing walls and a precast concrete roof system built in 1962. It provides storage for PCB-waste, LLW and mixed LLW, which is classified for national security purposes under provisions of the *Atomic Energy Act.* A RCRA operating permit was issued on September 28, 1995. The facility meets Y-12 Plant security requirements for classified waste management and guidelines for the management of LLW and mixed LLW.

A.5.1.9 *PCB Storage Facility*

The PCB Storage Facility (Building 9720-28) provides storage capability for PCB waste, primarily PCB-containing ballasts. Building 9720-28 is a 335 m^2 (3,600 ft^2), single-story building with masonry-bearing walls and a structural steel roof built in 1984.

A.5.1.10 *RCRA and Mixed Waste Staging and Storage Facility*

The RCRA Staging and Storage Facility (Building 9720-31) is a 610-m^2 (6,571 ft^2), single-story building with masonry-bearing walls and a precast concrete roof system built in 1986. A RCRA permit was issued on September 28, 1995. Solid, liquid, and sludge wastes are prepared for off-site shipment at this facility. The facility consists of seven storage rooms and seven staging rooms, each with a separate ventilation system. The staging rooms house small containers that are packed with compatible materials and shipped. The storage rooms hold larger containers, such as 208 L (55 gal) drums.

A.5.1.11 *Production Waste Storage Facility*

The Production Waste Storage Facility (also a Container Storage Area, Building 9720-32) has not yet been used for storage, but future use is planned. The building is separated into two areas, a smaller one for ignitable RCRA waste, and a larger area for non-ignitable waste. Both areas have curbing and may be used for containerized liquids if stored on self-containing pallets. A RCRA operating permit for the facility was issued September 3, 1996 for storage of hazardous and mixed waste. This facility houses the nondestructive assay equipment for Y-12 and has a design capacity for storage of 616,968 gal (2,335 m^3).

A.5.1.12 *Low-Level Waste Storage Pad*

The Low-Level Waste Storage Pad is located in the Sludge Handling Facility (Building 9720-44) which originally provided water filtration and sludge dewatering to support a storm sewer cleaning and relining project. The facility is currently being used to store containers of LLW sludge.

A.5.1.13 *Liquid Organic Solvent Storage Facility*

The Liquid Organic Waste Storage Facility (Building 9720-45, OD-10) is a 209 m^2 (2,250 ft^2) single-story pavilion with metal posts and roof panels, built in 1987. A RCRA permit was issued on September 30, 1994. It contains four 24,600 L (6,500 gal) and two 11,400 L (3,000 gal) stainless-steel tanks for storage of ignitable non-reactive liquids, including those contaminated with PCBs and uranium. In addition, a diked and covered storage area provides space for 40,000 L (10,600 gal) of containerized waste. The facility is set up for segregating various spent solvents for collection and storage. Major solvent waste streams are transferred to tanks until final disposition.

A.5.1.14 *RCRA and PCB Container Storage Area*

The RCRA and PCB Container Storage Area (Building 9720-58) is a 390 m^2 (4,200 ft^2), single-story, prefabricated metal building with metal wall panels built in 1987. It holds a RCRA permit issued on September 28, 1995. It is a warehouse facility used for staging prior to treatment or disposal of PCB- and RCRA- contaminated equipment (e.g., transformers, capacitors, and electrical switchgear) and non-reactive, non-ignitable RCRA, mixed, and PCB waste.

A.5.1.15 *Classified Container Storage Facility*

The Classified Container Storage Facility (Building 9720-59, also a Production Waste Storage Facility) is a 1,403 m^2 (15,105 ft^2), single-story, prefabricated metal building with metal wall panels. Building 9720-59 was issued a RCRA permit on September 3, 1995 and stores both RCRA and PCB wastes.

A.5.1.16 *Disposal Area Remedial Action Solid Storage Facility*

The DARA Solid Storage Facility (Building 9 720-60) provides 1,625 m^2 (17,500 ft^2) of storage space for PCB-, RCRA-, and uranium-contaminated soil. The facility has a synthetic liner for leachate collection and a leak detection system. Collected leachate is transferred to the Liquid Storage Facility for pretreatment. The DARA Solid Storage Facility is an interim status facility under RCRA, but is now being managed through the CERCLA process. No additional wastes are being added to the facility.

A.5.1.17 *OD7 Waste Oil Storage Tank Area*

Building 9811-1, houses three areas for storage of RCRA liquids (OD7, OD8, and OD9), and is an 81 m^2 (874 ft^2) single-story prefabricated metal building with metal wall panels, built in 1986. OD7 contains a diked storage area for tanks (permitted September 30, 1994). The OD7 contains four 114,000 L (30,000 gal) tanks, two 37,900 L (10,000 gal) tanks, and associated piping and pumps. The OD7 facility is now inactive and there are no plans to use it in the future.

A.5.1.18 *OD8 Waste Oil Solvent Drum Storage Facility*

The Waste Oil Solvent Drum Storage Facility (Building 9811-1, OD8) was issued a RCRA permit on September 28, 1995. It has a capacity for 750, 208 L (55 gal) drums and a smaller number of Tuff tanks. RCRA waste oil/solvent mixtures containing various concentrations of chlorinated and nonchlorinated hydrocarbon solvents, uranium, trace PCBs, and water for specific chemical constituents are stored at OD8 in 208 L (55 gal) drums and 1,140 L (300 gal) Tuff tanks.

A.5.1.19 *OD9 Waste Oil/Solvent Storage Facility*

The Waste Oil/Solvent Storage Facility (Building 9811-1, OD9) is a RCRA-permitted (September 30, 1994) storage facility that houses LLW, mixed LLW, and hazardous waste, including PCBs. It consists of a diked area supporting five 151,000 L (40,000 gal) tanks, a tanker transfer station with five centrifugal transfer pumps, and a drum storage area. Four tanks house PCB and RCRA wastes contaminated with uranium. A fifth tank is empty. A diked and covered pad furnishes space for 33 m^3 (1,165 ft^3) of containerized waste. The diked area contains additional space for a sixth 151,000 L (40,000 gal) tank.

A.5.1.20 *Organic Handling Unit*

The Organic Handling Unit in Building 9815 has a small (8 m^3) storage area associated with it. This facility is described in Section 5.2.6.

A.5.1.21 *Depleted Uranium Oxide Storage Vaults I and II*

The Depleted Uranium Oxide Storage Vaults I and II (Buildings 9825-1 and -2 oxide vaults) are located on Chestnut Ridge northeast of Building 9213. The vaults are constructed of reinforced concrete and provide a retrievable storage repository for uranium oxide, uranium metal, and a blended mixture of uranium sawfines and oxide. The vaults contain a negative pressure exhaust system that operates during material entry. The exhaust is filtered and monitored prior to its release to the atmosphere. The facility uses forklift trucks, electric hoists, and a motorized drum dumper. Waste is no longer accepted in the vaults. Building 9809-1 is also being used as storage for drummed, depleted uranium oxide materials; it is a 111 m^2 (1,200 ft^2), single-story building with masonry-bearing walls and a structural steel roof system built in 1990.

A.5.1.22 *West Tank Farm*

The West Tank Farm provides storage for mixed and LLW sludge and is associated with the WETF. It operates under RCRA permit-by-rule and has five 1.89 million L (500,000 gal) tanks that provide storage for mixed waste and three 378,541 L (100,000 gal) tanks that provide storage for radioactively contaminated calcium carbonate sludge generated in the WETF treatment processes. The WETF is described in Section 5.2.5.

A.5.1.23 *Oil Landfarm Soil Storage Facility*

The Oil Landfarm Soil Storage Facility is a RCRA-interim status facility containing approximately 1,377 m^3 (14,832 ft^3) of soil contaminated with PCBs and volatile organics (DOE 1993). The soil was excavated from the Oil Landfarm and Tributary 7 in 1989. The soil is contained in a covered, double-lined concrete dike with a leak-detection system. The leak-detection system will soon be modified to enhance detection capabilities.

A.5.1.24 *Old Salvage Yard*

The Old Salvage Yard, located at the west end of Y-12, contains both low-level uranium-contaminated and non-radioactive scrap metal. Most scrap currently sent to this area is contaminated. The Contaminated Scrap Metal Storage is an area within the Old Salvage Yard that is used to store uranium-contaminated scrap metal Contaminated scrap is placed in approved containers and eventually will be transferred to the aboveground storage pads or shipped off site for disposal. Non-contaminated scrap is sold when allowed.

A.5.1.25 *Salvage Yard*

The Salvage Yard is used for the staging and public sale of nonhazardous, non-radioactive scrap metal that has been approved by DOE for release. It consists of a 3.2 enclosed hectare (ha) (8 acres); 0.4 ha (1 acre) is paved. The New Salvage Yard provides accumulation and sorting space for the scrap metal. This facility is located on the north side of Bear Creek Road, near the Bear Creek Burial Grounds.

TABLE A.5.1–1.—*Storage Capabilities for Hazardous, Low-Level and Mixed Low-Level Waste at Y-12* [Page 1 of 4]

Facility Number/Name [a]	Waste Streams Stored [b]	Capacity [c]	Comment
Building 9201-5N, Cyanide Treatment Facility	Cyanide spent plating batches, mixed LLW	8 m^3 2,200 gal	RCRA permit issued September 28, 1995. Small Storage area. Primarily treatment facility for hazardous and mixed wastes (Table A.5.2-1 and Section A.5.2.7).
Building 9206, Container Storage Area	LLW and mixed LLW consisting of uranium-contaminated liquid, residue, and ash	15 m^3 3,975 gal	RCRA permit issued September 28, 1995
Building 9212, Container Storage Area	LLW and mixed LLW consisting of uranium-contaminated liquid, residue, and ash	15 m^3 3,814 gal	RCRA permit issued September 28, 1995. Hazardous waste will continue to be stored here for several years into the future
Building 9212, Tank Farm	Nitrate-bearing wastewater also containing hazardous and radioactive constituents	151 m^3 40,000 gal	RCRA permit-by-rule. Not yet in operation, but use is planned
Building 9416-35, Liquid Storage Facility	Liquid hazardous and mixed LLW	416 m^3	RCRA permit-by-rule. Also a pre-treatment unit (Table A.5.2-1). Provides temporary storage before treatment
Buildings 9500-120, 9500-121, and 9500-149 Containerized Waste Storage Area	LLW planned for Above Grade Storage	632 m^3 8443,060 gal 134,640 lgal	Three concrete pads. Formerly RCRA permitted, but now RCRA closed. No permit required
Building 9720-9, PCB and RCRA Hazardous Drum Storage Facility	PCB/RCRA/radioactive waste	1,404 m^3 370,800 gal 202,770 lgal	RCRA permit issued September 28, 1995
Building 9720-12, Container Storage Facility aka Low-level Waste Storage Areas	Solid LLW and mixed LLW	123 m^3 32,500 gal	RCRA permit issued September 28, 1995. Also contains hazardous and nonhazardous classified waste
Building 9720-25, Classified Waste Storage Area	Classified solid LLW and mixed LLW	198 m^3 32,470 gal 19,770 lgal	RCRA permit issued September 28, 1995

TABLE A.5.1–1.—*Storage Capabilities for Hazardous, Low-Level and Mixed Low-Level Waste at Y-12* [Page 2 of 4]

Facility Number/Name [a]	Waste Streams Stored [b]	Capacity [c]	Comment
Building 9720-28, PCB Storage Facility aka Waste Materials Preparation Facility	PCB waste	m^3 NA	Permit not required. Managed per 40 CFR 761 and EPA Compliance Agreement
Building 9720-31, RCRAand Mixed Waste Staging and Storage Facility	PCB/RCRA/radioactive waste	170 m^3 177,630 gal 101,990 lgal	RCRA permit issued September 28, 1995
Building 9720-32, Container Storage Area/Production Waste Storage Facility	RCRA ignitable and hazardous waste	2,335 m^3 616,968 gal	RCRA permit issued September 3, 1996. Has not yet been used, but use is planned
Building 9720-44, LLW Storage Pad	LLW sludge	NA	Building was formerly used for sludge dewatering project and now is used only for storage of low-level sludge.
Building 9720-45, OD-10, Liquid Organic Solvent Storage Facility	Liquid and solid mixed LLW. Waste oil, combustible and flammable liquids. Ignitable, non-reactive and radioactive waste	198 m^3 32,000 gal 10,560 gal	RCRA permit issued September 30, 1994
Building 9720-58, RCRA and PCB Container Storage Area	PCB-contaminated equipment, RCRA mixed waste	1,130 m^3 177,630 gal 120,860 lgal	RCRA permit issued September 28, 1995
Building 9720-59, Classified Waste (Container) Storage Area	PCB/RCRA/radioactive waste	1,090 m^3 287,943 gal	RCRA permit issued September 3, 1996
Building 9720-60, DARA Solid Storage Facility	Solid mixed LLW including PCB-contaminated waste	3,058 m^3 807,840 gal	RCRA permit application submitted June 1993. RCRA interim status. Facility full as of August 1994. Contains contaminated soil. Currently within the Environmental Restoration Program

TABLE A.5.1–1.—*Storage Capabilities for Hazardous, Low-Level and Mixed Low-Level Waste at Y-12* [Page 3 of 4]

Facility Number/Name [a]	Waste Streams Stored [b]	Capacity [c]	Comment
Building 9811-1, OD-7, Waste Oil Storage Tank Area	RCRA organics and mixed LLW contaminated with Beryllium	530 m^3 140,000 gal	RCRA permit issued September 30, 1994. Inactive unit, not currently planned for future use
Building 9811-1, OD-8, RCRA Storage Facility Waste Oil Solvent Drum Storage Facility	Liquid and solid hazardous waste, LLW and mixed LLW	723 m^3 102,100 gal 89,050 lgal	RCRA permit issued September 28, 1995
Building 9811-8, OD-9, Waste Oil/Solvent Storage Facility	LLW, Liquid mixed LLW (including PCBs), and hazardous waste. Non-ignitible, non-reactive oils/solvents, some with chlorinated organics	790 m^3 200,000 gal 8,800 gal	RCRA permit issued September 30, 1994. Site includes five storage tanks. Includes 33 m^3 of storage for drums
Building 9815, Organic Handling Unit	Liquid hazardous waste, solvents and mixtures containing RCRA hazardous constituents	8 m^3 2,500 gal	Storage space added to permit for treatment unit (Table A.5.2-1 and Sect. A.5.2.6) on November 19, 1997
Depleted Uranium Storage Vaults I and II (Buildings 9825-1 and 2 oxide vault) and Building 9809	Solid LLW (depleted uranium oxides and sawfines)	1,020 m^3	Two vaults of reinforced concrete no longer accept waste. Air permit for vaults. Building 9809 takes containerized depleted uranium oxide materials
West Tank Farm	Mixed LLW (sludge)/LLW sludge	10,600 m^3 2,800,000 gal	RCRA permit by rule. Storage associated with WETF (Table A.5.2-1 and Sect. A.5.2.5)
Building 9830-2 through 7, Abovegrade Low-level Waste Storage Facility	Solid LLW	7,130 m^3	Six aboveground pads for LLW awaiting completion of EMWMF. No permit required
Oil Landfarm Soil Storage Facility (Containment Pad)	Solid mixed waste contaminated with PCBs and volatile organics (soils excavated from Oil Landfarm closure)	536 m^3 115,117 gal	RCRA application submitted June 1993. Interim status. No new wastes being stored

TABLE A.5.1–1.—*Storage Capabilities for Hazardous, Low-Level and Mixed Low-Level Waste at Y-12* [Page 4 of 4]

Facility Number/Name [a]	Waste Streams Stored [b]	Capacity [c]	Comment
H-1 Salvage Yard, Contaminated Scrap Metal Storage Area (Old Salvage Yard)	Solid LLW (uranium-contaminated scrap)	4,740 m^3	No permit required. Scrap is containerized for later transfer to aboveground storage pads
New Salvage Yard	Non-hazardous, non-radioactive scrap metal	1 ac paved 8 ac enclosed	Accumulation area for scrap metal that is sold to the public. May not be classified as waste by regulatory definition, but included here for informational purpose

[a] Facility names may vary slightly between references. Both names are presented in a few instances to avoid confusion.
[b] The term "solid" as used here describes physical state, not a regulatory classification.
[c] Capacity (m^3 - cubic meter; gal- gallons; lgal - liquid gallons) refers to design capacity as indicated in a database of RCRA interim status and active units at the Y-12 Plant that is maintained and used for RCRA annual reporting. The database design capacities are in gallons and have been converted to m^3 for comparability with other waste information. Non-RCRA unit capacities were obtained from other sources, primarily DOE, 1996.
Notes: EMWMF - Environmental Management Waste Management Facility; DARA - Disposal Area Remedial Action;
Sources: Bechtel Jacobs 2000, LMES 2000, PAI 1996.

A.5.2 Treatment of Waste at Y-12

Table A.5.2-1 (located at the end of Section A.5.2) summarizes waste treatment capabilities at Y-12 by facility. Information on these facilities is based on the following references: Bechtel Jacobs 2000b, DOE 1995a, LMES 2000b, and PAI 1996.

A.5.2.1 *Central Pollution Control Facility*

The Central Pollution Control Facility (Building 9623), a 1,858 m^2 (20,000 ft^2) multi-story, structural-steel building with masonry walls was built in 1985. The Central Pollution Control Facility operates under RCRA permit-by-rule and an NPDES permit issued in April 28, 1995. It is the primary facility for treatment of non-nitrated waste. It receives wastes that are acidic or caustic, oily mop water containing beryllium, thorium, uranium, emulsifiers, and cleansers. It also receives waste already treated at other Y-12 facilities. The Central Pollution Control Facility provides both physical and chemical processing, including oil/water separation, neutralization, precipitation, coagulation, flocculation, carbon adsorption, decanting, and filtration. Treated water is discharged to EFPC through an NPDES monitoring station. Sludge from the treatment processes is transferred to the WETF. Spent carbon cartridges and filters are sent to ETTP for storage.

A.5.2.2 *Plating Rinsewater Treatment Facility*

The Plating Rinsewater Treatment Facility treats dilute, non-nitrate bearing, plating rinsewater contaminated primarily with chromium, copper, nickel, and zinc. In addition, the facility can treat cyanide-bearing wastes and remove chlorinated hydrocarbons. Currently, the facility is used less frequently because the Plating Shop (Building 9401-2) that formerly produced most of Y-12's rinsewater has been deactivated. The facility's neutralization, equalization, and cyanide destruction equipment are kept outdoors in a diked basin. The remainder of the facility process is located in Building 9623 with the Central Pollution Control Facility. Rinsewater may be received in tankers, polytanks, or in any acceptable waste shipping container. The Plating Rinsewater Treatment Facility performs the following treatment operations: pH adjustment, flow equalization, heavy metal removal, degassification, and clarification. After the clarification operation, the rinsewater is transferred to the Central Pollution Control Facility. Treated rinsewater is sometimes recycled for use as make-up water for Central Pollution Control Facility processes. Sludge from the clarification process is transferred to the Central Pollution Control Facility and then taken to the West Tank Farm for interim storage.

A.5.2.3 *Waste Coolant Processing Facility*

The Waste Coolant Process Facility (Building 9983-78) treats machine coolant waste and mop water from machining operations containing heavy metals, including uranium compounds and uranium metallic fines. The equipment and controls are located outside. Gravity feed is used to separate oils and water. The waste oil is then transferred to OD9 (Building 9811-1), or containerized and stored, and the wastewater flows into an extended aerator reactor. Sludge and sediment from the oils are drummed and stored. Sludge from the wastewater treated in the reactor is dried, drummed and sent to ETTP mixed waste storage. The treated wastewater is transferred to the Central Pollution Control Facility for further treatment and then discharged into EFPC.

A.5.2.4 *Central Mercury Treatment System*

The Central Mercury Treatment System (CMTS) is designed to treat mercury-contaminated sump water from former mercury use building. The CMTS was installed as part of the Y-12 Plant's Integrated Mercury Strategy Program to achieve compliance with regulations and guidance addressing mercury contamination in EFPC. Sump water from Buildings 9201-5, 9201-4, and 9204-4 is treated at the CMTS. The CMTS is located at the Central Pollution Control Facility. A new outfall (Outfall 551) is the discharge point where treated wastewater is discharged in conformance to NPDES monitoring guidelines.

Mercury-contaminated wastewater is pumped from building sumps located in Buildings 9201-4 and 9201-5 to the 2100-U tank, and into a ground equalization tank located just south of Building 9201-4. From the 2199-U tank, the wastewater is pumped to the Central Pollution Control Facility for treatment and discharge. Mercury-contaminated sump water is also accumulated in a Tuff tank located at Building 9204-4 and is periodically transferred to the Central Pollution Control Facility for treatment at the CMTS.

The CMTS process consists of equalization capacity provided by the 2100-U tank and F-901 tank, influent filtration, granular-activated carbon adsorption, neutralization, and carbon dewatering. The system is designed to treat a maximum of 50 gpm.

A.5.2.5 *West End Treatment Facility*

The WETF (Building 9616-7) treats mixed-LLW and LLW-contaminated wastewater generated by Y-12 production operations and other DOE-ORO meeting the facility waste acceptance criteria and operating under RCRA permit-by-rule. Treatment methods include hydroxide precipitation of metals, sludge settling and decanting, biodenitrification, bio-oxidation, pH adjustment, degasification, coagulation, flocculation, clarification, filtration, and carbon adsorption. Wastewaters are primarily nitrate-bearing and include the following: nitric acid wastes, mixed acid wastes, waste coolant solutions, mop water, and caustic wastes. Wastes are received at the WETF in 18,927-L (5,000-gal) tankers, 1136-L (300-gal) polytanks, drums, carboys, and small bottles. Detailed waste characterization documentation and jar tests are used to determine the treatment scheme for wastewater shipments. Treatment at WETF is performed in three processes: (1) Head End Treatment, (2) West Tank Farm biological treatment, and (3) Effluent Polishing. The Head End Treatment Process consists of waste receiving, hydroxide precipitation of heavy metals, sludge settling, and decanting. Biological treatment in the West Tank Farm consists of biodenitrification, then bio-oxidation.

The Effluent Polishing System consists of pH adjustment, degasification, coagulation, flocculation, clarification, filtration, carbon adsorption, and effluent discharge to the EFPC through an NPDES monitoring station.

Legacy mixed-LLW treatment sludges are presently being removed from sludge storage tanks at the West Tank Farm for off-site disposal. Currently generated mixed-LLW and LLW treatment sludges are being accumulated and concentrated for final characterization and disposal. Other treatment residuals, such as spent carbon and personal protective equipment, are being sent for immediate off-site disposal where feasible or otherwise characterized for on-site treatment or disposal.

A.5.2.6 *Organic Handling Unit for Mixed Waste*

The Organic Handling Unit (Building 9815) has replaced the Uranium Treatment Unit that was located on the east side of Building 9206. (Note: The Uranium Treatment Unit closure certification was accepted by the State of Tennessee on July 24, 1996, without comments.) The Organic Handling Unit provides storage and treatment of organic solutions containing enriched uranium. The uranium level in the waste material arriving at the Organic Handling Unit is typically less than 400 ppm. These wastes are characterized as mixed hazardous and radioactive wastes. The facility uses an assay reduction process to dilute the ^{235}U isotope with ^{238}U isotope in such a manner that they cannot be easily separated chemically or physically. This is accomplished by first mixing depleted uranyl nitrate with the organic solution and then neutralizing the organic solution by adding sodium hydroxide or other acceptable material. Since uranyl nitrate solution is not readily soluble in most organic solutions, “extractant” may be added to the organic solution.

TABLE A.5.2–1.—*Treatment Capabilities at Y-12 for Hazardous, Mixed Low-Level, and Low-Level Waste* [Page 1 of 4]

Treatment Unit	Treatment Method(s)	Input Streams	Output Streams	Capacity [a] (m^3/yr)	Comment
Building 9623, Central Pollution Control Facility (CPCF)	Neutralization, passive and press filtration, carbon adsorption, oil/water separation, flocculation, clarification, and sludge decanting	Non-nitrate liquids containing LLW, mixed LLW, and hazardous waste	Treated water discharged to EFPC, solids to WETF, and spent carbon to storage at ETTP	10,200	NPDES permit issued April 28, 1995. RCRA permit-by-rule. Utilization approximately 15% of capacity
Building 9623, Plating Rinsewater Treatment Facility	Cyanide destruction, neutralization, flow equalization, electrochemical reduction, degassification, coagulation	Non-nitrate plating wastewater containing industrial waste and RCRA heavy metals. Can also treat CN.	Treated wastewater used as process water for CPCF and discharged to EFPC, sludge to CPCF for treatment and then to WETF	30,283	RCRA permit-by-rule. Utilization rate approximately 2.5% (due to recent decrease in plating operations)
Building 9983-78, Waste Coolant Processing Facility (WCPF)	Oil skimming, aerobic biodegradation, clarification, sludge drying/blending	Liquid LLW and mixed LLW containing < 200 ppm nitrate	Treated water to CPCF, oil to Organic Liquid Storage Area, solids to mixed LLW storage at ETTP	1,363	RCRA permit-by-rule. Utilization approximately 71% of capacity
Building 9623, Central Mercury Treatment System (CMTS)	Filtration, clarification, carbon adsorption, neutralization, carbon dewatering	Mercury-contaminated sump water with low turbidity	Treated water transferred to CPCF, then discharged to EFPC, solids to Y-12 landfill	50 gal/min	Mercury is removed from groundwater pumped from former mercury-use buildings 9201-4, 9201-5, and 9204-4. Part of RMPE program to decrease mercury loading in EFPC

TABLE A.5.2–1.—*Treatment Capabilities at Y-12 for Hazardous, Mixed Low-Level, and Low-Level Waste* [Page 2 of 4]

Treatment Unit	Treatment Method(s)	Input Streams	Output Streams	Capacity [a] (m^3/yr)	Comment
Building 9616-7, WETF	Head End Treatment System (HETS): precipitation of metals, sludge settling and decanting; Tank Farm 1 and 2 (WTF bioreactors): biodenitrification, bio-oxidation; Effluent Polishing System (EPS): flocculation, clarification and filtration	Nitrate-bearing wastewater (up to 80%) and sludge containing LLW, mixed LLW, and RCRA hazardous and sanitary/industrial waste. Also small quantity of magnesium chips	Treated water discharged to EFPC. Solid/sludge to Tank Farm for storage	10,221	NPDES permit issued April 28, 1995. RCRA permit-by-rule. Utilization rate approximately 10% for wastewater. Processes approximately nine, 55 gal drums magnesium chips per year.
Building 9815, Organic Handling Unit	Mixing depleted uranyl nitrate with organic solution, neutralization	Liquid LLW and mixed LLW consisting of organic solutions containing enriched uranium	Neutralized wastewater goes to WETF	500 gal/day	RCRA permit issued September 28, 1995. Also has space for 9m^3 (2,500 gal) mixed waste storage
Building 9201-5N, Cyanide Treatment Facility (CTF)	Chemical oxidation (alkaline chlorination), pH adjustment	Liquid mixed LLW and hazardous waste primarily from cyanide spent plating bathes (10 - 60,000 ppm CN and trace heavy metals)	Treated water (< 10 ppm CN) to WETF	185 to 195 gal/day	RCRA permit issued September 28, 1995. Also storage for 8m^3 (2,200 gal) mixed waste. Air discharge permit. Total capacity assumes operation 250 days/yr, 8 hr/day. 1996 utilization rate at approximately 50%
Building 9818, Biodenitrification Unit	Neutralization, pH adjustment, nitrate removal	Liquid mixed LLW (nitrate solutions from enriched uranium recovery-Building 9212)	Biosludge to West Tank Farm Wastewater to WETF	2,100	RCRA permit-by-rule

TABLE A.5.2–1.—*Treatment Capabilities at Y-12 for Hazardous, Mixed Low-Level, and Low-Level Waste* [Page 3 of 4]

Treatment Unit	Treatment Method(s)	Input Streams	Output Streams	Capacity [a] (m^3/yr)	Comment
Building 9212, Uranium Recovery Operations	Leaching, filtration, dissolution, oxidation, evaporation, extraction	Metal and organic removal from aqueous stream, aqueous neutralization, purification for recycle	All waste diverted to Biodenitrification Unit	2,100	System exempt from permitting requirements under agreement with state. Same capacity as Acid Neutralization and Recovery Facility
Building 9616-7, Groundwater Treatment Facility (GWTF)	Carbon adsorption, air stripping, precipitation and filtration (iron removal)	Liquid LLW and mixed LLW (groundwater)	Treated groundwater discharged to EFPC, spent carbon and sludge to storage and TSCA incinerator, and filter bags to storage for off-site disposal	14,480	NPDES permit April 28, 1995. RCRA permit-by-rule. Facility running at capacity during rainy season
Building 9416-35, Liquid Storage Facility	Oil/water separation by filter cartridges (pre-treatment for GWTF)	Liquid mixed LLW (leachate from certain capped burial grounds in Bear Creek Valley)	Wastewater to GWTF, oil containing PCB and some RCRA constituents to TSCA Incinerator	3,975	RCRA permit-by-rule. Facility running at capacity during rainy season. Also a storage unit (Table A.5.1-1)
Building 9201-2, East End Mercury Treatment System	Filtration, clarification, carbon adsorption	Mercury-contaminated sump water with low turbidity	Treated water discharged to EFPC, solids to Y-12 landfill	30 gal/min	Mercury is removed from groundwater pumped from former mercury-use Building 9201-2. Part of RMPE Program to decrease mercury loading in EFPC
Building 9616-9, Steam Plant Wastewater Treatment Facility	Sedimentation, neutralization, precipitation, clarification and sludge dewatering	Wastewater from Steam Plant operations, demineralizers, and coal pile runoff	Treated water discharged to EFPC sanitary sewer system, solids to Y-12 sanitary landfill	177,914	NPDES permit. RCRA permit-by-rule. Utilization rate currently above design capacity
Building 9401-5, Uranium Chip Oxidation Facility	Thermal oxidation	Solid LLW (depleted uranium tailings)	Uranium oxide to depleted Uranium Oxide Storage Vaults	Classified	Treatment done by single drum batch

TABLE A.5.2–1.—*Treatment Capabilities at Y-12 for Hazardous, Mixed Low-Level, and Low-Level Waste* [Page 4 of 4]

Treatment Unit	Treatment Method(s)	Input Streams	Output Streams	Capacity [a] (m^3/yr)	Comment
Building 9401-4, Waste Feed Preparation Facility	Compaction/ repackaging	Compactible solid LLW	Compacted solid LLW	NA	This facility is no longer in operation

a Capacity combines all input waste streams.
Notes: CMTS - Central Mercury Treatment System; CN - Cyanide; CPCF - Central Pollution Control Facility; CTF - Cyanide Treatment Facility; EPS - Effluent Polishing System; HETS - Head End Treatment System; GWTF - Groundwater Treatment Facility; RMPE Program - Reduction in Mercury Plant Effluent Program; TSCA - *Toxic Substances Control Act*
Sources: Bechtel Jacobs 2000, LMES 2000, PAI 1996.

A.5.2.7 *Cyanide Treatment Unit*

The Y-12 Cyanide Treatment Unit (located in Building 9201-5N) provides storage and treatment of LLW and mixed LLW solutions containing metallic cyanide compounds from spent plating baths and precious metal recovery operations or other areas; the unit's RCRA permit was issued on September 28, 1995. Treatment is by chemical oxidation and pH adjustment. The cyanide reduction process performed within the unit is currently performed in 208 L (55 gal) containers. After waste is treated at the Cyanide Treatment Unit, it is transferred to the WETF for further treatment, then discharged to the EFPC.

A.5.2.8 *Biodenitrification Unit*

The Biodenitrification Unit (Building 9818) has been in stand-down, but restart is anticipated. It is capable of treating nitrate-bearing, liquid-mixed LLW generated by enriched uranium recovery operations in Building 9212. The denitrification unit removes nitrates from the waste and also separates liquids and solids. The wastewater is then transferred to the WETF for further treatment, and the sludge is transferred to the West Tank Farm.

A.5.2.9 *Uranium Recovery Operations*

Uranium Recovery Operations (Building 9212) is a recovery process to increase production efficiency at Y-12. Liquid waste from the operation is transferred to the Biodenitrification Unit. The system is exempt from permitting requirements under RCRA.

A.5.2.10 *Groundwater Treatment Facility*

The Groundwater Treatment Facility (Building 9616-7) treats wastewater from the Liquid Storage Facility at Y-12 and seepwater collected at ETTP and East Chestnut Ridge waste piles to remove volatile organic compounds (VOCs), non-VOCs, and iron. It is part of the DARA program to treat groundwater contaminated with LLW and mixed LLW that is collected from the Bear Creek Burial Grounds. The Groundwater Treatment Facility is located at the far west end of Y-12, in the same building as the WETF. This facility uses an air stripping operation to remove VOCs. In addition, carbon adsorption eliminates nonvolatile organics and PCBs. Precipitation and filtration are used to remove iron. After treatment, wastewater is sampled and recycled if additional processing is required. Wastewater that meets discharge specifications is pumped into the EFPC through a National Pollutant Discharge Elimination System (NPDES) monitoring station.

A.5.2.11 *Liquid Storage Facility*

The Liquid Storage Facility in Building 9416-35 provides pretreatment for contaminated groundwater and other remedial action wastewater. The facility is described in Section 5.1.4.

A.5.2.12 *East End Mercury Treatment System*

The East End Mercury Treatment System (EEMTS) is designed to treat mercury-contaminated sump water from Building 9201-2, a former mercury use building constructed in the late 1940s and located in the eastern part of the Y-12 Plant on Second Street directly south of the North Portal parking lot. The EEMTS was installed as part of the Y-12 Plant's Integrated Mercury Strategy Program to achieve compliance with regulations and guidance addressing mercury contamination in EFPC. The EEMTS process consists of influent filtration, granular-activated carbon adsorption, and associated water transfer equipment. Sump water from Building 9201-2 is treated at the EEMTS. A new outfall (Outfall 550) is the discharge point where treated water is discharged in conformance to NPDES monitoring guidelines. Mercury-contaminated wastewater is pumped from building sumps located in the basement of Building 9201-2 to the treatment unit installed on the first floor. The water is treated there and released to EFPC through the NPDES Outfall 550.

A.5.2.13 *Steam Plant Wastewater Treatment Facility*

The Steam Plant Wastewater Treatment Facility treats wastewater from Steam Plant operations, demineralizers, and coal pile runoff (MMES 1995a). Treatment processes include wastewater collection/sedimentation, neutralization, clarification, pH adjustment, and dewatering. The treatment facility uses automated processes for continuous operation. All solids generated during treatment are nonhazardous and are disposed of in the sanitary landfill. The treated effluent is monitored prior to discharge to the Oak Ridge public sewage system. The Y-12 utilities department manages this facility.

A.5.2.14 *Uranium Chip Oxidation Facility*

The Uranium Chip Oxidation Facility (Building 9401-5) is a 348 m^2 (3,750 ft^2), single-story, prefabricated building with metal wall panels built in 1987. The facility thermally oxidizes depleted and natural uranium machine chips under controlled conditions to a stable uranium oxide. Upon arrival, chips are weighed, drained of machine coolant, placed into an oxidation chamber, and ignited. The oxide is transferred into drums and transported to the uranium oxide storage vaults. The Uranium Chip Oxidation Facility is not designed to treat uranium sawfines. Hence, sawfines are currently blended with uranium oxide and placed in the oxide vaults as a short-term treatment method.

A.5.2.15 *Waste Feed Preparation Facility*

The Waste Feed Preparation Facility is a 335 m^2 (3,600 ft^2), single-story, prefabricated building with metal wall panels built in 1984 (Building 9401-4). This facility is no longer in operation. It was previously used to process and prepare solid LLW for volume reduction (compaction and repackaging) by an outside contractor or storage facility.

A.5.2.16 *Steam Plant Ash Disposal Facility*

The Steam Plant Ash Disposal Facility is used to collect, dewater, and dispose of sluiced bottom ash generated during operation of the coal-fired Y-12 Steam Plant. To comply with environmental regulations for landfill operations, it includes a leachate collection system and a transfer system to discharge the collected leachate into the Oak Ridge public sewage system. The dewatered ash is disposed of in Landfill VI.

A.5.3 Disposal of Waste at Y-12

On-site waste disposal facilities in operation at Y-12 are limited to industrial and construction/demolition landfills. Table A.5.3-1 (located at the end of Section A.5.3) summarizes waste disposal capabilities at Y-12. None of the landfills accept, or plan to accept, RCRA-hazardous, TSCA-regulated, or radioactive waste. Waste that contains residual radioactive materials at levels below authorized limits established in accordance with DOE Order 5400.5 may be accepted for disposal. All DOE facilities may receive materials containing residual radioactivity of any radionuclide on material surfaces provided that they are below limits specified in DOE Order 5400.5. Current waste acceptance criteria (WAC) for the landfills include a ceiling for residual radioactivity of 35 pCi/gm for total uranium on a volumetric basis. Materials containing uranium and other radioisotopes with residual levels of radioactivity below DOE authorized limits on a volumetric basis are accepted for disposal on a case-by-case basis. DOE is now reevaluating the existing ceiling of 35 pCi/gm for total uranium for the on-site disposal facilities, as well as future acceptance of materials containing residual levels of other isotopes, in accordance with guidance for the release and control of property containing residual radioactive material under DOE Order 5400.5 that were issued after the landfill began operations (DOE 1995b and 1997). Review of the WAC should not alter the type of wastes accepted at the Y-12 landfills. An overview of previously used landfills and a planned CERCLA waste disposal facility are also included in Table A.5.3-1 for background information. Information on the ORR disposal facilities is based on the following references: Burns 1993, FWC 1995, MMES 1992, MMES 1995b, PAI 1996, and Schaefer 2000.

A.5.3.1 *Industrial Landfill IV*

Industrial Landfill IV is used for disposal of classified, non-hazardous industrial waste, for construction/demolition waste, and for approved special waste. This landfill is intended for the disposal of classified waste. Approximately 12 percent of the landfill's design capacity has been filled. The landfill has a footprint of about 1.6 ha (4 acres).

A.5.3.2 *Industrial Landfill V*

Industrial Landfill V is used for disposal of unclassified, non-hazardous sanitary/industrial waste and for approved special waste. Approved special wastes have included asbestos materials, empty aerosol cans, materials contaminated with beryllium, glass, fly ash, coal pile runoff sludge, empty pesticide containers, and Steam Plant Wastewater Treatment Facility sludge. The landfill area is located on Chestnut Ridge near the eastern end of the Y-12 Plant and serves Y-12, ORNL, ETTP, and other DOE prime contractors at Oak Ridge. The landfill is equipped with a liner and leachate collection system. Disposal of special waste is approved on a case-by-case basis by the State of Tennessee. Requests are filed with the state to provide disposal for additional materials as needed. The landfill is approximately 15 percent filled. The landfill has a footprint of almost 10.5 ha (26 acres) and is being constructed in phases as disposal capacity is needed.

A.5.3.3 *Construction/Demolition Landfill VI*

Construction/Demolition Landfill VI accepts unclassified, non-hazardous construction/demolition debris and approved special waste. Dewatered ash from the Y-12 Steam Plant is currently disposed of in Landfill VI. The facility has been constructed to 100 percent design capacity and has been in operation since 1993. It is approximately 93 percent filled and has a footprint of about 1.6 ha (4 acres).

A.5.3.4 Construction/Demolition Landfill VII

Construction/Demolition Landfill VII has been constructed and is on standby status. It will not be placed in service until Landfill VI has been filled to capacity. It has a footprint of slightly more than 12 ha (30 acres).

A.5.3.5 On-site Low-Level Waste Disposal Capability

Y-12 has no active disposal facility on-site for LLW. All disposal activities at the Bear Creek Burial Grounds were terminated on June 30, 1991. These burial grounds were used to dispose of radiologically contaminated waste. Similar waste streams generated today are containerized and stored at Y-12 or are shipped off-site for disposal.

TABLE A.5.3.1.—*Disposal Capabilities at Y-12*

Facility Number and Name	Waste Streams Accepted	Capacity [a]	Comment
Industrial Landfill IV	Classified, nonhazardous, nonradioactive industrial wastes, construction/demolition wastes, and approved special wastes	Total capacity: 85,300 yd^3 (65,217 m^3) Approximately 4 acres Estimated remaining capacity: 88%	Permit issued by TDEC in January 1989. Placed in operation in October 1989. The landfill is developed in phases as disposal capacity is needed.
Industrial Landfill V	Unclassified, nonhazardous, nonradioactive industrial wastes, and approved special wastes	Total capacity: 2,145,039 yd^3 (1,640,000 m^3) Approximately 25.9 acres Estimated remaining capacity: 85%	Class II permit issued by TDEC in April 1993. Placed in operation in April 1994. The landfill is developed in phases as disposal capacity is needed. Replaced Sanitary Landfill II
Construction/Demolition Landfill VI	Construction/demolition debris and approved special wastes	Total capacity: 174,000 yd^3 (133,033 m^3) Approximately 4 acres Estimated remaining capacity: 7%	Class IV permit issued by TDEC in April 1993. Placed in operation in December of 1993. All phases of the landfill have been developed. CDL VII will be placed in operation when CDL VI is filled to capacity.
Construction/Demolition Landfill VII	Construction/demolition debris and approved special wastes	Total capacity: 1,850,000 yd^3 (1,414,426 m^3) Approximately 30.4 acres Estimated remaining capacity: 100%	Class IV permit issued by TDEC in December 1993. Facility was constructed and prepared for operation in January 1995. Currently in standby status. Facility will be placed in service when CDL VI fills to capacity.
Planned Facility of Interest			
Environmental Management Waste Management Facility	RCRA, TSCA, mixed and LLW generated by remedial actions under CERCLA	Total Capacity: 1,300,000 yd^3 (993,921 m^3)	Currently in design phase. Operation start anticipated for 2001
Inactive Facilities of Interest		**Estimated Capacity or Size if available**	
Spoil Area I	Construction debris	Approximately 4 acres	Completed 1985
Sanitary Landfill I	General trash and wastes from ORR		Facility was removed from service in 1983.
Sanitary/Industrial Landfill II	Unclassified, nonhazardous, nonradioactive waste and special waste when specifically permitted by TDEC	Approximately 10-12 acres	Placed in service in 1983. Final closure in 1995. Special waste permitted by TDEC included asbestos-containing materials, coal-pile runoff sludge, steam-plant wastewater treatment plant sludge, waste containing < 12ppm mercury, and materials contaminated with beryllium-oxide.

[a] Capacity refers to design capacity.
Sources: Burns 1993, FWC 1995, MMES 1995b, MMES 1992, PAI 1996, Schaefer 2000.

However, the Environmental Management Waste Management Facility that is currently under construction will provide a new disposal capability at ORR for various types of hazardous and radioactively-contaminated waste under certain conditions. This facility has only been approved to accept waste generated as a result of response actions to expedite cleanup of contamination that resulted from previous DOE and *Atomic Energy Act* (AEA) operations on the ORR and that are conducted under *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) authorization (or in a few cases, under the Inactive Hazardous Substances Site Remedial Action Program [State Superfund] of the State of Tennessee).

The Environmental Management Waste Management Facility will use state-of-the-art disposal technologies, including lined cells with leachate collection capabilities. The WAC for the Environmental Management Waste Management Facility are still being developed and are subject to approval by DOE, EPA, and TDEC. It has a design capacity of 993,921 m^3 (1,300,000 yd^3). Section 3.2.1 describes the Environmental Management Waste Management Facility.

A.6 TRAFFIC AND TRANSPORTATION

This section supports the results of the transportation analyses presented in Section 5.2 of this document. The various types of materials transported as a result of Y-12 operations that have the potential to impact human health include radioactive and hazardous (chemical, explosive, etc.) materials and wastes. For this SWEIS, DOE evaluated the transportation impacts associated with three material types (radioactive wastes, radioactive materials, and hazardous [nonradiological] materials/wastes) transported to and from multiple on-site (ORR) and off-site locations. The assumptions and methodology used in the transportation analysis are described in the following section.

A.6.1 Route Selection

To evaluate transportation impacts, DOE chose reasonable surrogate shipment routes to represent all the potential shipment destinations. Figure A.6.1-1 shows the location of the current weapons complex sites with stockpile stewardship and management missions. The shipments and routes modeled were based on 1998 shipment and receipt records for Y-12 operations. The shipping and receiving records for 1998 (No Action - Status Quo Alternative) Y-12 operations from the Enterprise Transportation Analysis System were reviewed and used as the basis to calculate the transportation impacts under the No Action - Planning Basis Operations Alternative. The information contained in these records included the number of shipments and receipts and the origins and destinations of shipments of radioactive materials and wastes, chemicals, and hazardous materials/wastes.

For 1998 operations, 1,025 total shipments and receipts were reported for Y-12. Of these, 685 shipments were of radiological materials, 47 shipments were of radiological waste, and the remaining 293 shipments were of hazardous wastes and materials. The shipments and receipts of these materials encompassed numerous locations throughout the United States. Table A.6.1–1 presents the various routes considered in this analysis and the total number of shipments for each origin/destination. A majority of the listed routes had a large number of shipments and receipts (10 or more); for these routes the actual origin and destination reported in the Enterprise Transportation Analysis System was modeled. Due to uncertainties in future projected shipments and receipts for Y-12 operations, the routes with fewer number of shipments and receipts (much less than 10) were collectively evaluated assuming the longest shipping distance. Although many of the actual routes were shorter in distance, assuming the longest potential distance bounds the impacts. The longest route considered was from Y-12 to Lawrence Livermore National Laboratory (LLNL) in Livermore, California.

TABLE A.6.1–1.—*Transportation Routes and Number of Shipments Analyzed*

Material Transported	Origin	Destination	Number of Shipments
Radioactive material	Y-12 Plant, TN	Columbia, SC	256
Hazardous material/waste	Y-12 Plant, TN	Columbia, SC	63
Radioactive material	Arlington Heights, IL	Y-12 Plant, TN	113
Hazardous material/waste	Y-12 Plant, TN	Oak Ridge, TN	84
Hazardous material/waste	Y-12 Plant, TN	ORNL, TN	51
Radioactive waste	Y-12 Plant, TN	Clive, UT	47
Hazardous material/waste	Y-12 Plant, TN	ETTP, TN	46
Hazardous material/waste	Y-12 Plant, TN	Houston, TX	29
Radioactive material	LLNL, CA	Y-12 Plant, TN	259
Radioactive material	Pantex, TX	Y-12 Plant, TN	22
Hazardous material/waste	Madison, WI	Y-12 Plant, TN	20
Radioactive material	Mound Facility, OH	Y-12 Plant, TN	26
Radioactive material	Y-12 Plant, TN	Los Alamos, NM	9

Note: ORNL-Oak Ridge National Laboratory
Source: HIGHWAY results.

Detailed route selection for material and waste shipments by truck was determined by the HIGHWAY 3.3 computer code (ORNL [Oak Ridge National Laboratory] 1993). HIGHWAY is a computerized road atlas that details more than 240,000 miles of interstate and other highways. The user can specify the routing criteria to constrain the route selection; options such as using only commercial routes, avoiding toll routes, and using only those routes that comply with DOT regulations for highway route-controlled quantities of radioactive materials can be selected. HIGHWAY calculates the total route length and the distances traveled through rural, suburban, and urban population zones. The distribution of distance among the population zones for the modeled routes is presented in Table A.6.1–2. The code also determines population densities (people per square kilometer) for the three population zones along the specified route using 1990 census data. Population densities determined by HIGHWAY for each modeled route are shown in Table A.6.1–3. The distance and population densities for each population zone are input into the RADTRAN 4 computer code to determine the incident-free (non-accident) and accident impacts for each shipment.

TABLE A.6.1–2.—*Transportation Routes and Population Zones*

Origin	Destination	Distance (km)		
		Rural	Suburban	Urban
Y-12 Plant, TN	Columbia, SC	322	129	3
Arlington Heights, IL	Y-12 Plant, TN	588	272	61
Y-12 Plant, TN	Oak Ridge, TN	0	3.2	0
Y-12 Plant, TN	ORNL, TN	8.2	3.1	0
Y-12 Plant, TN	Clive, UT	2642	316	43
Y-12 Plant, TN	ETTP, TN	10.8	7.3	0
Y-12 Plant, TN	Houston, TX	1,127.2	330.7	22.5
LLNL, CA	Y-12 Plant, TN	3,345	510	59
Pantex, TX	Y-12 Plant, TN	1,461	281	15
Madison, WI	Y-12 Plant, TN	730.1	313.9	63.8
Mound Facility, OH	Y-12 Plant, TN	306	162	14
Y-12 Plant, TN	Los Alamos, NM	1,935	312	21

Source: HIGHWAY results.

TABLE A.6.1–3.—*Population Density Distributions Along Modeled Routes*

Origin	Destination	Population Density (persons/km^2)		
		Rural	Suburban	Urban
Y-12 Plant, TN	Columbia, SC	14.1	262.1	1,836.1
Arlington Heights, IL	Y-12 Plant, TN	15.4	351	2,756.8
Y-12 Plant, TN	Oak Ridge, TN	0	166.2	0
Y-12 Plant, TN	ORNL, TN	4.9	89.8	0
Y-12 Plant, TN	Clive, UT	6.3	354.7	2,121.5
Y-12 Plant, TN	ETTP, TN	16.2	89.8	0
Y-12 Plant, TN	Houston, TX	12.9	321.5	2,085.3
LLNL, CA	Y-12 Plant, TN	6.5	340.1	2,069.3
Pantex, TX	Y-12 Plant, TN	9.4	294.2	1,963.1
Madison, WI	Y-12 Plant, TN	15.5	342.3	2,047.4
Mound Facility, OH	Y-12 Plant, TN	17.3	342.4	2,047.4
Y-12 Plant, TN	Los Alamos, NM	8.0	314.2	1,906.5

Source: HIGHWAY results.

A.6.2 Vehicle-Related Impacts

This section addresses the impacts of traffic accidents and vehicle emissions associated with transporting each material or waste type to its destination. These impacts are not related to the radioactive or hazardous materials/wastes being transported and would be the same as the impacts from the transportation of any nonhazardous material. DOE calculated accident impacts as the number of fatalities that would be expected due to additional vehicle traffic along the proposed routes. Fatalities were calculated on a per shipment basis and were then totaled for all shipments of the specified material and route. Calculations were based on the unit-risk factors (risk per kilometer traveled) developed from national statistics for highway accident-related deaths (SNL 1986). These nonradiological unit-risk factors are presented in Table A.6.2–1.

TABLE A.6.2–1.—*Nonradiological Unit-Risk Factors Associated With Truck Transport (per one-way shipment)*

	Rural	Suburban	Urban
Fatalities (fatalities/km)			
Nonoccupational	5.3×10^{-8}	1.3×10^{-8}	7.5×10^{-9}
Occupational	1.5×10^{-8}	3.7×10^{-9}	2.1×10^{-9}
Latent fatalities from vehicle emissions (latent fatalities/km)	--	--	1.0×10^{-7}

Source: SNL 1986.

In addition to risks from accidents, DOE estimated health risks from vehicle emissions. Impacts from vehicle emissions were calculated as the expected number of excess latent fatalities. The distance traveled in an urban population zone and the impact factor for particulate and sulfur dioxide truck exhaust emissions (SNL 1982) were used to estimate urban-area pollution effects due to waste shipments. The impact factor, 1.0×10^{-7}, estimates the number of latent fatalities per kilometer traveled. This impact factor is only valid for urban population zones; therefore, latent fatalities expected from exhaust emissions are only estimated for the total distance that is traveled through urban zones. Note that impacts due to exhaust gases are small relative to impacts from accident fatalities. The nonradiological latent fatality unit-risk factor is also presented in Table A.6.2–1.

Table A.6.2–2 presents vehicle-related impacts such as number of fatalities for total round-trip shipments between analyzed locations. These values were multiplied by the appropriate number of route shipments (Table A.6.1–1) to obtain the total impacts. All shipments were assumed to be round trip to account for the return of the empty shipping casks. Therefore, the data in Table A.6.2–2 were created assuming twice the one way mileage shown in Table A.6.1–2. The expected vehicle pollution latent fatalities were calculated only for distance traveled in urban population zones.

TABLE A.6.2–2.—*Vehicle-Related Impacts for Total Round-Trip Truck Shipment*

Origin	Destination	Shipment Type	Fatalities		Latent Fatalities from Vehicle Emissions
			Occupational	Public	
Y-12 Plant, TN	Columbia, SC	Radioactive material	2.72×10^{-3}	9.61×10^{-3}	1.54×10^{-4}
Y-12 Plant, TN	Columbia, SC	Hazardous waste/material	6.70×10^{-4}	2.36×10^{-3}	3.78×10^{-5}
Arlington Heights, IL	Y-12 Plant, TN	Radioactive material	2.25×10^{-3}	7.95×10^{-3}	1.38×10^{-3}
Y-12 Plant, TN	Oak Ridge, TN	Hazardous waste/material	2.00×10^{-6}	7.00×10^{-6}	0
Y-12 Plant, TN	ORNL, TN	Hazardous waste/material	1.37×10^{-5}	4.84×10^{-5}	0
Y-12 Plant, TN	Clive, UT	Radioactive waste	3.84×10^{-3}	1.36×10^{-2}	4.04×10^{-4}
Y-12 Plant, TN	ETTP, TN	Hazardous waste/material	1.74×10^{-5}	6.14×10^{-5}	0
Y-12 Plant, TN	Houston, TX	Hazardous waste/material	1.05×10^{-3}	3.72×10^{-3}	1.31×10^{-4}
LLNL, CA	Y-12 Plant, TN	Radioactive material	2.70×10^{-2}	9.55×10^{-2}	3.06×10^{-3}
Pantex, TX	Y-12 Plant, TN	Radioactive material	1.01×10^{-3}	3.57×10^{-3}	6.60×10^{-5}
Madison, WI	Y-12 Plant, TN	Hazardous waste/material	4.90×10^{-4}	1.73×10^{-3}	2.55×10^{-4}
Mound Facility, OH	Y-12 Plant, TN	Radioactive material	2.71×10^{-4}	9.58×10^{-4}	7.28×10^{-5}
Y-12 Plant, TN	Los Alamos, NM	Radioactive material	5.44×10^{-4}	1.92×10^{-3}	3.78×10^{-5}

Note: Based on travel through urban areas only.
Source: SNL 1982.

A.6.3 Cargo-Related Incident-Free Impacts

This section estimates the radiological impacts of incident-free transportation (i.e., no occurrence of accidents) to occupational and public receptors. When radioactive materials or wastes are transported, there is some external radiation dose from the transported cargo. DOE used the RADTRAN 4 model (SNL 1992) to estimate the radiological impacts. Required route-specific inputs such as the number of miles traveled, population densities adjacent to shipping routes, and the number of miles traveled in each of the population zones (urban, suburban, and rural) are determined using the HIGHWAY model described in Section A.6.2. Four radiation exposure scenarios were analyzed using the RADTRAN 4 code as follows:

- Along Route (off-link): Exposure of members of the public who reside adjacent to routes of travel
- Sharing Route (on-link): Exposure of members of the public sharing the right of way
- Stops: Exposure of members of the public while shipments are at rest stops
- Occupational (crew): Exposure of vehicle crews

Among the more sensitive RADTRAN 4 input parameters is the Transportation Index (TI). The TI represents the radiation dose at 1 m away from the surface of the shipping package and is limited by regulation (10 CFR 71). Although experience indicates that the external dose rate is well below the regulatory limit in many shipments, RADTRAN 4 modeling was performed with the regulatory limit TI of 10.

The incident-free impacts estimated from RADTRAN 4 are in units of person-rem. These can be converted into latent cancer fatalities (LCFs) using conversion factors. For doses to the public, one person-rem is expected to cause 5×10^{-4} LCFs, and for doses to workers one person-rem is expected to cause 4×10^{-4} LCFs (ICRP 1991).

In addition to the RADTRAN 4 inputs described in Section A.5.5, other unique parameters can affect impacts from truck shipments. The vehicle speed was assumed to be 15, 25, and 55 mph in urban, suburban, and rural zones, respectively. DOE believes that these speeds actually underestimate the probable speed of the truck through each of the population zones. This assumption results in a conservative overestimation of exposure and also accounts for the possibility of speed reductions due to traffic. All truck shipments were assumed to have 0.011 hour of stopping time for every kilometer traveled, accounting for overnight stopping. Transport of the distance between the waste and the crew is assumed to be 10 m. During stops, there are an assumed 50 members of the public present 20 m from the waste shipment.

A.6.4 Cargo-Related Accident Impacts

This section presents the impacts due to transportation accidents in which an environmental release of radioactive material/waste occurs. Radiological impacts were evaluated considering the probability of a given accident occurring and the consequences of that accident. The RADTRAN 4 model estimates the collective accident risk to populations by considering the spectrum of possible accidents and summing the results for each type of accident. The estimates in Section A.6.4.1 do not show the risk from a given accident occurring but present the total expected impacts considering the probability and consequences of all accidents.

A.6.4.1 *Accident Types*

All accidents can be represented by a spectrum of severity classes ranging from those considered least severe to most severe. The severity class of an accident is dependent on the crush force or impact speed and the duration of a 1,300-Kelvin fire (NRC 1977). The accident severity categories and associated conditional probabilities found in NUREG-0170 (NRC 1977) were used in assessing cargo-related accident impacts for this analysis. Each accident severity category has an associated conditional probability. The conditional probabilities represent the likelihood that an accident will involve the mechanical forces and the heat energy associated with each of the categories.

Table A.6.4–1 shows what fraction of the total accidents would be expected to be from each severity category, as based on NUREG-0170. For example, of all possible truck accidents that may occur, 55 percent would be classified as a Level 1 severity accident. According to these fractional occurrences, a Level 1 accident occurs more often but is the least severe while a Level 8 is highly unlikely but is the most severe. The table also represents the fraction of all accidents of that type that could occur in each of the population density zones. Of all expected Level 1 severity accidents, 10 percent would occur in the rural population density zone, another 10 percent would occur in the suburban population density zone, and 80 percent would occur in the urban population density zone.

TABLE A.6.4–1.— *Accident Conditional Probability of Occurrences*

Accident Severity Category	Fractional Occurrences	Population Density Zone		
		Rural	Suburban	Urban
Truck				
1	0.55	0.1	0.1	0.8
2	0.36	0.1	0.1	0.8
3	0.07	0.3	0.4	0.3
4	0.02	0.3	0.4	0.3
5	2.8×10^{-3}	0.5	0.3	0.2
6	1.1×10^{-3}	0.7	0.2	0.1
7	8.5×10^{-5}	0.8	0.1	0.1
8	1.5×10^{-5}	0.9	0.05	0.05

Source: NRC 1977.

A.6.4.2 *Accident Release*

As with the accident severity categories and conditional probabilities discussed in the previous section, accident releases were calculated using NUREG-0170 (NRC 1977). Three factors are used to determine the amount of material that is released into the environment and available for inhalation. These factors include the release fraction, the aerosolized fraction, and the respirable fraction.

The release fraction is the fraction of material that would be released from the shipping container in an accident of a given severity category. For this analysis, all waste containers were assumed to be Type B shipping containers with material release fractions assumed to be typical for low-level radioactive waste. The estimated release fractions are reported in Table A.6.4–2.

The aerosolized fraction represents the fraction of the material released in an accident of a given severity that becomes aerosolized. The respirable fraction represents the fraction of aerosolized material that could be inhaled. Both of these factors are dependent on the physical and chemical characteristics of the waste form. For this analysis, the aerosolized and respirable fractions for the radioactive material and waste considered were assumed to be 1 (i.e., all the material that is released is aerosolized and respirable).

TABLE A.6.4–2. — *Estimated Release Fractions*

Accident Severity Category	Release fraction
1	0
2	0
3	0.001
4	0.01
5	0.05
6	0.1
7	0.5
8	1

Source: Modeling results.

A.6.4.3 *Radiological Material and Waste Characterization*

To determine the potential cargo-related impacts from accidents, DOE estimated the radiological content of the radioactive materials and wastes shipped to and from Y-12. For both the radiological materials and wastes transported representative concentrations were assumed due to the classification of actual concentrations. The radionuclide concentrations (curies per kilogram) and amounts per package (curies per package) used in the analysis are presented in Tables A.6.4–3 and A.6.4–4. The wastes and materials were assumed to be transported in 55-gal drums with radioactive materials shipment having 50 packages per shipment and radioactive waste shipments having 48 packages per shipment.

TABLE A.6.4–3.—*Representative Uranium Concentrations for Radioactive Materials*

Radionuclide	(Ci/kg)	(Ci/package)
U-232	$8.80x10^{-4}$	0.0792
U-234	$2.10x10^{-3}$	0.189
U-235	$8.40x10^{-5}$	$7.56x10^{-3}$
U-236	$9.71x10^{-6}$	$8.73x10^{-4}$
U-238	$3.20x10^{-4}$	0.0288

Source: Modeling results.

TABLE A.6.4–4.—*Representative Uranium Concentrations for Radioactive Wastes*

Radionuclide	(Ci/kg)	(Ci/package)
U-232	$8.80x10^{-4}$	0.0845
U-234	$5.88x10^{-4}$	0.0565
U-235	$1.89x10^{-5}$	$1.81x10^{-3}$
U-236	$2.05x10^{-6}$	$1.97x10^{-4}$
U-238	$3.27x10^{-4}$	0.0314

Source: Modeling results.

A.6.4.4 *Exposure Pathways for Released Material*

RADTRAN 4 assumes that the material available to the receptor in any given accident is dispersed into the environment according to standard Gaussian diffusion models. Default data for atmospheric dispersion were used, representing an instantaneous ground-level release and a small diameter source cloud. The calculation of the collective population dose after the release and dispersal of radioactive material includes the following pathways:

- External exposure to a passing radioactive cloud
- External exposure to contaminated soil
- Internal exposure from inhaling airborne contaminants

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 1 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
Defense Program (DP) Facilities Currently Surplus				
9104-01	OFFICE BLDG.	5,340	B-1	1969
9104-02	OFFICE BLDG.	5,340	B-1	1970
9104-03	OFFICE BLDG.	5,340	B-1	1970
9208-00	ENGINEERING	27,000	A-3	1945
9213-00	SURPLUS FACILITY (OLD CRITICALITY E)	23,500	B-1	1951
9401-02	PLATING SHOP	12,900	B-4	1946
9404-03	STORAGE	5,500	A-5	1947
9404-08	CARPENTRY/ELECTRICAL SHOP	3,000	A-2	1949
9409-15	COOLING TOWER FOR 9204-3	1,350	WOOD	1987
9409-19	COOLING TOWER FOR 9207	3,550	WOOD	1951
9409-28	COOLING TOWER FOR 9207	770	WOOD	1962
9409-29	COOLING TOWER FOR 9207	1,850	MET./WD.	1964
9409-32	COOLING TOWER FOR 9207	1,500	MET./WD.	1966
9416-02	UTILITIES-WATER TREATMENT	250	A-1	1944
9416-14	UTILITIES-WATER TREATMENT	44	A-5	1964
9416-22	UTILITIES - WATER TREATMENT	44	A-5	1964
9416-23	UTILITIES - WATER TREATMENT	44	A-5	1967
9416-25	UTILITIES-WATER TREATMENT	64	A-5	1964
9416-27	FIRE PROTECTION VALVE HOUSE	64	A-5	1978
9418-04	TANK BLDG.	400	A-1	1944
9418-05	TANK BLDG.	400	A-1	1944
9418-06	UTILITIES-TANK BLDG.	400	A-4	1944
9418-09	UTILITIES-TANK BLDG.	400	A-1	1944
9620-02	Z OIL FILTER & PUMPHOUSE	1,000	A-1	1945
9703-11	POST 16-WEST PORTAL	590	A-1/A-5	1955
9703-14	POST 3-SOUTH PORTAL (9213 AREA)	100	A-4	1952
9720-32A	PSO OPERATIONS	3,400	A-3	1970
9720-36	EXPLOSIVES STORAGE MAGAZINE	128	A-1	1974

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 2 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9722-06	MOTOR GENERATOR BLDG. (9934-59)	144	A-4	1987
9723-16	OFFICE BUILDING	11,025	D-3	1944
9724-01	TSD PARKING FACILITY	288	A-1	1987
9732-02	CARPENTER SHOP	400	A-4	1944
9732-03	PAINTER FACILITY	400	A-4	1944
9733-04	ELECTRICAL ENGINEERING	11,450	A-4	1945
9734-00	PROJECT ENGINEERING	11,700	A-2	1951
9754-02	MOTOR VEHICLE SERVICE STATION	276	A-3	1979
9767-03	COMPRESSOR BLDG.	8,500	A-3	1959
9767-05	COMPRESSOR BLDG.	1,300	A-4	1962
9767-07	UTILITIES	404	A-4	1968
9770-01	EMERGENCY GENERATOR	155	A-2	1945
9770-06	PROCESS ANALYSIS-SAMPLING STATION	43	A-4	1954
9770-07	PROCESS ANALYSIS-SAMPLING STATION	43	C-3	1968
9823-00	UTILITIES-COAL SAMPLING STATION	400	A-5	1965
9824-04	GAS AUTOCLAVE FACILITY	1,400	A-5	1976
9824-05	GAS AUTOCLAVE FACILITY	600	A-5	1976
9828-05	WEST PROPANE FACILITY	225	A-5	1977
9949-26	POST 6 PEDESTRIAN ENTRANCE NW 92	30	A-5	1978
9949-29	POST 32 (NW OF 9720-6)	60	A-1	1980
9949-31	POST 40 ON 30 FT TOWER	38	A-5	1980
9949-35	POST 45	36	A-5	1983
9949-36	POST 48 ON TOWER (SE 9107)	36	A-5	1983
9949-37	POST 41	36	A-5	1984
9949-43	POST 21, GUARD BOOTH CHECK POINT	110	A-5	1987
9949-44	POST 21A, GUARD BOOTH CHECK POINT	40	A-5	1987
9949-47	POST 47, ASSESSMENT TOWER (TOWER)	49	A-5	1988
9949-48	POST 42, ASSESSMENT TOWER (TOWER)	49	A-5	1988
9949-49	POST 49, ASSESSMENT TOWER (TOWER)	49	A-5	1987

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 3 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9949-50	POST 46, ASSESSMENT TOWER (TOWER)	49	A-5	1988
9949-51	POST 43, ASSESSMENT TOWER (TOWER)	49	A-5	1988
9949-56	POST 37	49	B-5	1986
9949-58	POST 39	49	B-5	1986
9949-59	POST 36	49	B-5	1986
9949-60	POST 27	100	A-5	1986
9949-63	POST 10	36	A-5	1988
9949-64	POST 10, ID CHECK BOOTH	98	A-5	1988
9949-68	POST 14	36	A-5	1988
9983-09	OFFICES AND TESTING	576	C	1969
9983-10	OFFICES	540	C	1968
9983-11	STORAGE	480	C	1966
9983-13	OFFICES	576	C	1975
9983-15	UTILITIES	576	C	1973
9983-AG	ENVIRONMENTAL RESTORATION	1,960	C	1989
9983-AH	ENVIRONMENTAL RESTORATION	1,960	C	1989
9984-A-00	RADIO COMMUNICATIONS	192	A-2	1964
9990-02	PERIMETER AIR MONITORING STATION 32	168	FIBGL.	1987
9999-02	MOTOR GENERATOR	140	A-4	1949
76 Total DP Facilities Currently Surplus		**161,237**		
Projected Surplus Within 10 Years (Funding Dependent)				
9201-05	ASSEMBLY OPERATIONS	530,500	B-2/B-4	1945
9204-04	ASSEMBLY OPERATIONS	307,475	B-2	1949
9206-00	ENRICHED URANIUM OPERATIONS	67,294	B-3	1946
9409-17	COOLING TOWER FOR 9206	1,400	WOOD	1944
9416-09	PUMPHOUSE	300	A-1/A-2	1945
9510-02	DISPOSAL PIT	900	A-1	1944
9616-04	CHEMICAL SERVICES	120	A-5	1958
9622-00	DYE PENETRANT WASTE STORAGE	217	A-4	1979

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 4 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9720-17	URANIUM CHEMISTRY (STEEL & TRANS)	4,100	A-1	1958
9767-02	UTILITIES	1,200	A-1	1945
9768-00	UTILITIES	1,200	A-2	1945
11 Total DP to Be Surplus Within 10 Years		**914,706**		
Continuing Mission				
0081-22	TEMPORARY BULK WORK ORDER MATE	14,578	A-1	1944
0910-00	BOOSTER PUMPING STATION	1,475	A-4	1966
1401-02	RIVER CHLORINE BLDG. (T-318)	44	STL. & TRN.	
1404-01	RIVER PUMP STATION (T-278)	1,968	A-4	
1404-02	RIVER CHLORINE BLDG. (T-318)	462	A-3	
1404-03	RIVER COMPUTER ROOM	252	A-4	
1404-04	RIVER KMNO4 BLDG.	208	A-3	
1404-06	RIVER SWITCH-GEAR BLDG.	864	A-3	
1404-07	EGRF-EQUIPMENT STORAGE BLDG.	14,500	A-4	
1405-00	WATER PLANT	123,540	B-3	1943
1405-01	WATER PLANT 4 MILLION GALLON RES	30,250	A-4	1943
1405-02	WATER PLANT 3 MILLION GALLON RES	30,100	A-4	1943
1414-00	BOOSTER STATION	7,646	A-4	1954
1415-00	RESERVOIR-SCARBORO RD.	N/A	CONC. F/TK	1954
1416-00	BEAR CR. RESERVOIR-WEST	N/A	CONC. F/TK	1954
1417-00	CATHODIC PROTECTION OF RESERVOIR	N/A	CONC. F/TK	1954
1501-01	ELZA SWITCHYARD EQUIP. ROOM (K-74)	2,800	A-2	1944
1501-02	BATTERY ROOM STORAGE	1,950	A-2	1944
1501-03	ALTERNATE 161-kV FEEDER (K-741-A)	305	A-4	1989
2001-00	ROADS & GROUNDS SHOP	5,625	A-1	1968
2002-00	WATER PLANT MAINTENANCE BLDG.	4,900	A-5	1978
2002-01	BLDG. UNDER SURGE TANK	5,625	A-5	
2002-01A	GENERATOR BLDG.	432	A-3	
2003-00	WATER PLANT THICKENER PUMP STA.	396	A-4	1980

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 5 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
2004-00	WATER PLANT DIKE PREVENTER STA.	320	A-4	1980
2005-00	HEAVY EQUIPMENT GARAGE	3,900	A-1	1984
2006-00	10-IN. EAST BACKFLOW PREVENTER B	360	A-4	1987
2007-00	PUMP STORAGE BLDG.	840	A-5	1988
2008-00	EQUIPMENT STORAGE BLDG.	1,254	A-5	1988
2009-00	PARTS STORAGE BLDG.	583	A-4	1988
2010-00	SALT STORAGE BLDG.	1,253	A-5	1988
2011-00	VEHICLE WASH BLDG.			
2013-00	METER BUILDING	524	A-5	
2014-00	WATER TREATMENT BLDG.	224	A-5	
7620-00	CLARK CENTER			
7621-00	HEADQUARTERS BLDG. (FOR 7620)	793	A-1	
7622-00	BARBECUE SHELTER (FOR 7620)	2,123	A-1	
7623-00	BATH HOUSE (FOR 7620)	1,008	CINDER BLK.	
9100-11	SWINE SHED-W		A-7	
9100-12	SWINE SHED-E		A-1	
9100-13	SWINE SHED BARN		A-1	
9100-14	SWINE PRODUCTION		A-1	
9103-00	OFFICES INFORMATION PROCESSING C	71,800	B-1	1971
9106-00	OFFICES	16,000	B-2	1977
9107-00	TRANSPORTATION SAFEGUARD FACILITY	11,742	A-3	1980
9109-00	OFFICE BLDG.	9,350	B-3	1984
9110-00	OFFICE BLDG.	8,630	B-3	1985
9111-00	NUMERICAL CONTROL TOOL DESIGN	15,000	B-6	1984
9112-00	MECHANICAL DESIGN COMPUTER APPL.	11,500	B-6	1984
9113-00	TRIDENT II OFFICE BLDG.	60,850	B-5	1987
9114-00	MK-F OFFICE BLDG.	37,500	B-5	1987
9115-00	HS OFFICES	15,300	B-3	1989
9116-00	HS OFFICES	15,300	B-3	1988

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 6 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9117-00	INTERACTIVE GRAPHICS SYS. OPER. C	19,500	A-5	1987
9119-00	FCAP '88 OFFICE BLDG.	72,458	B-5	1991
9201-01	TOOL DESIGN	263,128	B-2	1955
9201-01W	SEAWOLF ASSEMBLY FACILITY	8,770	B-5	1990
9201-05N	PRODUCTION MACHINING PLATING SPE.	80,500	B-2	1972
9201-05W	MACHINE SHOP	61,000	B-2/B-4	1967
9202-00	BUDGETS	128,800	B-1	1954
9203-00	LABORATORY DEVELOPMENT	41,700	B-2	1954
9203A-00	LABORATORY DEVELOPMENT	13,650	B-3	1968
9204-02	ASSEMBLY OPERATIONS	270,000	B-1	1945
9204-02E	ASSEMBLY OPERATIONS	151,200	B-1	1969
9205-00	UTILITIES	3,443	A-4	1951
9212-00	ENRICHED URANIUM OPERATIONS	314,377	B-2	1949
9215-00	ENRICHED URANIUM MACHINING & FORMING	157,000	B-2	1959
9217-00	GENERAL SHOPS	1,350	A-5	1965
9217-01	GENERAL SHOPS	1,350	A-5	1965
9219-00	LABORERS, IRONWORKERS, & RIGGER	7,350	A-3	1965
9401-03	PROCESS MAINTENANCE	74,200	B-4	1955
9404-01	STORES (ANIMAL FEED & BEDDING)	4,650	A-2	1951
9404-02	PLANT & INSTR. AIR COMPRESSORS	4,650	B-2	1955
9404-05	PAINT SHOP	5,800	A-2	1944
9404-06	TOWER WATER PUMPHOUSE	800	A-2	1944
9404-09	RUBBER SHOP	3,340	A-1	1945
9404-10	PUMPHOUSE B-2	3,400	A-1	1945
9404-11	PURIFICATION FACILITY	1,000	A-2	1944
9404-12	PUMPHOUSE A-4	1,900	A-2	1944
9404-13	PUMPHOUSE A-5	1,000	A-2	1944
9404-16	UTILITIES S. B-4	1,480	A-4	1953
9404-17	PUMPHOUSE SW A-4 SB & MW	1,400	STL/TRN.	1955

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 7 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9404-18	MW PLANT (STEEL & TRANSITE)	4,100	A-1	1955
9404-20	WEST END LABORERS AND MASONS	1,000	A-1	1955
9404-21	PUMPHOUSE 24-IN. BOOSTER PUMPS	553	A-4	1973
9404-24	FIRE WATER PUMPHOUSE	1,040	A-4	1991
9409-02	ORIGINAL AII COOLING SPRAY POND	5,600	CONC.	1960
9409-06	COOLING TOWER FOR 9731	1,800	MET./WD	1943
9409-10	COOLING TOWER FOR 9204-2	2,400	WOOD	1949
9409-12	COOLING TOWER FOR 9201-4	2,004	WOOD	1956
9409-13	COOLING TOWER FOR 9201-5	7,300	WOOD	1958
9409-18	COOLING TOWER FOR 9202	1,350	WOOD	1956
9409-20	COOLING TOWER FOR 9204-4	1,600	CONC.	1988
9409-22	COOLING TOWER FOR 9212	4,200	WOOD	1953
9409-22E	COOLING TOWER FOR 9212	1,332	METAL	1967
9409-23	COOLING TOWER FOR 9995	3,350	MET./WD.	1957
9409-24	COOLING TOWER FOR 9212	1,450	WOOD	1955
9409-24E	COOLING TOWER FOR 9212	600	METAL	
9409-26	COOLING TOWER FOR 9215	1,900	WOOD	1961
9409-30	COOLING TOWER FOR 9737	480	WOOD	1966
9409-31	COOLING TOWER FOR 9202	940	WOOD	1965
9409-33	COOLING TOWER FOR 9995	500	MET./WD.	1971
9409-34	COOLING TOWER SE 9727-4	528	MET./WD.	1983
9409-35	COOLING TOWER FOR 9720-6	100	METAL	1986
9409-36	COOLING TOWER FOR 9213	80	METAL	
9416-01	UTILITIES-WATER TREATMENT	72	A-2	1971
9416-04	COOLING TOWER CONTROLS	230	A-4	1943
9416-10	UTILITIES-WATER TREATMENT	300	A-1/A-2	1945
9416-11	UTILITIES-WATER TREATMENT	44	A-5	1964
9416-12	UTILITIES-WATER TREATMENT	44	A-5	1965
9416-13	UTILITIES-WATER TREATMENT	44	A-5	1965

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 8 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9416-15	UTILITIES-WATER TREATMENT	44	A-5	1967
9416-16	UTILITIES-WATER TREATMENT	44	A-5	1967
9416-17	UTILITIES-WATER TREATMENT	44	A-5	1967
9416-18	UTILITIES - WATER TREATMENT	50	A-5	1967
9416-19	UTILITIES - WATER TREATMENT	50	A-5	1964
9416-20	UTILITIES WATER TREATMENT	90	A-5	1967
9416-21	UTILITIES - WATER TREATMENT	64	A-5	1967
9416-24	UTILITIES - CONTROL BLDG.	64	A-2	1973
9416-26	UTILITIES - WATER TREATMENT	64	A-5	1965
9416-28	FIRE PROTECTION VALVE HOUSE	150	A-4	1983
9416-29	EFFLUENT MONITORING STATION	99	CONC. BELOW GRAD	1985
9416-30	FIRE PROTECTION VALVE HOUSE	44	A-5	1972
9416-31	FIRE PROTECTION VALVE HOUSE	171	A-4	1986
9416-32	WATER TREAT. BLDG. & VALVE HOUSE	200	A-5	1987
9416-33	WATER TREAT. BLDG. & VALVE HOUSE	200	A-5	1987
9416-36	VALVE HOUSE	45	A-5	1990
9416-37	VALVE HOUSE	43	A-5	1990
9416-38	SPRINKLER VALVE HOUSE	36	A-5	1989
9416-39	SPRINKLER VALVE HOUSE	43	A-5	1990
9416-40	SPRINKLER VALVE HOUSE	43	A-5	1990
9416-41	SPRINKLER VALVE HOUSE	171	A-5	1989
9416-42	SPRINKLER VALVE HOUSE	50	A-5	1986
9416-43	SPRINKLER VALVE HOUSE	48	A-5	1993
9416-44	SPRINKLER VALVE HOUSE	75	A-5	1994
9416-45	VALVE HOUSE W. OF B-2	45	A-5	1970
9416-46	VALVE HOUSE N. OF 9423	64	A-5	1984
9417–06	WATER SPRINKLER RISER	336	A-5	1985
9417-07	WATER HEATER BLDG.	336	A-5	1988
9417-08	DECHLORINATION FACILITY	144	A-9	1991

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 9 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9417-09	DECHLORINATION FACILITY	90	A-9	1991
9418-10	VACUUM PUMP BLDG.	80	A-3	1992
9419-02	UTILITY (WOOD & TRANSITE)	1,000	A-1	1944
9420-00	CONSOLIDATED SHOPS	27,217	A-5	1980
9420-01	HOST/TRIG TRAINING	5,000	A-5	1985
9422-01	STORM DRAIN MONITORING	80	C	1987
9422-02	STORM DRAIN MONITORING	64	C	1987
9422-03	STORM DRAIN MONITORING	72	C	1987
9422-04	STORM DRAIN MONITORING	64	C	1987
9422-05	STORM DRAIN MONITORING	64	C	1987
9422-06	STORM DRAIN MONITORING	64	C	1987
9422-08	STORM DRAIN MONITORING-SITE 14A	64	A-7	
9422-10	STORM DRAIN MONITORING	64	C	1987
9422-11	STORM DRAIN MONITORING	64	C	1987
9422-12	STORM DRAIN MONITORING	64	C	1987
9422-13	STORM DRAIN MONITORING	64	C	1987
9422-14	STORM DRAIN MONITORING-SITE SP	64	C	1987
9422-15	STORM DRAIN MONITORING	64	C	1987
9422-16	STORM DRAIN MONITORING	64	C	1987
9422-17	STORM DRAIN MONITORING	64	C	1987
9422-18	SANITARY SEWER MONITORING- STA	120	C	1991
9422-20	OUTFALL MONITORING - SITE IHgTU	64	C	1993
9422-21	STORM DRAIN MONITORING- SITE WE	64	C	1993
9423-00	MAINTENANCE	5,000	A-5	1987
9423-02	METER BLDG.	224	A-5	1993
9424-03	FOAM BLDG. FOR 9720-58	300	A-5	1993
9501-01	ELECT. SUBSTATION/9201-1	NA	NA	1943
9501-02	ELECT. SUBSTATION/9201-2	NA	NA	1943
9501-03	ELECT. SUBSTATION/9201-3	NA	NA	1943
9501-04	ELECT. SUBSTATION/9204-1	NA	NA	1943

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 10 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9501-05	ELECT. SUBSTATION/9201-4	NA	NA	1944
9501-06	ELECT. SUBSTATION/9201-5	NA	NA	1944
9501-07	ELECT. SUBSTATION/9204-2	NA	NA	1943
9501-08	ELECT. SUBSTATION/9204-3	NA	NA	1944
9501-09	ELECT. SUBSTATION/9204-4	NA	NA	1944
9610-00	OIL AND PAINT STORAGE	2,350	A-4	1944
9610-01	FLAMMABLE LIQUID STORAGE	135	A-5	1989
9611-02	SEWAGE EJECTOR STATION	200	A-1	1986
9611-03	SEWAGE LIFT STATION PKG. FIBER	176	UG-FIBRE	1993
9611-04	LEACHATE LIFT SUMP	293	UG-CONC.	1993
9616-03	CHEMICAL UNLOADING STATION	1,400	A-1	1945
9616-03TK3	WORK SHOP - MAINTENANCE	380	PLATE TANK	1945
9616-05	CYLINDER STORAGE BLDG. (FLUORINE)	2,800	A-5	1987
9616-09	STEAM PLANT WASTE WATER FACILITY	3,300	A-5	1985
9616-10	BULK SULFURIC ACID UNLOADING STA.	335	A-5	1986
9621-00	RCRA STORAGE AREA	770	CONC.	1945
9625-00	KATHABAR EQUIPMENT	1,300	A-5	1987
9626-00	MK-F SECURITY/MEDICAL	5,000	A-5	1977
9627-00	MK-F TRAINING/ENVIRONMENT	9,248	A-5	1986
9701-05	POST 15 - EAST PORTAL & WAITING RO	400	A-4	1960
9701-06	POST 5 - EAST PORTAL	150	A-4	1960
9702-00	TELEPHONE & TELEGRAPH	2,090	A-4	1953
9702-01	TELEPHONE COMM. CTR. OFFICE	14,400	A-3	1995
9703-15	S&H OFFICE/TRAINING	12,056	A-5	1987
9703-16	IRON WORKER SHOP	6,600	A-5	1962
9704-02	ACCOUNTING & BUDGET	43,650	B-6	1952
9706-01	PHYSICAL SECURITY DEPARTMENT	6,900	A-2	1945
9706-01A	COMPLIANCE & RESOURCE MANAGEMENT	7,700	A-2	1946
9706-02	MEDICAL	27,600	A-2	1948

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 11 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9709-00	TRAINING FACILITY, CENTER FOR CONT	53,000	A-1	1954
9710-02	POST 21 (GUARD HEADQUARTERS)	25,540	A-1	1948
9710-03	GUARD HEADQUARTERS (NEW)	41,124	B-3	1988
9711-01	TECHNICAL LIBRARY	27,092	A-1	1960
9711-05	CONFERENCE ROOM	57,650	B-1/B-6	1948
9712-00	GARAGE	33,890	A-1	1945
9714-00	TRANSPORTATION SAFEGUARDS	41,183	A-5	
9714-01	RANGE TOWER	64	A-5	1988
9714-02	SECURITY BOOTH	48	A-5	1989
9720-01	STORES	43,000	A-1	1944
9720-02	MAINTENANCE STORES (BULK MATERIAL)	47,800	A-1	1944
9720-03	DUO PACKING & SHIPPING	8,400	A-3	1965
9720-04	OFFICE AND EXCESS MAT'L FUNCTION	12,960	A-4	1969
9720-05	PSO WAREHOUSE	53,979	A-1/A-4	1945
9720-06	GENERAL PLANT MAINTENANCE	63,700	B-4	1952
9720-07	BM STORES	28,300	A-5	1955
9720-08	STORES	142,700	A-5	1957
9720-12	STORAGE WAREHOUSE	15,000	A-4	1957
9720-13	PLANT MAINTENANCE WAREHOUSE	10,700	A-5	1955
9720-14	WEAPONS RETURN STORAGE	2,400	A-5	1955
9720-15	PAINT SHOP	5,100	A-3	1955
9720-16	MAINTENANCE (RIGGERS)	15,000	A-5	1957
9720-18	DEPLETED URANIUM STORAGE	6,050	A-5	1958
9720-19	FOAM SHOP	3,756	A-4	1962
9720-19A	SHOP	2,475	A-4	1987
9720-19B	STORAGE BUILDING	3,000	A-4	
9720-20	DEVELOPMENT MAINT. SHOPS & OFFICES	4,800	A-5	1963
9720-21	STORES	2,950	A-4	1964
9720-22	STORAGE	16,000	A-3	1967

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 12 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9720-23	BULK CHEMICAL STAGING BLDG.	2,600	A-5	1986
9720-24	CLASSIFIED TOOL STORAGE	11,200	A-3	1970
9720-26	MERCURY STORAGE	13,600	A-4	1963
9720-27	REACTIVE METAL STORAGE	1,200	A-3	1971
9720-28	INTERIM - LLW DISPOSAL BLDG.	3,600	A-3	1984
9720-30	STORAGE FACILITY	792	A-5	1974
9720-33	ON HOLD FOR FUTURE USE STORAGE	39,903	A-3	1970
9720-34	STORAGE & SHOP	800	A-5	1963
9720-37	AMMUNITION STORAGE	210	A-5	1980
9720-38	MATERIAL DISPATCHING STOR. BLDG.	7,700	A-5	1982
9720-40	STORAGE SHED FOR GAS BOTTLES	1,300	A-5	1990
9720-46	LITHIUM STORAGE	3,465	A–5	1988
9720-47	SODIUM HYPOCHLORITE STATION	2,400	A-5	1987
9720-48	MAINTENANCE - STORAGE PUMPS	3,750	A-5 OPN	1986
9720-49	MAINTENANCE - STORAGE	2,500	A-5 OPN	1986
9720-50	MAINTENANCE - STORAGE	4,000	A-5 OPN	1986
9721-51	MAINTENANCE - STORAGE	2,500	A-5 OPN	1986
9720-52	MAINTENANCE - STORAGE	4,000	A-5 OPN	1986
9720-53	MAINTENANCE - STORAGE	4,000	A-5 OPN	1987
9720-60	SOLIDS STORAGE FACILITY (DARA SOIL)	14,000	A-8	1989
9720-73	LINEMAN BLDG. (LABORER YARD)	1,800	A-5	1994
9720-74	90 DAY - STANDBY BLDG.	192	A-5	1994
9720-75	90 DAY - HAZ. WASTE STORAGE BLDG.	488	A-5	1994
9720-76	90 DAY - WORK BAY STORAGE BLDG.	240	A-5	1994
9720-77	90 DAY - NON-HAZ. WASTE STORAGE	255	A-5	1994
9720-78	90 DAY - NON-HAZ. WASTE STORAGE	276	A-5	1994
9720-79	CHOCKER BARN (9929-1 YARD)	1,404	A-5	1994
9720-80	EQUIPMENT STORAGE	120	C	1996
9720-81	EQUIPMENT STORAGE	120	C	

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 13 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9721-00	BIODENITRIFICATION NITRIC ACID REC	288	A-5	1989
9722-02	MEDICAL EMERGENCY	820	A-1	1944
9722-03	ELECTRICAL MAINTENANCE - EMERGE	5,100	A-5	1983
9722-04	EMERGENCY GENERATOR BLDG.	352	A-4	1988
9722-05	MOTOR GENERATOR BLDG. (9949-57)	144	A-4	1987
9723-04	ELECTRICAL MAINTENANCE	10,700	A-1	
9723-14	ADMINISTRATIVE OFFICES	16,800	A-1	1954
9723-18	CHANGE HOUSE	15,900	A-1	1944
9723-19	CHANGE HOUSE	15,000	A-1	1944
9723-21	UTILITIES	4,600	A-1	1944
9723-24	LABORATORY DEVELOPMENT	12,122	A-1	1950
9723-25	ADMINISTRATIVE OFFICES	19,590	B-6	1949
9723-26	CHANGE HOUSE - SHOE EXCHANGE	96	A-5	1981
9723-27	CHANGE HOUSE	11,750	A-5	1989
9723-28	CHANGE HOUSE & EMERG. MEDICAL	10,000	A-5	1990
9723-31	CHANGE HOUSE	29,172	A-5	1991
9723-33	CHANGE HOUSE	12,740	A-5	1991
9724-00	RADIO BLDG. REPEATER STATION (CH)	240	A-5	1981
9724-02	RADIO REPEATER STATION (BUFFALO)	480	A-5	1988
9724-03	RADIO REPEATER STATION	187	A-4	1951
9724-05	TRANSMITTER RECEIVING STATION	87	A-4	
9725-00	COMPOSITE MANUFACTURING CENTER	6,000	A-5	1986
9727-03	UTILITIES	2,950	A-5	1955
9727-04	UTILITIES	1,750	A-5	1963
9727-04A	UTILITIES	960	A-3	1963
9728-00	LAUNDRY	13,600	A-1	1943
9729-00	STORES $C0_2$ SHIP., REC., DELIVERY	3,500	A-2	1943
9731-00	SITE PROGRAMS MAINTENANCE	37,300	B-1	1944
9732-01	GENERAL SHOPS	400	A-4	1944

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 14 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft²)	Construction Type[a]	Year Built
9733-01	CATALOG LIBRARY	14,750	A-2	1951
9733-02	ENGINEERING DIVISION	13,200	A-1	1945
9733-03	ELECTRICAL ENGINEERING	11,400	A-1	1951
9736-00	ESTIMATING	7,800	B-2	1944
9737-00	ELECTRICAL	63,400	B-1	1960
9738-00	GENERAL SHOPS	8,750	A-2	1944
9739-00	PROJECT ENGINEERING	21,600	A-2	1947
9744-00	UTILITIES	8,400	A-2	1944
9752-00	UTILITIES	1,200	A-2	1944
9754-03	MOTOR VEHICLE SERVICE STA. (NEW)	312	A-3	
9755-00	CAR WASH BLDG.	100	A-5	1985
9755-00A	ADDITION TO CAR WASH BLDG.	1,250	A-5	
9764-00	OFFICES	4,450	A-1	1946
9766-00	OFFICES	35,450	A1	1944
9767-01	UTILITIES	3,500	A-2	1948
9767-04	UTILITIES	5,390	A-5	1962
9767-06	OFFICE BLDG.	7,500	B-3	1967
9767-08	CHILLER BLDG.	4,800	A-5	1984
9767-09	TRANSFORMER, SWITCHGEAR AND EM	211	A-4	1962
9767-10	CHILLER BLDG. (AREA 5)	12,000	A-5	1989
9767-11	CHILLER BLDG. (DEV. 9202)	4,860	A-5	1986
9767-12	CHILLER BLDG. (9737)	3,000	A-5	1985
9767-13	CHILLER BLDG. (COMPRESSOR) WEST	20,460	A-5	1986
9769-00	ANALYTICAL LABORATORIES	19,520	B-1	1945
9769-00E	ANALYTICAL LAB ADDITION	11,736	B-5	1991
9770-03	LABORATORY STORAGE	242	A-2	1963
9770-08	PROCESS ANALYSIS -SAMPLING STA.	50	A-3	1970
9770-09	WASTE MONITORING STATION	75	A-4	1980
9771-00	MAIL ROOM	2,050	A-1	1945

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 15 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9802-01	UTILITIES	166	A-4	1945
9802-02	UTILITIES	166	A-4	1955
9803–00	UTILITIES	176	A-4	1955
9804-00	UTILITIES	128	A-4	1955
9805-00	DEUTERIUM GAS STORAGE	1,850	A-3	1959
9805-01	DEUTERIUM PROD. FACILITY	6,895	A-5	1957
9808-00	PLANT MAINTENANCE	6,700	A-5	1956
9811-02	TANKER TRANSFER STA., TRIDENT II	1,875	A-8	1989
9811-03	TANKER TRANSFER STATION	1,800	A-5	1989
9811-04	TANKER TRANSFER STA., TRIDENT II	1,455	A-5	1989
9811-05	WASTE COOLANT FACILITY	4,800	CONC.	1990
9811-06	DRY ASH HANDLING FACILITY	1,518	B-5	1990
9811-07	WET ASH HANDLING FACILITY	5,900	A-8	
9811-09	SPILL CONTROL TRANSFER STATION	1,016	A-5	1988
9811-12	TRANSFORMER OIL RECYCLING FAC.	9,480	A-5	1997
9812-00	TANK PIT	1,500	A-5	1963
9813-00	AMMONIA STORAGE	1,300	A-5	1959
9814-00	TEAMSTER OFFICE	864	A-5	1945
9815-00	ORGANIC HANDLING FACILITY	1,020	A-1	1960
9816-00	FIRE DEPARTMENT	590	A-4	1962
9817-00	FIRE DEPARTMENT	2,700	A-5	1962
9817-01	SMOKE TRAINING FACILITY	800	A-4	1980
9817-02	FIRE TRAINING FACILITY	600	A-5	1990
9818-00	NITRIC ACID RECOVERY FACILITY	7,500	B-4	1976
9819-00	RECORDS STORAGE	805	A-5	1945
9820-00	ELECTRICAL STORAGE	384	A-5	1962
9821-01	EXPLOSIVE FORMING	120	A-5	1962
9821-02	EXPLOSIVE FORMING	60	A-5	1962
9821-03	EXPLOSIVE FORMING	1,600	A-5	1962

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 16 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9821-04	FORMING COIL HOUSE	200	A-5	1964
9821-05	MAGAZINE BUNKER FOR EXPLOSIVE F	224	CONC. BLK	1985
9821-06	MAGAZINE BUNKER FOR EXPLOSIVE F	224	CONC. BLK.	1985
9822-00	SOLVENT SETTLING BASIN	620	CONC.	1958
9824-01	HIGH PRESSURE TEST CELL	800	A-4	1968
9824-02	HIGH PRESSURE TEST CELL	300	A-4	1968
9824-03	HIGH PRESSURE ACCUMULATOR BUNK	198	A-4	1974
9826-00	TRUCK SCALES	1,800	A-5	1987
9826-01	COMPUTER BLDG. FOR TRUCK SCALES	63	A-1/A-5	1987
9826-02	COMPUTER BLDG. FOR TRUCK SCALES	64	A-5	1986
9827-00	ROD BENDING SHOP\STORAGE	945	A-1	1945
9828-01	BAG FILTER SYSTEM	500	B-5	1973
9828-02	PROBE STATION	172	A-5	1973
9828-03	FILTER HOUSE	500	A-5	1973
9830-01	CAPCA OIL &SOIL STOR. VAULT- RUB	3,920	A-8	1989
9831-00	ELECTRICAL SHOP	16,900	A-5	1945
9929-01	OLD CARPENTER SHOP	15,000	A-1	1944
9949-01	POST 7 (NW 9202)	400	A-1	1967
9949-03	POST 12 (NW 9201-2)	96	A-5	1993
9949-04	POST 25 (TO 9207)	30	A-5	1978
9949-05	POST 2 (NORTH PORTAL)	80	A-5	1978
9949-06	POST 14 (CENTRAL PORTAL)	535	A-1/A-5	1945
9949-07	POST 9 (NORTH 9201-1)	142	A-1	1973
9949-17	POST 3 (AT 9213)	125	A-4	1985
9949-25	POST 44 ON TOWER	81	A-5	1988
9949-28	POST 28	60	A-5	1988
9949-30	POST 17 TEMP.	60	A-5	1980
9949-33	POST 24 (N 9204-01)	38	A-5	1983
9949-38	HARDENED GUARD BOOTH, EAST PORTAL	160	B-1/B-5	1987

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 17 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft²)	Construction Type[a]	Year Built
9949-39	HARDENED GUARD POST 23A	40	A-5	1987
9949-40	POST 22B, GUARD BOOTH CHECK POINT	55	A-5	1987
9949-41	POST 22A, GUARD BOOTH CHECK POINT	40	A-5	1987
9949-42	POST 22, GUARD BOOTH CHECK POINT	40	A-5	1987
9949-45	POST 20, HARDENED GUARD POST	160	B-1/B-5	1987
9949-46	POST 20A, NON-HARDENED GUARD BOOTH	40	A-5	1987
9949-52	POST 13 (VENDOR'S ACCESS ENTRANCE)	234	A-2	1987
9949-55	POST 2	238	A-5	1985
9949-57	POST 38	49	B-5	1986
9949-61	POST 1	36	A-5	1988
9949-62	POST 1, ID CHECK BOOTH	98	A-5	1988
9949-65	POST 16	36	A-5	1988
9949-66	POST 16, ID CHECK BOOTH	98	A-5	1988
9949-67	POST 16, ID CHECK BOOTH	50	A-5	1988
9949-69	POST 14, ID CHECK BOOTH	98	A-5	1988
9949-70	POST 8, ID CHECK BOOTH	215	B-5	1988
9949-71	POST 8	60	A-5	1988
9949-72	POST 8	60	A-5	1988
9949-73	POST 8	50	A-5	1988
9949-74	POST 24, ID CHECK BOOTH	300	A-5	1988
9949-75	POST 24, ID CHECK BOOTH	50	A-5	1988
9949-76	POST 33, ID CHECK BOOTH	128	B-1/B-5	1988
9949-77	POST 33, ID CHECK BOOTH	50	A-5	1988
9949-78	POST 33, ID CHECK BOOTH	60	A-5	1988
9949-79	POST 17, ID CHECK BOOTH	45	A-5	1988
9949-80	POST 33, ID CHECK BOOTH	60	A-5	1988
9949-83	POST 33 EQUIPMENT BUILDING	420	C	
9959-00	STORES	4,525	A-3	1954
9959-01	ELECTRICAL STORAGE	170	A-3	1966

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 18 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9959-02	STORES - CYLINDER STORAGE	2,265	A-3	1944
9959-03	CHEMICAL STORAGE	49	A-5	1966
9976-00	UTILITIES	3,100	WD. & TRN.	1955
9977-00	UTILITIES (NITROGEN STATION)	270	STL. & TRN.	1943
9977-01	UTILITIES (NITROGEN STATION)	750	STL. & TRN.	1964
9977-02	UTILITIES	2,700	CONC. & CONC. BLK.	1955
9980-00	FORMER PHYSICAL TESTING, X-RAY	5,900	B-2	1950
9981-00	UTILITIES PHYSICAL TESTING, X-RAY	13,020	B-2	1949
9983-00	RADCON ORGANIZATION	1,165	A-1	1944
9983-01	TRAINING	672	C	1976
9983-02	LUNCH ROOM	576	C	1969
9983-06	LUNCH ROOM	1,200	C	1969
9983-18	HP TRAILER	1,230	C	1972
9983-20	OFFICE		C	
9983-24	ELECTRICIANS TRAILER	420	C	1969
9983-28	OFFICES FOR MKF	600	C	1980
9983-29	RADIO BASE TRAILER	612	C	1969
9983-30	TECHNICAL INFORMATION OFFICE	1,344	C	1986
9983-31	OFFICES FOR EMCS	450	C	1969
9983-32	OFFICES	720	C	1987
99833-35	OFFICES	720	C	1986
9983-37	HEALTH PHYSICS	600	C	1986
9983-39	OFFICES	600	C	1986
9983-40	CHANGEHOUSE	1,440	C	1986
9983-43	OFFICES - ALLEGHENY ELEC., INC.	450	C	1986
9983-45	ELECTRICAL TRAILER	600	C	1986
9983-46	ELECTRICAL TRAILER	720	C	1986
9983-47	TRAILER (INACTIVE)	600	C	1984
9983-49	SURVEY/ENGINEERING TRAILER	420	C	1986

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 19 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft²)	Construction Type[a]	Year Built
9983-55	OFFICE	2,160	C	1986
9983-58	ENVIRON. RESTORATION OFFICES	2,160	C	1986
9983-62	OFFICES	3,600	C	1990
9983-63	OFFICES	3,600	C	1990
9983-64	OFFICES	3,600	C	1990
9983-65	OFFICES	3,600	C	1990
9983-66	OFFICES - MECHANICAL ENGINEERING	2,160	C	1986
9983-68	CHANGEHOUSE	1,440	C	1986
9983-71	MODULAR OFFICE TRAILERS	3,600	C	1990
9983-72	MODULAR OFFICE TRAILERS	3,600	C	1990
9983-73	PROJECT ENGINEERING OFFICES	1,440	C	1977
9983-76	WEST BURIAL OR LANDFILL (WAS K-150)	720	C	1985
9983-77	WEST BURIAL OR LANDFILL (WAS K-150)	576	C	1976
9983-79	WEST LANDFILL OFFICE	576	C	1986
9983-81	OFFICES - CONSTRUCTION ENGINEER	1,344	C	1986
9983-82	ENGINEERING OFFICES	1,344	C	1986
9983-83	OFFICES	4,771	C	1973
9983-84	HP TRAILER	1,344	C	1986
9983-85	OFFICES, FIRE PROTECTION (WAS K-1550Q)	720	C	1973
9983-86	TRAINING CENTER	4,320	C	1986
9983-88	TRANSPORTATION SAFEGUARDS (W91	1,344	C	1969
9983-90	CONST. ENGR. OFFICE (WAS K-1550-M)	720	C	1986
9983-94	PHYSICAL THERAPY (S 9706-2)	2,160	C	1987
9983-97	ELECTRICAL TRAILER	600	C	1987
9983-99	CHANGEHOUSE	1,440	C	1986
9983-AD	ENGINEERING OFFICES	1,344	C	1986
9983-AF	ENGINEERING OFFICES	1,344	C	1986
9983-AJ	EQUIPMENT ROOM	630	C	1990

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 20 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9983-AK	CLASSROOM ASSOC.	630	C	1990
9983-AL	OFFICES	280	C	1986
9983-AR	BREAK ROOM N. OF 9949-45	288	C	1992
9983-AS	BREAK ROOM SW OF 9825-2	288	C	1992
9983-AT	BREAK ROOM SW OF 9204-3	288	C	1992
9983-AV	STORES - HAZ. MATERIALS SA485	120	C	1992
9983-AW	RANGE EQUIPMENT STORES BLDG.	288	C	1992
9983-AZ	WTSD SAMPLING CREW TRAILER	363	C	1993
9983-BR	HEALTH PHYSICS	155	C	1993
9983-BZ	STORAGE BLDG.	240	C	1993
9983-CC	BOUNDARY CONTROL STATION #42	112	C	1993
9983-CD	BOUNDARY CONTROL STATION #23	120	C	1993
9983-CE	BOUNDARY CONTROL STATION #22	120	C	1993
9983-CF	BOUNDARY CONTROL STATION #9	120	C	1993
9983-CH	ENVIRONMENTAL 90 DAY YARD	840	C	1994
9983-CJ	TRAILER (INACTIVE)	200	C	1994
9983-CK	PERSONNEL FROM 9720-5	840	C	1994
9983-CL	OFFICE PERSONNEL	200	C	1994
9983-CM	TRAILER (INACTIVE)	224	C	1994
9983-CN	CONSTRUCTION SUPPORT	144	C	1994
9983-CR	CONSTRUCTION SUPPORT	128	C	1994
9983-CS	TRAILER (INACTIVE)	128	C	1994
9983-CT	ELECTRICAL CONSTRUCTION SUPPORT	192	C	1994
9983-CU	ELECTRICAL CONSTRUCTION SUPPORT	128	C	1994
9983-CV	FISHER EQIUPMENT TRAILER	360	C	1994
9983-CW	CONSTRUCTION SUPPORT	300	C	1994
9983-CX	ESCORT/VEHICLE DISPATCH OFFICE	200	C	1994
9983-CY	FIELD OFFICE	198	C	1994
9983-CZ	TRAILER (INACTIVE)	144	C	1994

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 21 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft²)	Construction Type[a]	Year Built
9983-EB	HP SUPPORT TO CONST. ACTIVITIES	240	C	
9983-EE	FLAMMABLE LIQUID STORAGE	200	C	
9983-EF	CONSTRUCTION SUPPORT, WAREHOUSE	200	C	
9983-EG	TRAILER (INACTIVE)	288	C	
9983-EJ	OFFICE SPACE	720	C	
9983-EP	WAREHOUSE STORAGE SHED	216	C	
9983-EQ	WAREHOUSE STORAGE SHED	120	C	
9983-ER	TRAILER (INACTIVE)	120	C	
9983-ES	TRAILER (INACTIVE)	120	C	
9983-ET	TRAILER (INACTIVE)	120	C	
9983-EW	STORAGE	552	C	
9983-EY	RADCON TECH OFFICE	120	C	
9983-EZ	CONSTRUCTION SUPPORT, ELECTRICA	720	C	
9983-FA	CONSTRUCTION SUPPORT, ELECTRICA	240	C	
9983-FC	OFFICE SPACE	180	C	1996
9983-FD	OFFICE SPACE	1,307	C	1996
9983-FE	OFFICE SPACE	1,307	C	1996
9983-FF	OFFICE SPACE	1,307	C	1996
9983-FG	OFFICE SPACE	1,307	C	1996
9983-FH	CONSTRUCTION SUPPORT	120	C	1996
9983-FJ	OFFICE SPACE	480	C	1996
9983-FM	OFFICE SPACE	240	C	1996
9983-FN	OFFICE SPACE	240	C	1996
9983-FP	RESTROOMS	96	C	1996
9983-FQ	RESTROOMS	96	C	1996
9983-FR	RESTROOMS	96	C	1996
9983-FS	OFFICE SPACE	1,440	C	1996
9983-FT	OFFICE SPACE	660	C	1996
9983-FV	OFFICE SPACE	600	C	1998

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 22 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9985-00	FIRE ALARM MONITOR STATION	71	A-5	1972
9987-00	INACTIVE RECORDS STORAGE	2,094	B-1	1943
9989-00	SO_2 MONITOR STATION (Y# 176240)	48	C	1973
9990-00	SO_2 MONITOR STATION	48	C	1973
9990-01	GAS PRESSURE REDUCING STATION	175	STL. & TRN.	1961
9990-03	COAL SAMPLING STATION	4,270	B-1	1989
9993-00	MAINTENANCE STORAGE	3,120	STL. & TRN.	1974
9995-00	PLANT LABORATORY	84,000	B-2	1952
9996-00	WEAPON MATERIAL MANAGEMENT ESO	33,501	B-3	1955
9998-00	H-1 FOUNDRY	137,100	B-3	1949
9999-00	MOTOR GENERATOR (W9212)	515	A-4	1955
9999-05	EMERGENCY GENERATOR BLDG.	250	A-4	1986
9999-06	ELECTRICAL SWITCHGEAR BLDG.	2,976	B-3	
9999-07	EMERGENCY GENERATOR BLDG.	250	A-4	1986
K-1650-00	CENTRAL CONTROL FACILITY	21,120	B-2	
K-741A	POWER OPERATED	304		
533 Total DP w/Continuing mission		**4,412,496**		
620 Total DP		**5,488,439**		
Environmental Management (EM) Facilities				
9201-04	ALPHA 4 (OUT OF SERVICE)	561,900	B-2	1945
9401-04	MAINT. FREE ISSUE FAC. - INTERIM LLW	3,600	A-5	1984
9401-05	URANIUM CHIP OXIDIZERS	3,750	A-5	1987
9404-07	HS STORAGE PUMPHOUSE	3,000	A-2	1944
9424-01	FOAM HOUSE FOR OD-9 (FP)	350	A-5	1993
9424-02	FOAM HOUSE FOR OD-10 (FP)	400	A-5	1993
9616-06	LIQUID WASTE FACILITY	2,600	A-5	1989
9616-07	WEST ENVIRONMENTAL PROJECT	24,554	B-5	1985

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 23 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9616-08	FILTER TREATMENT FACILITY	1,125	A-5	1986
9616-11	LEACHATE TREATMENT FACILITY	4,805	A-5	1989
9623-00	CENTRAL POLLUTION CONTROL FACILITY	20,000	B-3	1985
9624-00	ENVIRONMENTAL SUPPORT FACILITY	37,200	A-5	1992
9704-01	OFFICES, COMPUTER ROOM & UTILITIES	8,700	A-1	1952
9720-09	RCRA	12,500	A-5	1955
9720-25	STORES	17,600	A-4	1962
9720-31	RCRA - MIXED STORAGE BLDG	6,571	A-4	1986
9720-32	NDA FACILITY	30,977	A-3	1970
9720-41	PROCESS STORAGE BLDG.	3,306	A-5	1988
9720-44	SLUDGE HANDLING FACILITY	4,900	A-5	1986
9720-45	LIQUID ORGANIC WASTE FACILITY	2,250	A-5	1987
9720-58	TRANSFORMER STORAGE AREA (PCB)	4,200	A-5	1987
9720-59	PRODUCTION WASTE STORAGE FACILITY	15,105	A-5	
9722-00	OFFICE, BREAKROOM	1,000	A-5	1987
9809-01	URANIUM OXIDE STORAGE SHED	1,200	A-3	1990
9811-01	WASTE OIL STORAGE	4,875	A-5	1988
9811-08	TRANSFER STA. (OIL DISPOSAL, OD-9)	874	A-5	1986
9825-01	UNDERGROUND VAULT (CONCRETE)	1,600	CONC.	1984
9825-02	UNDERGROUND VAULT (CONCRETE)	1,600	CONC.	1984
9830-02	STORAGE PAD FACILITY - RUBB	7,172	A-8	1993
9830-03	STORAGE PAD FACILITY - RUBB	7,172	A-8	1993
9830-04	STORAGE PAD FACILITY - RUBB	7,172	A-8	1993
9830-05	STORAGE PAD FACILITY - RUBB	7,172	A-8	1993
9830-06	STORAGE PAD FACILITY - RUBB	7,172	A-8	1993
9830-07	STORAGE PAD FACILITY - RUBB	7,172	A-8	1993
9840-04	DRUM CLEANING STATION (OD10)	312	A-5	1993
9983-44	OFFICES (SANITARY LANDFILL NO. 2)	336	C	
9983-67	ENVIRON. RESTORATION OFFICES	2,160	C	1986

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 24 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9983-74	OFFICES IN SALVAGE YARD (WAS K-15)	720	C	1986
9983-78	OFFICE TRAILER FOR WASTE COOLING	200	C	1986
9983-93	ENGINEERING OFFICES	624	C	1986
9983-BC	INGRESS & EGRESS BLDG. TF#2	118	C	1993
9983-BD	TRUCK DRIVER'S WAITING AREA	294	C	1993
9983-BE	TANK FARM OFFICE	294	C	1993
9983-BF	INGRESS & EGRESS BLDG. TF#1	118	C	1993
9983-BG	CARPENTER'S SHOP	294	C	1993
9983-BH	SAW SHOP	294	C	1993
9983-BJ	METAL SHED - STORAGE	396	C	1993
9983-BK	INSULATOR SHOP	384	C	1993
9983-BL	LUNCH ROOM	288	C	1993
9983-BM	INGRESS & EGRESS BLDG. TF#3	121	C	1993
9983-BN	WEST END TRAINING CENTER	1,043	C	1993
9983-BP	LAUNDRY	245	C	1993
9983-BQ	FOREMAN'S OFFICE	247	C	1993
9983-BS	STORAGE SHED	307	C	1993
9983-BT	MAINT. PLANNER/COORD. OFFICE	245	C	1993
9983-BU	GENERAL FOREMAN'S OFFICE	245	C	1993
9983-BV	FOREMAN'S OFFICE	245	C	1993
9983-BW	MAINTENANCE SUPPLY BLDG.	290	C	1993
9983-BX	LUNCH ROOM	288	C	1993
9983-BY	INGRESS & EGRESS BLDG. TF#4	124	C	1993
9983-CA	OFFICE TRAILER	240	C	1993
9983-CB	BOUNDARY CONTROL STATION	216	C	1993
9983-CG	WTSD SAMPLING CREW TRAILER	150	C	1993
9983-CQ	WTSD SAMPLING CREW TRAILER	198	C	1994
9983-EX	OFFICE FOR TECH	120	C	
9983-FK	RESTROOMS	96	C	1996

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 25 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9983-FL	OFFICE SPACE	240	C	1996
	67 Total EM Facilities	**835,066**		
Energy Research (ER) Facilities				
9102-01	OFFICE BLDG.	6,250	A-4	1964
9102-02	OFFICE BLDG.	6,200	B-3	1976
9105-00	OFFICE BLDG.	7,400	B-3	1977
9108-00	TECHNICAL STAFF OFFICES - ET	7,510	A-3	1981
9201-02	SITE PROGRAMS MAINTENANCE	257,200	B-1	1944
9201-03	SITE PROGRAMS MAINTENANCE	187,300	B-1	1944
9204-01	ENGINEERING	196,700	B-1	1944
9204-03	PU LAB	216,200	B-3	1945
9207-00	LAB/OFFICE	247,500	B-3	1945
9210-00	UTILITIES	65,700	B-3	1945
9211-00	UTILITIES	76,600	B-3	1945
9220-00	UTILITIES	22,350	A-3	1967
9224-00	CELL FRACTIONATION SYSTEMS	10,100	A-3	1968
9401-01	ENGINE TEST CELLS	12,000	A-4	1945
9404-04	PUMPHOUSE	5,500	A-2	1947
9409-04	COOLING TOWER FOR 9201-2	7,650	WOOD	1945
9422-00	HELIUM COMPRESSOR BLDG.	2,500	A-5	1980
9610-02	FLAMMABLE MATERIALS STORAGE	683	A-4	1990
9610-03	FLAMMABLE MATERIALS STORAGE	512	A-4	1990
9720-39	COLD STORAGE BLDG.	8,000	A-5	1984
9735-00	LAB	15,100	B-2	1944
9743-2	ANIMAL QUARTERS	22,000	A-2	1949
9770-02	RADIATION SOURCE	155	A-2	1945

TABLE A.4–2.—*Y-12 Plant Facilities* [Page 26 of 26]

Building Number	Description and/or Use	Gross Floor Area (ft^2)	Construction Type[a]	Year Built
9983-16	ANIMAL RADIATION-FAC. CONTROL	100	C	1972
9983-17	CONTROL SOURCE & EXPOSURE ROOM	720	C	1972
9999-01	MOTOR GENERATOR (E 9204-3)	500	A-1	1986
9999-03	ELECTRICAL SWITCHGEAR & RECTIFIER	2,400	A-5	1978
9999-04	ELECTRICAL EQUIPMENT	300	A-5	1979
	28 Total ER Facilities	**1,385,130**		
	620 BLDG. Total DP	**5,488,439**		
	67 BLDG. Total EM	**835,066**		
	28 BLDG. Total ER	**1,385,130**		
	715 TOTAL BLDG. Total Y-12 Plant	**7,708,635**		

Note: 9983-XX number denotes the facility is a trailer.

[a] Construction Type Legend

A. Single-story building with
1. Wood frame
2. Masonry bearing walls with wood roof framing
3. Masonry bearing walls with structural steel roof system.
4. Masonry bearing walls with precast concrete roof system
5. Prefabricated metal building with metal wall panels
6. Prefabricated metal building with masonry walls
7. Precast concrete wall panels with concrete roof system
8. Concrete basin with pre-engineered structure (metal and polyester)

B. Multi-story building with
1. Reinforced concrete structure with masonry walls
2. Reinforced concrete and structural steel with masonry walls
3. Structural steel skeleton with masonry walls
4. Structural steel skeleton with cement-asbestos wall panels
5. Structural steel skeleton with metal panels
6. Wood frame

C. Prefabricated portable structure

Note: In general, all wood frame buildings with wood framing have asphalt shingle roof coverings, prefabricated buildings have metal panels, and all others have built-up roofs.

Source: SPAS 1999.

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APPENDIX D: HUMAN HEALTH AND WORKER SAFETY

D.1 INTRODUCTION

This appendix to the Y-12 Site-Wide Environmental Impact Statement (SWEIS) provides supplemental information pertaining to potential human health impacts associated with radiation exposures, chemical exposures, and worker safety issues due to No Action - Status Quo Alternative operations and those proposed under the No Action - Planning Basis Operations Alternative, the Highly Enriched Uranium (HEU) Storage Mission, and the Special Materials Mission Alternatives analyzed in the Y-12 SWEIS. Human health risks from radiological and chemical exposures are presented in Sections D.2 and D.3, respectively. In these sections, a comprehensive evaluation of the potential risks associated with human exposure to environmental media (air, surface water, soils, sediment, and groundwater) was conducted using either data from 1998 or the most recent data available to establish the No Action - Status Quo Alternative baseline.

Impacts to worker safety are evaluated in Section D.4. The summaries presented in Section D.5 provide public health profiles pertaining to cancer incidence rates and mortalities for the United States, Tennessee, Anderson County, and Roane County. Section D.6 presents a description of relevant epidemiologic studies. Section D.7 presents technical analysis of potential impacts to workers and the public due to accidents.

D.2 RADIOLOGICAL IMPACTS ON HUMAN HEALTH

D.2.1 Radiation and Radioactivity

Radiation is everywhere. Although most radiation occurs naturally, a small percentage is manmade. Humans are constantly exposed to naturally occurring radiation through sources such as the solar system and the earth's rocks and soils. This type of radiation is referred to as *background radiation,* and it always surrounds us. Background radiation remains relatively constant over time and is present in the environment today just as it was hundreds of years ago. Manmade sources of radiation include medical and dental x-rays, radio and television transmissions, household smoke detectors, and materials released from nuclear and coal-fired powerplants. The following sections describe some important principles concerning the nature, types, sources, and effects of radiation and radioactivity.

D.2.1.1 *What Is Radiation?*

All matter in the universe is composed of tiny particles called atoms, and it is the activity of these particles that produces radiation. While the atom is infinitesimally small, it is composed of even smaller particles, called electrons, protons, and neutrons. *Electrons* are negatively charged particles that are principally responsible for chemical reactivity. *Protons* are positively charged particles, and *neutrons* are neutral. Protons and neutrons are located in the center of the atom, called the nucleus. Electrons reside in a designated space around the *nucleus*. The total number of protons in an atom is called its *atomic number*.

Atoms of different types are known as elements. There are over 100 natural and manmade elements. Atoms of the same element always contain the same number of protons and electrons, but may differ by their number of constituent neutrons. Atoms of an element having a different number of neutrons are called the *isotopes* of the element. The total number of protons and neutrons in the nucleus of an atom is called its *mass number*, which is used to name the isotope. For example, the element uranium has 92 protons. Therefore, all isotopes of uranium have 92 protons. Each isotope of uranium is designated by its unique mass number: ^{238}U, the principal naturally occurring isotope of uranium, has 92 protons and 146 neutrons; ^{234}U has 92 protons and 142 neutrons; and ^{235}U has 92 protons and 143 neutrons. Atoms can lose or gain electrons in a process known as *ionization*.

Ionizing radiation has enough energy to free electrons from atoms, creating ions that could cause biological damage. Although it is potentially harmful to human health, ionizing radiation is used in a variety of ways, many of which are familiar to us in our everyday lives. An x-ray machine is one form of ionizing radiation. Likewise, most home smoke detectors use a small source of ionizing radiation to detect smoke particles in the room's air. The two most common mechanisms in which ionizing radiation is generated are the electrical acceleration of atomic particles such as electrons (as in x-ray machines) and the emission of energy from nuclear reactions in atoms. Examples of ionizing radiation include alpha, beta, and gamma radiation.

Alpha radiation occurs when a particle consisting of two protons and two neutrons is emitted from the nucleus. Alpha particles, because of their relatively large size, do not travel very far and do not penetrate materials well. Alpha particles lose their energy almost as soon as they collide with anything, and therefore a sheet of notebook paper or the skin's surface can be used to block the penetration of most alpha particles. Alpha particles only become a source of radiation dose after they are inhaled, ingested, or otherwise taken into the body.

Beta radiation occurs when an electron or positron is emitted from an atom. Beta particles are much lighter than alpha particles and therefore can travel faster and farther. Greater precautions must be taken to stop beta radiation. Beta particles can pass through a sheet of paper but can be stopped by a thin sheet of aluminum foil or glass. Most of the radiation dose from beta particles occurs in the first tissue they penetrate, such as the skin, or dose may occur as the result of internal deposition of beta emitters.

Gamma and x-ray radiation are known as electromagnetic radiation and are emitted as energy packets called *photons*, similar to light and radio waves, but from a different energy region of the electromagnetic spectrum. Gamma rays are emitted from the nucleus as waves of pure energy, whereas x-rays originate from the electron field surrounding the nucleus. Gamma rays travel at the speed of light , and because they are so penetrating, concrete, lead, or steel is required to shield them. For example, to absorb 95 percent of the gamma energy from a ^{60}Co source, 6 cm of lead, 10 cm of iron, or 33 cm of concrete would be needed.

The neutron is another particle that contributes to radiation exposure, both directly and indirectly. Indirect exposure is associated with the gamma rays and alpha particles that are emitted following neutron capture in matter. A neutron has about one quarter of the weight of an alpha particle and can travel 2.5 times faster than an alpha particle. Neutrons are more penetrating than beta particles, but less penetrating than gamma rays. They can be shielded effectively by water, graphite, paraffin, or concrete.

Some elements such as uranium, radium, plutonium, and thorium, share a common characteristic–they are unstable or radioactive. These radioactive isotopes are called *radionuclides* or *radioisotopes*. As these elements attempt to change into more stable forms, they emit invisible rays of energy or particles at rates which decrease with time. This emission is known as radioactive decay. The time it takes a material to lose half of its original radioactivity is referred to as its half-life. Each radioactive isotope has a characteristic half-life. The half-life may vary from a millionth of a second to millions of years, depending upon the radionuclide. Eventually, the radioactivity will essentially disappear.

As a radioactive element emits radioactivity, it often changes into an entirely different element that may or may not be radioactive. Eventually, however, a stable element is formed. This transformation may require several steps, known as a decay chain. Radium, for example, is a naturally occurring radioactive element with a half-life of 1,622 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays to polonium and, through a series of steps, to bismuth, and ultimately to lead.

Nonionizing radiation bounces off or passes through matter without displacing electrons. Examples include visible light and radio waves. At this time, scientists are unclear as to the effects of nonionizing radiation on human health. In this Y-12 SWEIS, the term radiation is used to describe ionizing radiation.

D.2.1.2 *How is Radiation Measured?*

Scientists and engineers use a variety of units to measure radiation. These different units can be used to determine the amount, and intensity of radiation. Radiation can be measured in *curies*, *rads*, or *rems*. The *curie* describes the activity of radioactive material. The rate of decay of 1 gram of radium is the basis of this unit of measure. It is equal to 3.7×10^{10} disintegrations (decays) per second.

The *rad* is used to measure the absorbed dose of radiation. One rad is equal to the amount of radiation that leads to the deposition of 0.01 joule of energy per kilogram (kg) of absorbing material.

A *rem* is a measurement of the dose from radiation based on its biological effects. The rem is used to measure the effects of radiation on the body. As such, 1 rem of one type of radiation is presumed to have the same biological effects as 1 rem of any other type of radiation. This standard allows comparison of the biological effects of different types of radiation. Note that the term millirem (mrem) is also often used. A millirem is one one-thousandth (0.001) of a rem.

D.2.1.3 *How Does Radiation Affect the Human Body?*

Ionizing radiation affects the body through two basic mechanisms. The ionization of atoms can generate chemical changes in body fluids and cellular material. Also, in some cases the amount of energy transferred can be sufficient to actually knock an atom out of its chemical bonds, again resulting in chemical changes. These chemical changes can lead to alteration or disruption of the normal function of the affected area. At low levels of exposure, such as the levels experienced in an occupational or environmental setting, these chemical changes are very small and ineffective. The body has a wide variety of mechanisms that repair the damage induced. However, occasionally, these changes can cause irreparable damage that could ultimately lead to initiation of a cancer, or change to genetic material that could be passed to the next generation. The probability for the occurrence of health effects of this nature depends upon the type and amount of radiation received, and the sensitivity of the part of the body receiving the dose.

At much higher levels of acute exposure, at least 10 to 20 times higher than the legal limits for occupational exposures (the limit for annual occupational exposures is 5 rem), damage is much more immediate, direct, and observable. Health effects range from reversible changes in the blood to vomiting, loss of hair, temporary or permanent sterility, and other changes leading ultimately to death at acute exposures (above about 100 times the regulatory limits). In these cases, the severity of the health effect is dependent upon the amount and type of radiation received. Exposures to radiation at these levels are quite rare, and, outside of intentional medical procedures for cancer therapy, are almost always due to accidental circumstances.

For low levels of radiation exposure, the probabilities for induction of various cancers or genetic effects have been extensively studied by both national and international expert groups. The problem is that the potential for health effects at low levels is extremely difficult to determine without extremely large, well-characterized populations. For example, to get a statistically valid estimate of the number of cancers caused by an external dose equivalent of 1 rem, 10 million people would be required for the test group, with another 10 million for the control group (BEIR 1990). The risk factors for radiation-induced cancer at low levels of exposure are very small, and it is extremely important to account for the many nonradiation-related mechanisms for cancer induction, such as smoking, diet, lifestyle, chemical exposure, and genetic predisposition. These multiple factors also make it difficult to establish cause-and-effect relationships that could attribute high or low cancer rates to specific initiators.

The most significant ill-health effects that result from environmental and occupational radiation exposure are cancer fatalities. These ill-health effects are referred to as “latent” cancer fatalities (LCFs) because the cancer may take many years to develop and for death to occur. Furthermore, when death does occur, these ill-health effects may not actually have been the cause of death.

Health impacts from radiation exposure, whether from sources external or internal to the body, generally are identified as somatic (affecting the individual exposed) or genetic (affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects rather than genetic effects. The somatic risks of most importance are the induction of cancers.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues. The thyroid and skin demonstrate a greater sensitivity than other organs; however, such cancers also produce relatively low mortality rates because they are relatively amenable to medical treatment.

D.2.1.4 *What are Some Types of Radiation Dose Measurements?*

The amount of ionizing radiation that the individual receives during the exposure is referred to as *dose*. An external dose is delivered only during the actual time of exposure to the external radiation source. An internal dose, however, continues to be delivered as long as the radioactive source is in the body, although both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time. The measurement of radiation dose is called *radiation dosimetry* and is completed by a variety of methods depending upon the characteristics of the incident radiation.

External radiation is measured as a value called deep dose equivalent. Internal radiation is measured in terms of the committed effective dose equivalent (CEDE). The sum of the two contributions (deep dose equivalent and CEDE) provides the total dose to the individual, called the total effective dose equivalent (TEDE). Often the radiation dose to a selected group or population is of interest and is referred to as the collective dose equivalent, with the measurement units of *person-rem*.

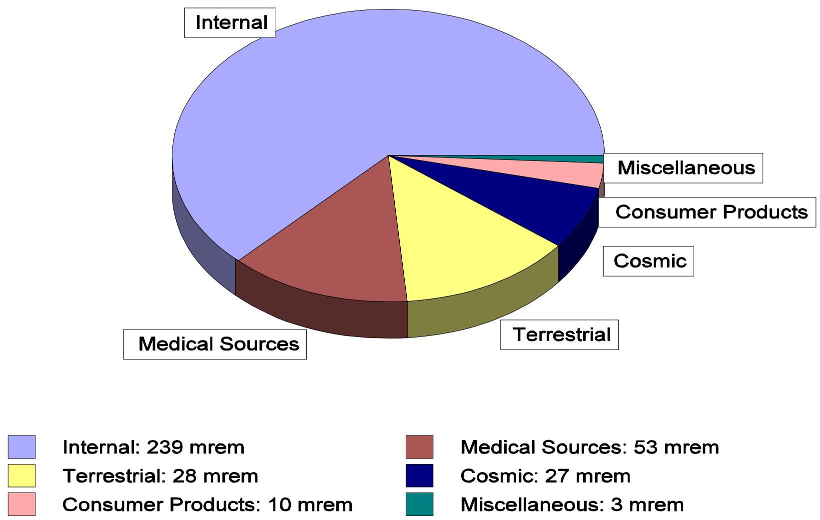
D.2.1.5 *What are Some Sources of Radiation?*

Several different sources of radiation have been identified. The majority of them are naturally occurring or background sources, which can be categorized as cosmic, terrestrial, or internal radiation sources. Manmade radiation sources include consumer products, medical sources, and other miscellaneous sources. The average American receives a total of about 360 mrem per year from all sources of radiation, both natural and manmade (Figure D.2.1-1).

Cosmic radiation is ionizing radiation resulting from energetically charged particles from space that continuously hit the earth's atmosphere. These particles and the secondary particles and photons they create are referred to as cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level. For example, a person in Denver, CO, is exposed to more cosmic radiation than a person in New Orleans, LA. The average annual dose to persons in the United States is about 27 mrem. The average cosmogenic dose contribution (mostly due to carbon-14) adds another 1 mrem. The average dose equivalent in Tennessee is about 45 mrem per year. When shielding and the time spent indoors are considered, the dose for the surrounding population is reduced to about 36 mrem per year.

Terrestrial radiation is radiation emitted from the radioactive materials in the earth's rocks, soils, and minerals. Radon, radon progeny, potassium, isotopes of thorium, and isotopes of uranium are the elements responsible for most terrestrial radiation. The average annual dose from terrestrial radiation is about 28 mrem, but the dose varies geographically across the country. Typically reported values are about 16 mrem on the Atlantic and Gulf coastal plains and about 63 mrem on the eastern slopes of the Rocky Mountains.

The average external gamma exposure rate in the vicinity of the Oak Ridge Reservation (ORR) is about 51 mrem per year.



Source: DOE 1999c.

FIGURE D.2.1–1.—*Average U.S. Annual Doses from Common Radiation Sources.*

Internal radiation arises from the human body metabolizing natural radioactive material that has entered the body by inhalation ingestion, or through an open wound. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, bismuth, polonium, potassium, rubidium, and carbon. The major contributors to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon which contribute about 200 mrem per year. The average dose from other internal radionuclides is about 39 mrem per year, most of which results from potassium-40 and polonium-210.

Consumer products also contain sources of ionizing radiation. In some products, like smoke detectors and airport x-ray machines, the radiation source is essential to the operation of the product. In other products, such as televisions and tobacco products, the radiation occurs incidentally to the product function. The average annual dose from consumer products is about 10 mrem.

Medical source radiation is an important diagnostic tool and is the main source of exposure to the public from manmade radiation. Exposure is deliberate and directly beneficial to the patient exposed. In general, medical exposures from diagnostic or therapeutic x rays result from beams directed to specific areas of the body. Thus, all body organs generally are not irradiated uniformly. Nuclear medicine examinations and treatments involve the internal administration of radioactive compounds or radiopharmaceuticals by injection, inhalation, consumption, or insertion. Even then, radionuclides are not distributed uniformly throughout the body. Radiation and radioactive materials also are used in the preparation of medical instruments, including the sterilization of heat-sensitive products such as plastic heart valves. Diagnostic x rays result in an average annual exposure of 39 mrem. Nuclear medical procedures result in an average annual exposure of 14 mrem. It is recognized that the averaging of medical doses over the entire population does not account for the potentially significant variations in annual dose among individuals, where greater doses are received by older or less healthy members of the population.

A few additional sources of radiation contribute minor doses to individuals in the United States. The doses from nuclear fuel cycle facilities, such as uranium mines, mills, and fuel processing plants, nuclear power plants, and transportation routes have been established to be less than 1 mrem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive material from DOE facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials contributes less than 1 mrem per year to the average individual dose. Air travel contributes approximately 1 mrem per year to the average dose.

D.2.2 Radioactive Materials at Y-12

The release of radiological contaminants into the environment at Y-12 occurs almost exclusively as a result of plant production, maintenance, and waste management activities. This section describes the primary radioactive sources at Y-12, how DOE regulates radiation and radioactive materials, and the data sources and methodologies used to evaluate the potential health effects of radiation exposure to the worker and public.

D.2.2.1 *What Are Some Y-12 Sources That May Lead to Radiation Exposure?*

Historically, Y-12 has conducted many operations that involve the use of enriched, natural, and depleted uranium. These have included recovery and recycle operations; purification processes; and metal forming, machining, and material handling operations. The releases from these operations consisted primarily of uranium particulates, fumes, and vapors. Under the current Y-12 mission to dismantle weapons components, store nuclear material, and pursue new technologies, uranium remains the primary radionuclide. In addition to the Y-12 operations, the Oak Ridge National Laboratory (ORNL) also operates research facilities located at Y-12. The ORNL facilities emit a variety of radionuclides from small-scale research projects conducted by the Life Sciences Division and Chemical Technology Division laboratories.

Potential radiation exposures at Y-12 could result primarily from process materials, industrial radiation generation equipment, and criticality or nuclear accidents. The most common process materials are enriched uranium and depleted uranium. Both materials are primarily alpha emitters. However, ^{235}U does emit low-level gamma radiation. In addition, protactinium, neptunium, and thorium have been detected as secondary radionuclides. Most of the external dose from depleted uranium results from the ^{234}Th and ^{234}Pa daughter products, with ^{234}Pa being the stronger contributor, due to its emission of a strong beta particle as well as several gamma and X rays.

Airborne emissions contribute the most significant potential for radiation dose at Y-12. National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations specify that any source that potentially can contribute >0.1 mrem/year TEDE to an off site individual is to be considered a “major source” and emissions from that source must be continuously sampled. As such, there are a number of process exhaust stacks at Y-12 that are considered major sources. At the end of 1998, Y-12 had 51 active stacks that were being monitored.

In addition to major sources, there are a number of minor sources that have the potential to emit radionuclides to the atmosphere. Minor sources are composed of any ventilation systems or components such as vents, laboratory hoods, room exhausts, and stacks that do not meet the criteria for a major source but are located in or vent from a radiological control area. Emissions from Y- 12 room ventilation systems are estimated from radiation control data collected on airborne radioactivity concentrations in the work areas. Other emissions from unmonitored processes and laboratory exhausts are categorized as minor emission sources. There were 54 unmonitored areas of uranium emissions from room ventilation systems or process stacks, and 28 minor emission points were identified from ORNL activities at facilities within the boundary of Y-12. Seven minor emission points were identified at the Analytical Chemistry Organization (ACO) Union Valley Laboratory.

In addition, there are also five areas of potential fugitive and diffuse sources at Y-12, consisting of a contaminated metal salvage yard, three storage areas, and a tooling lay-down area. Diffuse and fugitive sources include any source that is spatially distributed, diffuse in nature, or not emitted with forced air from a stack, vent, or other confined conduit. They include emissions from sources where forced air is not used to transport the radionuclides to the atmosphere. In this case, radionuclides are transported entirely by diffusion or thermally driven air currents. Typical examples include emissions from building breathing; resuspension of contaminated soils, debris, or other materials; unventilated tanks; ponds, lakes, and streams; wastewater treatment systems; outdoor storage and processing areas; and leaks in piping, valves, or other process equipment.

Liquid discharges are another source of radiation release and exposure. Three types of liquid discharge sources at Y-12 include treatment facilities, other point- and area-source discharges, and in-stream locations. In addition, the sanitary sewer is monitored since Y-12 is permitted to discharge domestic wastewater to the city of Oak Ridge publicly owned treatment works (POTW).

Soils and sediment also provide a potential for radiation exposure. The generation of fugitive dust from potentially contaminated surface soils is captured by both the perimeter air monitoring stations and onsite uranium particulate monitoring. Sediment exposed on creek banks and flood plains or transported to the off-site environment serves as an additional source of radiation exposure.

Groundwater transport of radionuclides to potential off-site receptors also provides the potential for radiation exposure. A comprehensive groundwater monitoring program is in place at the Y-12 Plant to track contaminant transport and to ensure the public safety.

D.2.2.2 *How Does DOE Regulate Radiation Exposure?*

The release of radioactive materials and the potential level of radiation doses to workers and the public are regulated by the U.S. Department of Energy (DOE) for its contractor facilities. Under conditions of the *Atomic Energy Act* (as amended by the *Price-Anderson Amendments Act of 1988*), DOE is authorized to establish Federal rules controlling radiological activities at the DOE sites. The act also authorizes DOE to impose civil and criminal penalties for violations of these requirements. Some Y-12 activities are also regulated through a DOE Directives System that is contractually enforced.

Occupational radiation protection is regulated by the Occupational Radiation Protection Rule, 10 CFR 835. DOE has set occupational dose limits for an individual worker at 5,000 mrem per year. Accordingly, Y-12 has set administrative exposure guidelines at a fraction of this exposure limit to help enforce the goal to manage and control worker exposure to radiation and radioactive material as low as reasonably achievable (ALARA). The Y-12 ALARA administrative control level for the whole body is 1,500 mrem per year for enriched uranium operation workers and 1,000 mrem per year for other Y-12 workers.

Environmental radiation protection is currently regulated contractually with DOE Order 5400.5. This Order sets annual dose standards to members of the public, as a consequence of routine DOE operations, of 100 mrem through all exposure pathways. The Order requires that no member of the public receive an annual dose greater than 10 mrem from the airborne pathway and 4 mrem from ingestion of drinking water. In addition, the dose requirements in the Radionuclide National Emission Standards for Hazardous Air Pollutants (Rad-NESHAP) limit exposure of an individual member of the public to airborne releases of radionuclides to a maximum of 10 mrem/year.

D.2.2.3 *Data Sources Used to Evaluate Public Health Consequences from Routine Operations*

Because Y-12 operations have the potential to release measurable quantities of radionuclides to the environment that result in exposure to the worker and the public, Y-12 conducts environmental surveillance and monitoring activities. These activities provide data that are used to evaluate radiation exposures that contribute to dose to the public. Each year, environmental data from the ORR and each of the facilities, including Y-12, are collected and analyzed in accordance with the guidelines specified in DOE Order 5400.1 *General Environmental Protection Program*. The results of these environmental monitoring activities are summarized in the Oak Ridge Reservation's *Annual Site Environmental Report* (ASER) (DOE 1999c). The environmental monitoring conducted at Y-12 consists of two major activities: effluent monitoring and environmental surveillance.

Effluent monitoring involves the collection and analysis of samples or measurements of liquid (waterborne) and gaseous (airborne) effluents prior to release into the environment. These analytical data provide the basis for the evaluation and official reporting of contaminants, assessment of radiation and chemical exposures to the public, and demonstration of compliance with applicable standards and permit requirements.

Environmental surveillance data provide a direct measurement of contaminants in air, water, groundwater, soil, food, biota, and other media subsequent to effluent release into the environment. These data verify Y-12's compliance status and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose and exposure assessment of Y-12 Plant operations and effects, if any, on the local environment. The effluent and environmental surveillance data presented in the ASER were used as the primary source of data for the analysis of radiation exposure to the public for the No Action Alternative.

Ongoing remedial investigation data for soils, surface water, and groundwater collected from areas of concern at Y-12 served as an additional source of environmental data to evaluate the potential health effects of radiation and chemical exposure presented in the SWEIS. The remedial investigation data were collected to support a determination of the need for remedial action, if any, to protect human health and the environment at locations where radiological and/or chemical contaminants were known to have been treated, stored, disposed of, or released to the environment. The Remedial Investigation for the Upper East Fork Poplar Creek (UEFPC) characterization area encompasses the developed Y-12 industrial areas and includes waste management areas as well as dispersed areas of contamination from operations not related to the management of wastes. The remedial investigation documents the nature and extent of contamination, environmental conditions, results of fate and transport modeling, and the estimated risks to human health and the environment. Because the UEFPC characterization area is within the bounds and covers the majority of the area evaluated in the SWEIS, the data presented therein will be used to supplement the information contained in the ASER.

D.2.2.4 *Methodology for Estimating Radiological Impacts*

Airborne Radionuclides. The public health consequences of radionuclides released to the atmosphere from operations at Y-12 were characterized and calculated in the ASER. TEDEs were derived for a maximally exposed offsite individual and to the entire population residing within 80 km (50 mi) of the center of the ORR (See Appendix E.4). The dose calculations were modeled using *The Clean Air Act Assessment Package of 1988* (CAP-88) package of computer codes (Beres 1990). CAP-88 was developed to demonstrate compliance with the Rad-NESHAP, 40 CFR 61, Subpart H, which governs the emissions of radionuclides other than radon from DOE facilities. Six emission points were modeled for Y-12. Table D.2.2-1 lists the emission point parameter values and receptor locations used in the dose calculations. Meteorological data used in the calculations were in the form of joint frequency distributions of wind direction, wind speed class, and atmospheric stability category derived from data collected at the 60-m height on Tower MT6 for all sources at Y-12.

The exposure assumptions for the dose calculations were that each person remained at home (actually, outside of the house), unprotected, during the entire year and obtained food according to the rural pattern defined in the NESHAP background documents (DOE 1999k). This pattern specifies that 70 percent of the vegetables and produce, 44.2 percent of the meat, and 39.9 percent of the milk consumed by each person are produced in the local area (e.g., a home garden). The remaining portions of each food group are assumed to be produced within 80 km (50 mi) of the ORR. For collective TEDE estimates, production of beef, milk, and crops within 80 km (50 mi) of the ORR was calculated using the state-specific production rates provided with CAP-88.

TABLE D.2.2–1.—*Emission Point Parameters and Receptor Locations Used in the Dose Calculations*

Source Name	Type	Release Height (m)	Diameter (m)	Gas Exit Velocity (m/s)	Gas Exit Temperature (°C)	Distance (m) and Direction to Maximally Exposed Individual			
						Y-12		ORR	
Y-Monitored Stacks	Point	20	NA	NA	Ambient	1,080	NNE	12,200	SSW
Y-Minor Processes	Point	20	NA	NA	Ambient	1,080	NNE	12,200	SSW
Y-Lab Hoods	Point	20	NA	NA	Ambient	1,080	NNE	12,200	SSW
Y-ASO Union Valley	Point	9.75	0.8	10	Ambient	2,410	WSW	15,000	SW
Y-9207	Point	20	NA	NA	Ambient	700	NW	13,100	S
Y-9204-3	Point	20	NA	NA	Ambient	1,100	N	12,100	SSW

Source: Adapted from DOE 1999c.

Surface Water. The health consequences of radionuclides contained in surface water were characterized and evaluated from surveillance and monitoring data in the ASER. Water samples were collected and analyzed to determine the concentration of selected radiological parameters. The resultant concentrations of radionuclides in surface water were compared to established risk-based concentration values to identify contaminants of concern.

Sediment and Soil. Sediment data were collected and presented in the ASER. Due to the limited number of samples and analytes, no risk evaluation was performed for these data. The soil/sediment data collected as part of the remedial investigation of the UEFPC were used to evaluate potential exposure to the public. In the risk assessment for the UEFPC characterization area, data were segregated into exposure units, representative concentrations were derived, and risks/hazards were calculated for several exposure pathways. The pathway considered most appropriate for use in this Y-12 SWEIS was the open-recreational land use scenario. Risks/hazards were calculated for this scenario using standard U.S. Environmental Protection Agency (EPA) risk methodology and default exposure parameters.

Groundwater. Data from the Y-12 groundwater monitoring program were compiled and evaluated as part of the remedial investigation for the UEFPC characterization area. Excess lifetime cancer risks and hazard quotients (HQs) were calculated for groundwater contaminants under two exposure scenarios: drinking water ingestion for a non-protected Y-12 Plant worker and ingestion, inhalation, and dermal contact for an off-site resident. For purposes of this SWEIS, the industrial drinking water ingestion scenario is considered to be of use in evaluating potential exposure under normal operating conditions. The industrial drinking water ingestion scenario assumes that a Plant worker ingests 1 L/day of groundwater for 250 days/year for 25 years. The residential scenario is a hypothetical future exposure scenario that is currently known to be an incomplete exposure pathway where no current receptors exist and therefore is not considered to be representative of current conditions.

D.2.2.5 *Risk Characterization and Interpretation of Radiological Data*

The risk estimators for determining the health consequences of radiation exposure are 500 excess fatal cancers per million person-rem for the general public and 400 excess fatal cancers per million person-rem for workers (BEIR 1990). The higher risk estimator for the general public reflects the inclusion of sensitive population groups, such as children. Based on recommendations of the International Commission on Radiological Protection (ICRP 1991), the health risk estimators for nonfatal cancer and genetic disorders among the general public are 20 percent (100 per million person-rem) and 26 percent (130 per million person-rem), respectively, of the fatal cancer risk estimator of 400 Latent Cancer Fatalities (LCFs) per million person-rem. In this SWEIS, only fatal cancers are presented.

The number of LCFs in the general population or in the workforce is determined by multiplying 500 LCFs per million person-rem with the calculated collective population dose (person-rem), or 400 LCFs per million person-rem with the calculated collective workforce dose (person-rem), respectively.

For example, in a population of 100,000 people exposed only to natural background radiation of 0.3 rem per year, 15 cancer fatalities per year would be inferred to be caused by the radiation (100,000 persons x 0.3 rem per year x 0.0005 cancer fatalities per person-rem = 15 cancer fatalities per year).

Sometimes, calculations of the number of excess cancer fatalities associated with radiation exposure do not yield whole numbers and, especially in environmental applications, may yield numbers less than 1.0. For example, if a population of 100,000 were exposed as above, but to a total dose of only 0.001 rem, the collective dose would be 100 person-rem, and the corresponding estimated number of cancer fatalities would be 0.05 (100,000 persons x 0.001 rem x 0.0005 cancer fatalities/person-rem = 0.05 fatal cancers).

A nonintegral number of cancer fatalities such as 0.05 should be interpreted as a statistical estimate. That is, 0.05 is interpreted as the average number of deaths that would result if the same exposure situation were applied to many different groups of 100,000 people. In most groups, no person (0 people) would incur a cancer fatality from the 0.001 rem dose each member would have received. In a small fraction of the groups, one fatal cancer would result; in exceptionally few groups, two or more fatal cancers would occur. The average number of deaths over all the groups would be 0.05 fatal cancers (just as the average of 0, 0, 0, and 1 is 1/4, or 0.25). The most likely outcome is 0 cancer fatalities.

These same concepts apply to estimating the effects of radiation exposure on a single individual. Consider the effects, for example, of exposure to background radiation over a lifetime. The "number of cancer fatalities" corresponding to a single individual's exposure over a (presumed) 72-year lifetime to 0.3 rem per year is the following:

1 person x 0.3 rem/year x 72 years x 0.0005 cancer fatalities/person-rem =
0.011 cancer fatalities

Total number of fatal cancers in general population from annual exposure =

$$\left(\frac{500}{10^6 \text{person} - \text{rem}}\right) \text{x} \left(\begin{array}{c}\text{annual} \\ \text{collective} \\ \text{dose(person} - \text{rem)}\end{array}\right)$$

or

Total number of fatal cancers in worker population from annual exposure =

$$\left(\frac{400}{10^6 \text{person} - \text{rem}}\right) \text{x} \left(\begin{array}{c}\text{annual} \\ \text{worker} \\ \text{population} \\ \text{collective} \\ \text{dose} \\ \text{(person} - \text{rem)}\end{array}\right)$$

This could be interpreted that the estimated effect of background radiation exposure on the exposed individual would produce a 1.1 percent chance that the individual might incur a fatal cancer caused by the exposure.

Health effects resulting from exposure to both airborne and waterborne radionuclides may also be evaluated by comparing estimated concentrations to established radionuclide-specific, risk-based concentration values. For example, DOE Order 5400.5 establishes Derived Concentration Guidelines (DCGs) for the inhalation of air and the ingestion of water. The DCG is the concentration of a given radionuclide for one exposure pathway (e.g., ingestion of water) that would result in a TEDE of 100 mrem per year to a reference man, as defined by the International ICRP Publication 23 (ICRP 1975).

To ensure that exposure via the drinking water pathway is limited to the established 4 mrem/year, 4 percent of the DCG values are used as comparison values. Members of the public are assumed to ingest 730 L/year (2 L/day) of water or to inhale 8,400 m^3/yr (23 m^3/day) of air at the DCG level. The exposure is assumed to occur 24 hours per day for 365 days per year. The DCG values are used as reference concentrations for conducting environmental protection programs at DOE sites, as screening values for considering best available technology for treatment of liquid effluents, and for making dose comparisons. Using radiological data, percentages of the DCG for a given isotope are calculated.

D.2.3 Risk Estimates and Health Effects for Potential Radiation Exposures to Workers

For the purpose of evaluating radiation exposure, Y-12 workers may be designated as radiation workers, nonradiation workers, or visitors based upon the potential level of exposure they are expected to encounter in performing their work assignments.

Radiation workers are either Lockheed Martin Energy Systems, Inc. (LMES) employees, or subcontractors whose job assignments place them in proximity to radiation-producing equipment and/or radioactive materials. These workers are trained for unescorted access to radiological areas, and may also be trained radiation workers from another DOE site. These workers are assigned to areas that could potentially contribute to an annual TEDE of more than 100 mrem per year. All trained radiation workers wear dosimeters.

Nonradiation workers may be either LMES employees or subcontractors who are not currently trained as radiation workers but whose job assignment may require their occasional presence within a radiologically controlled area with an escort. They may be exposed to transient radiation fields as they pass by or through a particular area, but their job assignments are such that annual dose equivalents in excess of 100 mrem are unlikely. Based upon the locations where such personnel work on a daily basis, they may be issued a Personal Nuclear Accident Dosimeter.

Visitors are individuals who do not perform routine work at Y-12. They are not trained radiation workers and are not expected to receive 100 mrem in a year. Their presence in radiological areas is limited, in terms of time and access. These individuals generally enter specified radiological areas on a limited basis for walk-through or tours with a trained escort. As appropriate, visitors participate in dosimetry monitoring when requested by the hosting division.

D.2.3.1 *Radiological Health Effects for Workers Under Alternative 1A (No Action - Status Quo Alternative)*

A primary goal of the Y-12 Radiation Protection Program is to keep worker exposures to radiation and radioactive material ALARA. Such a program must evaluate both external and internal exposures with the goal to minimize worker radiation dose. The worker radiation dose presented in this SWEIS is the total TEDE incurred by workers as a result of normal operations. This dose is the sum of the external whole body dose, including dose from both photons and neutrons, and internal dose, as required by 10 CFR 835. The internal dose is the 50-year CEDE. These values are determined through the Y-12 Plant External and Internal Dosimetry Programs.

The External Dosimetry Program at Y-12 provides personnel monitoring information necessary to determine the dose equivalent received following external exposure of a person to ionizing radiation. The program is based on the concepts of effective dose equivalent, as described in publications of the ICRP and the International Commission on Radiation Quantities and Units.

Internal dose monitoring programs are conducted at Y-12 to estimate the quantity and distribution of radionuclides to which a worker may have been exposed. The internal dose monitoring program consists of urinalysis, fecal analysis, lung counting, continuous air monitoring, and retrospective air sampling. Dose assessments are generally based on bioassay data. Bioassay monitoring methods and participation frequencies are required to be established for individuals who are likely to receive intakes that could result in a CEDE that is greater than 100 mrem.

Table D.2.3-1 lists the individual and collective doses for all radiation workers from 1990 to 1998, as presented in the Y-12 Dosimetry Record System (DRS) database. Table D.2.3-2 lists the individual collective doses for all monitored workers, from 1990 to 1998. Monitored workers include radiation workers, nonradiation workers, and visitors. The doses projected for the No Action - Status Quo Alternative are based on 1998 data.

Note that the 1998 data reflect higher dose values as a result of the use of a more conservative risk model in 1998 than that used in previous years and the resumption of some operations. This model contains parameters based upon conservative assumptions pertaining to the solubility of materials in the body. This resulted in higher internal dose contributions; however, DOE has recently approved the use of a new dosimetry model using more accurate dose assumptions that could potentially lower doses by as much as 20 percent. Implementation of the new model will affect dose calculations for the period beginning January 1, 2000. The radiation doses and projected health impacts to workers for No Action - Status Quo Alternative are summarized in Table D.2.3-3.

TABLE D.2.3–1.—*Y-12 Annual Individual and Collective Radiation Doses for all Rad Workers from 1990 - 1998*

Year	Number of Rad Workers	Average Individual Worker Dose (mrem)	Rad Worker Collective Dose (person-rem)
1990	2,907	14.8	43.16
1991	3,050	7.3	22.27
1992	2,787	13.1	36.46
1993	2,701	6.8	18.48
1994	2,533	5.4	13.58
1995	2,924	3.1	9.10
1996	3,140	3.1	9.73
1997	3,552	2.96	10.51
1998[a]	3,563	11.4	40.61

[a] 1998 data reflect higher doses due to the use of a more conservative risk model in 1998 than that used in previous years and the resumption of some operations.
Source: Adapted from Y-12 1999.

TABLE D.2.3–2.—*Annual Individual and Collective Radiation Doses for All Monitored Y-12 Workers (Rad and Non-Rad) from 1990 - 1998*

Year	Number of Monitored Workers	Average Individual Worker Dose (mrem)	Site Worker Collective Dose (person-rem)
1990	9,799	5.0	48.95
1991	10,824	2.7	29.60
1992	10,273	3.7	37.91
1993	9,995	2.1	20.52
1994	9,748	1.6	15.31
1995	9,327	1.1	10.27
1996	9,159	1.2	10.90
1997	4,758	2.2	10.69
1998[a]	5,128	8.0	41.24

[a] 1998 data reflect higher doses due to the use of a more conservative risk model in 1998 than that used in previous years.
Source: Adapted from Y-12 1999.

TABLE D.2.3–3.—*Radiation Doses and Estimated Health Impacts to Workers from Y-12 No Action - Status Quo Alternative Normal Operations*

Worker Dose	Radiation Dose	No. of LCFs
Baseline		
Annual Average Individual Worker Dose (mrem/yr)	8.0	3.2×10^{-6}[a]
Annual Workforce Collective Dose (person-rem/yr)	41.02	1.64×10^{-2}

[a] This represents the risk of latent cancer fatality for an individual worker.

The radiological doses for rad and non-rad workers within the major production operations for No Action - Status Quo Alternative are presented in Appendix E (Table E.4.2-3). Dose values from this table were used to estimate the number of projected LCFs and are presented in Table D.2.3-4.

D.2.3.2 *Radiological Health Effects for Workers Under Alternative 1B (No Action - Planning Basis Operations Alternative)*

For No Action - Planning Basis Operations Alternative, it was determined that annual enriched uranium emissions and other effluents for the 2001-2010 time period can be assumed to be 65 percent of the 1987 levels (LMES 2000a). However, internal dose reporting requirements were not in effect until 1989. Prior to that time, only external (deep) dose was reported. The average deep dose for all monitored Y-12 employees was 16 mrem in 1987, 12 mrem in 1989, and less than 5 mrem for subsequent years. Consequently, 1989 radiation doses provide the best available data for estimating radiation impacts to the worker for No Action - Planning Basis Operations Alternative. The full value of the 1989 dose, rather than 65 percent, was used to provide a conservative estimate of the average worker dose. The radiation doses and projected health impacts to workers for No Action - Planning Basis Operations Alternative are presented in Tables D.2.3–5 and D.2.3–6. The projected health impacts to workers for major production operations are presented in Table D.2.3-7.

D.2.3.3 *Radiological Health Effects Under the Highly Enriched Uranium Storage Mission Alternative*

The process operations projected for the HEU Materials Facility include loading, unloading, and storage of canned materials and general fissile containers; nondestructive evaluation activities; sampling, canning, and recontainerization of special nuclear materials; and materials inventory and tracking. Because these activities closely mirror current operations at the 9720-5 facility, radiation doses from 9720-5 warehouse operations were used to estimate the projected health impacts to HEU workers. Table D.2.3-8 presents the radiation dose and projected health impact to workers for the No Action - Planning Basis Operations Alternative and for two operating scenarios (new facility and upgrade to Bldg. 9215) under the HEU Storage Mission Alternative. Under the No Action - Planning Basis Operations Alternative, normal operations at the 9720-5 warehouse would be expected to continue at the levels conducted in 1998.

It is expected that 90 to 95 percent of the designated on-site materials will be relocated to the HEU Materials Facility during the first year of operation. Operations during the initial relocation would more closely resemble 1999 activities. During 1999, much of the HEU inventory was retrieved from storage, weighed, tagged, and returned to storage as part of a criticality safety validation process. The doses incurred by workers through the increased handling of materials during this process provide a reasonable estimate of the dose that would likely be received during the initial phase of facility operation. The average deep dose for 1999 was increased by a factor of 3 to account for the relative increase in the number of hours projected for workers during the relocation phase.

After the relocation phase, normal HEU Materials Facility operations should result in annual worker doses at or below the 1998 levels (15 - 21 mrem) due to:

- The use of gloveboxes, inert atmosphere, negative air pressure, and other engineered controls
- Automated inventory and tracking system should result in significant reduction in dose from 1998 levels
- Management of facility operations to minimize and eliminate, where possible, the use and creation of radiologically contaminated areas
- Decreased number of workers

TABLE D.2.3–4.—*Estimated Radiological Health Effect for Workers for Major Production Operations (No Action - Status Quo Alternative)*

	Radiological Workers				All Workers (Radiological and Non-Radiological)			
Operation	**Number of Workers**	**Individual Worker Doses (mrem)**	**Collective Dose (person-rem)**	**LCFs**	**Number of Workers**	**Average Individual Worker Dose (mrem)**	**Collective Dose (person-rem)**	**LCFs**
Enriched Uranium	192	85.83	16.48	$6.59x10^{-3}$	393	8.0	3.14	$1.26x10^{-3}$
Depleted Uranium	220	10.92	2.40	$9.6x10^{-4}$	223	8.0	1.78	$7.12x10^{-4}$
Assembly/Disassembly/ Quality Evaluation	150	10.63	1.59	$6.36x10^{-4}$	160	8.0	1.28	$5.12x10^{-4}$
Product Certification	125	3.2	0.4	$1.6x10^{-4}$	150	N/A	1.20	$4.80x10^{-4}$
Analytical Chemistry Organization	126	0.95	0.12	$4.8x10^{-5}$	163	N/A	1.30	$5.20x10^{-4}$
Y-12 Plant	3563	11.4	40.61	$1.62x10^{-2}$	5128	8.0	41.24	$1.64x10^{-2}$

Source: Based on Appendix E, Table E.4.2.–3.

The Special Materials Mission Alternatives would have no impact on the No Action - Planning Basis Operations Alternative levels because there were no radiological operations associated with this mission.

TABLE D.2.3–5.—*Y-12 Worker Individual and Collective Radiation Doses for Alternative 1B No Action - Planning Basis Operations Alternative*

	All Workers (Rad and Non-Rad)
No. of workers	5,128
Average worker dose (mrem)	11.6
Collective dose (person-rem)	59.48

Source: Y-12 1999.

TABLE D.2.3–6.—*Radiation Doses and Health Impacts to Workers Under the No Action - Planning Basis Operations Alternative*

Worker Dose	Radiation Dose	No. of LCFs
Annual Average Individual Worker Dose (mrem/yr)	11.6	4.64×10^{-6}[a]
Annual Workforce Collective Dose (person-rem/yr)	59.48	2.38×10^{-2}

[a] This represents the risk of latent cancer fatality for an individual worker.
Source: Y-12 1999.

TABLE D.2.3–7.—*Radiological Health Effects for Workers for Major Production Operations Under the No Action - Planning Basis Operations Alternative*

	All Workers (Rad and Non-Rad)			
Operation	**No. of Workers**	**Average Individual Worker Dose (mrem)**	**Collective Dose (person-rem)**	**Latent Fatal Cancers**
Enriched Uranium	492	11.6	5.71	2.28×10^{-3}
Depleted Uranium	223	11.6	2.59	1.04×10^{-3}
Assembly/Disassembly/ Quality Evaluation	160	11.6	1.86	7.44×10^{-4}
Product Certifications	158	11.6	1.83	7.32×10^{-4}
Analytical Services	180	11.6	2.09	8.36×10^{-4}
Y-12 Plant	5128	11.6	59.48	2.38×10^{-2}

Source: Based on LMES 2000a.

TABLE D.2.3–8.—*Radiation Doses and Health Impacts to Workers Under the Highly Enriched Uranium Storage Mission Alternative*

No Action - Planning Basis Operations Alternative	
Dose (mrem)	21
No. of involved workers	35
Collective dose (person-rem)	0.74
No. of fatal cancers	3×10^{-4}
HEU Storage Mission Alternatives	
Initial Relocation Operations	
Dose (mrem)	150
No. of involved workers	35
Collective dose (person-rem)	5.25
No. of fatal cancers	2.1×10^{-3}
Normal Operations	
Dose (mrem)	21
No. of involved workers	14
Collective dose (person-rem)	0.29
No. of fatal cancers	1.16×10^{-4}

Source: Based on LMES 2000a; LMES 2000b.

D.2.4 Risk Estimates and Health Effects for Potential Radiation Exposures to the Public for Alternative 1A (No Action - Status Quo Alternative)

Dose estimates for exposure to releases of radiological contaminants from Y-12 were compiled from the ASER for 1997 and 1998 and the remedial investigation for UEFPC to establish the No Action - Status Quo Alternative for contaminant environmental concentrations and the subsequent potential exposure results. Dose estimates for the determined alternatives were calculated using standard environmental transport codes and exposure assumptions. In both cases, the dose estimates were then compared to relevant regulatory criteria and are presented below.

D.2.4.1 *Health Effects of Airborne Radionuclides*

Effluent Monitoring. Releases of radiological contaminants, primarily uranium, into the atmosphere at Y-12 are continuously monitored in accordance with NESHAP regulations. NESHAP regulations specify that any source that potentially can contribute >0.1 mrem/year TEDE to an offsite individual is to be considered a "major source" and emissions from that source must be continuously sampled. Uranium stack losses were measured continuously on 51 of 57 (six were temporarily shut down) process exhaust stacks (major sources) in 1998. Particulate matter (including uranium) was filtered from the stack sample; filters at each location were changed routinely, from one to three times per week, and analyzed for total uranium. In addition, the sampling probes and tubing were removed quarterly and washed with nitric acid; the washing was analyzed for total uranium. At the end of the year, the probe-wash data were included in the final calculations in determining total emissions from each stack.

In addition to the active stacks at Y-12, “minor sources” of radionuclide release are included in the estimate of emissions. Minor sources at the Y-12 Plant are described below:

- **Laboratory exhaust:** Uranium and other radionuclides are handled in millicurie quantities at facilities within the boundary of Y-12 as part of ORNL and Y-12 ACO laboratory activities. In addition, emissions from the ACO laboratory located 1/3 mile east of the Plant on Union Valley Road are included in Y-12 source term. The releases from the ACO are minimal and have negligible effects on the total Y-12 dose.

- **Room Exhaust:** Radionuclide releases from process room ventilation systems are estimated from radiation control data collected on airborne radioactivity concentrations in the work areas. Areas where the monthly average concentrations exceeded 10 percent of the DOE derived air concentration worker protection guidelines are included in the annual emissions estimate.

Emissions from unmonitored process and laboratory exhausts, categorized as minor emission sources, are estimated according to EPA-approved calculation methods. In 1998, 50 minor emission points were identified from unmonitored radiological processes and laboratories. Twenty-eight minor emission points were identified from ORNL activities at facilities within the boundary of Y-12. Seven minor emission points were identified at the ACO Union Valley laboratory. No areas were identified where room ventilation emissions exceeded 10 percent of the derived air concentration worker protection guidelines. Table D.2.4-1 lists the quantities of enriched and depleted uranium estimated to have been released into the atmosphere as a result of Y-12 Plant activities during 1998.

TABLE D.2.4–1.—*Y-12 Plant Airborne Uranium Emission Estimates, 1998*

Source of Emissions	Quantity Emitted	
	Ci	kg
Enriched Uranium		
Process exhaust (monitored)	0.012	0.184
Process and laboratory exhaust (unmonitored)	0.00009	0.0014
Room exhaust (from health physics data)	0.00	0.00
Depleted Uranium		
Process exhaust (monitored)	0.0021	3.93
Process and laboratory exhaust (unmonitored)	0.0031	5.85
Room exhaust (from health physics data)	0.00	0.00
Total	0.017	9.97

Source: DOE 1999c.

Environmental Surveillance. Ambient air monitoring is performed to measure radiological parameters directly in the ambient air adjacent to the facility. Ambient air monitoring provides direct measurement of airborne concentrations of radionuclides and other hazardous pollutants in the environment, allows facility personnel to determine the relative level of contaminants at the monitoring locations during an emergency, verifies that the contributions of fugitive and diffuse sources are insignificant, and serves as a check on dose-modeling calculations. In 1998, three low-volume uranium particulate monitoring stations were operated by Y-12 within the Plant boundaries. For 1998, the average 7-day concentration of uranium at the three monitored locations ranged from a low of 0.00001 $\mu g/m^3$ to a high of 0.00044 $\mu g/m^3$ (DOE 1999c).

Additionally, air monitoring was conducted on the ORR to perform surveillance of airborne radionuclides at the reservation perimeter and to collect reference data from a remote location not affected by activities on the ORR. The closest perimeter monitoring station, Station 40, monitors the east end of the Y-12. Station 46 measures off-site impacts of the Y-12 operations in the Scarboro Community and is located near the theoretical area of maximum public pollutant concentrations as calculated by air quality modeling. A comparison of data collected from the monitoring locations indicates that there is no appreciable difference between the concentrations of radionuclides detected at the monitoring locations, Stations 40 and 46, and the reference station, Station 52 (Table D.2.4-2).

TABLE D.2.4–2.—*Environmental Surveillance Perimeter Air Monitoring Results*

Monitoring Location	^{7}Be	^{60}Co	^{137}Cs	^{40}K	^{3}H	^{234}U	^{235}U	^{238}U	Gross alpha	Gross beta
Station 40	2.6×10^{-14}	*b*	2.3×10^{-17}	*b*	3.5×10^{-12}	1.8×10^{-17}	1.0×10^{-18}	1.3×10^{-17}	1.9×10^{-15}	4.7×10^{-15}
Station 46	3.7×10^{-14}	*b*	*b*	*b*	*b*	1.5×10^{-17}	*b*	1.5×10^{-17}	*b*	*b*
Station 52 (reference)	3.1×10^{-14}	*b*	3.6×10^{-17}	4.7×10^{-16}	3.3×10^{-12}	5.0×10^{-18}	7.5×10^{-19}	4.6×10^{-18}	2.4×10^{-15}	*b*
Inhaled Air DCG	4.0×10^{-8}	8×10^{-11}	4×10^{-10}	9×10^{-10}	2×10^{-1}	9.0×10^{-14}	1.0×10^{-13}	1.0×10^{-13}	*c*	*c*

[a] All values are mean concentrations in μCi/mL.
[b] Not detected at 95 percent confidence level.
[c] No DCGs are available for gross alpha and beta.
Source: Adapted from DOE 1999c.

Summary of Health Effects from Airborne Radionuclides. The TEDE received by the hypothetical maximally exposed individual (MEI) for Y-12 was calculated to be 0.53 mrem (0.0053 mSv) based on both monitored and estimated effluent data (see Appendix E). This individual is located about 1,080 m (0.7 mi) north-northeast of the Y-12 release point. The major radionuclide emissions from Y-12 are nuclides ^{234}U, ^{235}U, ^{236}U, and ^{238}U. The contribution of Y-12 emissions to the 50-year committed collective TEDE to the population residing within 80 km (50 mi) of the ORR was calculated to be about 4.3 person-rem (0.043 person-Sv) which is approximately 35 percent of the collective TEDE (12 person-rem) for the ORR. Both the individual and collective TEDE are well below all applicable DOE and NESHAP criteria.

D.2.4.2 *Health Effects of Waterborne Radionuclides*

Effluent Monitoring. Radiological monitoring is conducted in accordance with the guidelines specified in the *Radiological Monitoring Plan for the Oak Ridge Y-12 Plant: Surface Water*, (LMES 1995a). The results of this monitoring are submitted quarterly as an addendum to the *National Pollutant Discharge Elimination System* [NPDES] *Discharge Monitoring Report*. Under the monitoring program, effluent monitoring is continued at three types of locations: treatment facilities, other point and area source discharges, and in-stream locations. Table D.2.4-3 lists the radiological parameters monitored at Y-12 in 1998. These parameters were selected based on operational history and the results of past monitoring activities. Table D.2.4-4 provides a summary of the locations sampled along with the sum of DCG percentages for each location.

The Radiological Monitoring Plan also addresses monitoring of the sanitary sewer. Y-12 is permitted to discharge domestic wastewater to the city of Oak Ridge POTW. Radiological monitoring of this discharge is also conducted and is reported to the city of Oak Ridge. The following parameters are monitored routinely: alpha, beta, and gamma activity, plutonium, and uranium.

Radiological monitoring of storm water is required by the NPDES permit, and a comprehensive monitoring plan has been designed to fully characterize pollutants in stormwater runoff. The most recent version of the plan was issued in December of 1998, *Storm Water Pollution Prevention Plan for the Oak Ridge Y-12 Plant*, which incorporates the radiological monitoring requirements (LMES 1996).

TABLE D.2.4–3.—*Surface Water Radiological Parameters Monitored at the Y-12 Plant in 1998*

Parameters	Specific Isotopes	Ingested Water DCG (pCi/L)[a]	Rationale for Monitoring
Uranium isotopes	^{234}U	20	These parameters reflect the major activity, uranium processing, throughout the history of Y-12 and are the dominant detectable radiological parameters in surface water.
	^{235}U	24	
	^{238}U	24	
	total U	20	
	weight percent ^{235}U	NA	
Fission and activation products	^{3}H	80,000	These parameters reflect a minor activity at Y-12, processing recycled uranium from reactor fuel elements, from the early 1960s to the late 1980s and will continue to be monitored as tracers for beta and gamma radionuclides, although their concentrations in surface water are low.
	^{90}Sr	40	
	^{99}Tc	4,000	
	^{137}Cs	120	
Transuranium isotopes	^{241}Am	1.2	These parameters are related to recycle uranium processing. Monitoring continued because of their half-lives and presence in groundwater.
	^{237}Np	1.2	
	^{238}Pu	1.6	
	$^{239/240}Pu$	1.2	
Other isotopes of interest	^{226}Ra	4[b]	These parameters reflect historical thorium processing and natural radionuclides necessary to characterize background radioisotopes.
	^{228}Ra	4[b]	
	^{228}Th	16	
	^{230}Th	12	
	^{232}Th	2	

[a]Ingested water DCGs are 4 percent of the water DCGs recommended in DOE Order 5400.5 Chapter III Derived Concentration Guides for Air and Water and represent the DOE criterion of 4 mrem EDE from ingestion of drinking water.
[b]Combined radium-226 and radium-228 shall not exceed 5 x 10^{-9} μCi/mL per DOE Order 5400.5.
Source:DOE 1999c.

Environmental Surveillance. Surface water environmental surveillance monitoring is conducted on the ORR to assess the impact of past and current DOE operations on the quality of local surface water. Sampling locations are downstream of ORR waste sources, at reference points on streams and reservoirs upstream of waste sources, and at public water intakes. Discharges from Y-12 enter the Clinch River via Bear Creek and the East Fork Poplar Creek (EFPC), both of which enter Poplar Creek before it enters the Clinch River, and by discharges from Rogers Quarry into McCoy Branch and then into Melton Hill Lake. Sampling locations pertinent to the evaluation of Y-12's impact on surface water quality and the parameters analyzed are listed in Table D.2.4-5 along with the results and the appropriate DCG.

TABLE D.2.4–4.—*Summary of Y-12 Plant Radiological Monitoring Plan Sampling Locations and Results for 1998*

Outfall No.	Location	Sum of DCG percentage
	Y-12 Plant wastewater treatment facilities	
501	Central Pollution Control Facility	1.6
502	West End Treatment Facility	8.6
503	Steam Plant Wastewater Treatment Facility	No flow
512	Groundwater Treatment Facility	6.1
520	Steam Condensate	No flow
551	Central Mercury Treatment Facility	4.6
	Other Y-12 Plant point and area source discharges	
S17	Kerr Hollow Quarry	2.8
S19	Rogers Quarry	3.6
	Y-12 Plant instream locations	
BCK 4.55	Bear Creek, plant exit (west)	5.0
Station 17	East Fork Poplar Creek, plant exit (east)	3.9
200	North/south pipes	6.5

Source: DOE 1999c.

Sampling and analysis of surface water at the easternmost monitoring station (Station 17 on UEFPC) and at the westernmost monitoring station (BCK 4.55/NPDES Outfall 304) provide information regarding the concentrations of radionuclides from Y-12 operations that contribute to increased risk to the public. Table D.2.4-6 lists the monitoring results for these two locations along with the associated DCG. In comparing the 4 percent DCG with the average values of the detected radionuclides, none were found to exceed the DCG. However, a comparison of the maximum detected value with the DCG would identify radium (^{228}Ra) as the only radionuclide to exceed the DCG as was reported in the 1998 ASER.

Summary of Health Effects from Waterborne Radionuclides. Radiological data for all effluent monitoring locations were well below the allowable DCGs. The highest summed percentage of DCGs was from the West End Treatment Facility (WETF). Radium (^{228}Ra) was the major contributor of radioactivity there, contributing 7.6 percent to the total 8.6 percent of the sum of the percentages of the DCGs. In 1998, the total mass of uranium and associated curies released from the Y-12 Plant at the eastern-most monitoring station (Station 17 on UEFPC) and the western-most monitoring station (BCK 4.55) was 375 kg or 0.167 Ci. No single radionuclide in the Y-12 contribution to the sanitary sewer exceeded 1 percent of the DCG. Radiological monitoring of storm water is consistent with past years. Uranium is the dominant constituent and increases during storm flow either due to surface sources or increased groundwater flow. Radionuclide concentrations in surface water do not, therefore, pose an adverse health impact to the public.

TABLE D.2.4–5.—*Oak Ridge Reservation Surface Water Surveillance Sampling Pertinent to Y-12*

Location	Parameters	Maximum Results (pCi/L)[a]	4% Ingested Water DCG (pCi/L)	Results/DCG (percent)
Bear Creek downstream from the Y-12 Plant inputs (Bear Creek km 0.6)	^{60}Co	3.1	200	0.02
	Gross alpha	6.1	15[b,c]	*c*
	Gross beta	5.7	*c*	*c*
	Total U	5.2	20	0.26
	^{234}U	2.0	20	0.10
	^{235}U	0.080	24	0.003
	^{238}U	4.2	20	0.21
East Fork Poplar Creek (EFPC) prior to entering Poplar Creek (EFPC km 0.1)	Gross alpha	3.0	15[b,c]	*c*
	Gross beta	5.4	*c*	*c*
	Total U	2.5	20	0.13
	^{234}U	1.0	20	0.05
	^{238}U	1.4	20	0.07
EFPC downstream from floodplain (EFPC km 5.4)	^{60}Co	3.0	200	0.02
	Gross alpha	2.5	15[b,c]	*c*
	Gross beta	4.5	*c*	*c*
	Total U	3.0	20	0.15
	^{234}U	1.5	20	0.08
	^{238}U	1.4	20	0.07
McCoy Branch prior to entering the Clinch River (McCoy Branch km 1.8)	^{60}Co	2.7	200	0.01

[a] All radionuclide concentrations were determined to be significantly greater than zero.
[b] A National Primary Drinking Water Standard of 15 pCi/L is available for gross alpha.
[c] No DCG is available for gross alpha or beta. The allowable drinking water dose to the public established in DOE Order 5400.5 is 4 mrem/year.
Source: Adapted from DOE 1999c.

D.2.4.3 *Health Effects from Sediment Radionuclides*

No sediment samples were collected at either in-stream locations or at outfalls during calendar year 1998. As such, the most recent sediment data available, 1997, are presented herein. In addition, sediment data collected as part of the remedial investigation of the UEFPC characterization area are presented to supplement the available historical data.

Environmental Surveillance. In 1997, the Environmental Monitoring Plan for the ORR was modified and sediment sampling at Y-12 in EFPC and Bear Creek was discontinued. However, as a best management practice, Y-12 collected one sample from EFPC and one from Bear Creek. The samples were analyzed for mercury, PCBs, and isotopes of uranium since historical data indicated these are contaminants of concern that are present at detectable levels in the sediment. The purpose of the annual sampling is to determine if these contaminants are accumulating in the sediment. The results for the radionuclides measured are presented in Table D.2.4-7.

TABLE D.2.4–6.—*Environmental Surveillance Surface Water Monitoring Results (pCi/L) Collected to Determine Release of Radionuclides to the Off-site Environment.* [a]

Radionuclide	Concentration at Station 17	Concentration at Station BCK 4.55	4 percent Drinking Water DCG
^{241}Am	0.76	*b*	1.2
^{60}Co	1.1	*b*	200
^{237}Np	0.058	*b*	1.2
^{238}Pu	0.078	*b*	1.6
$^{239/24}$Pu	0.0067	*b*	1.2
^{228}Ra	2.1	*b*	4
^{99}Tc	7.6	14	4,000
^{228}Th	0.093	0.061	16
^{230}Th	0.35	0.5	12
^{232}Th	0.018	*b*	2
^{234}Th	4	7.8	400
^{3}H	262	*b*	80,000
^{234}U	1.8	4	20
^{235}U	0.095	0.23	24
^{238}U	4	7.8	20

[a] Yearly average values reported.
[b] Not detected above minimum analytical detection value.
Source: Adapted from DOE 1999c.

Sediment data collected at mainstream locations indicate that gross alpha, gross beta, ^{241}Am, total radium, ^{228}Ra, and ^{230}Th were detected. Isotopes with background levels that were detected above their associated background concentration are ^{237}Np, ^{99}Tc, $^{233/234}$U, ^{235}U, and ^{238}U. Isotopic activities for total radioactive strontium, ^{137}Cs, ^{228}Th, and ^{232}Th were not above their respective background values.

Sediment data collected within pipes and catch basins corresponding to particular outfalls or location indicate that uranium isotopes are ubiquitous and were detected at all but one sampled location. The most prevalent isotope was ^{238}U (DOE 1998c).

Remedial Investigation. Sediment data collected in support of the remedial investigation for the UEFPC characterization area were aggregated into two categories: samples collected *inside* the Y-12 Plant boundary and those collected *outside* the Y-12 Plant boundary. Estimates of exposure for the open recreational land use were calculated for each aggregate. All data collected were compared to radionuclide-specific risk-based concentration values. The result of this comparison is a list of radionuclides detected in sediment that were evaluated quantitatively in the risk assessment and includes ^{237}Np, ^{228}Ra, total radium-alpha activity, $^{233/234}$U, ^{235}U, and ^{238}U. The risk assessment for the UEFPC characterization area concludes that exposure to sediment via the open recreational exposure scenario for radionuclides would not result in risks within the EPA range of concern (10^{-4}–10^{-6}) for either the inside or outside Y-12 Plant boundary aggregates. Thus, limited exposure to radionuclides in sediment does not pose a significant health threat.

TABLE D.2.4–7.—*1997 Results of Y-12 Plant Sediment Monitoring*

Analyte (pCi/g)	Station 17 (EFPC)	Station 9.4 (Bear Creek)
^{226}Ra	2.8	2. 4
^{228}Th	0.97	0.70
^{230}Th	1.2	0.41
^{232}Th	0.73	0.68
^{234}U	2.6	3.6
^{235}U	0.13	0.20
^{238}U	2.9	6.3

Source: DOE 1998b.

D.2.4.4 *Health Effects from Radionuclides in Soils*

Soil samples are not collected as part of the environmental monitoring activities at the ORR. Therefore, the remedial investigation data for the UEFPC characterization area will be used as the sole source of soil data (DOE 1998c). The investigation of UEFPC characterization area evaluated both exposure to surface and subsurface soils. Evaluation of the open recreational land use scenario indicated that the primary contributor to radiological risks for the adult receptor was ^{137}Cs. Excess cancer risks (ECRs) were calculated according to the methods outlined in Section D.3.1.3 for the ingestion, inhalation, and external exposure pathway and are 1.8 x 10^{-6}, 6.3 x 10^{-12}, and 1.1 x 10^{-4}, respectively. The risk from external exposure was the primary contributor to unacceptable risk. This external exposure was mitigated by a removal action that occurred subsequent to the samplling and analysis and is therefore no longer a public health concern. Radionuclides detected in subsurface soils were not determined to pose a potential threat of adverse health effects. Excess cancer risks were well below the EPA range of concern.

D.2.4.5 *Health Effects from Radionuclides in Groundwater*

Radionuclides detected in groundwater monitoring data that exceeded risk-based radionuclide-specific screening levels were evaluated quantitatively in the risk assessment for the UEFPC Characterization Area and include ^{241}Am, ^{137}Cs, ^{238}Pu, ^{226}Ra, ^{228}Ra, ^{228}Th, Tritium, ^{234}U, ^{235}U, ^{236}U, and ^{238}U (DOE 1998c). An evaluation of the risks resulting from exposure to radionuclides in groundwater was conducted for an industrial and residential scenario only. Data were compiled and sorted into four aggregates: an exit pathway aggregate, a shallow clastics aggregate, an intermediate clastics aggregate, and Union Valley and arboretum wells aggregate. An ECR was calculated for each aggregate for each receptor. No unacceptable ECRs were calculated for the industrial scenario for any aggregate. Evaluation of the residential ingestion of groundwater indicated that exposure to concentrations of radionuclides in the exit pathway aggregate and the shallow clastics aggregate would result in ECRs within the EPA range of concern. The total pathway risk for the residential exit pathway aggregate was 1.1 x 10^{-4} and for the shallow clastics aggregate was 1.6 x 10^{-4}. The radionuclides contributing to these pathway risks are listed in Table D.2.4–8.

TABLE D.2.4–8.—*Radionuclides of Concern for Residential Groundwater Scenario*

Aggregate	Radionuclide of Concern	Excess Cancer Risk
Pathway Residential Exit	^{137}Cs	2.5×10^{-6}
	^{226}Ra	1.2×10^{-5}
	^{228}Ra	7.5×10^{-6}
	^{228}Th	1.1×10^{-6}
	^{234}U	4.4×10^{-5}
	^{235}U	1.8×10^{-6}
	^{238}U	3.9×10^{-5}
Shallow Clastics	^{137}Cs	2.3×10^{-6}
	^{226}Ra	5.5×10^{-5}
	^{228}Ra	4.6×10^{-6}
	^{99}Tc	6.2×10^{-5}
	^{228}Th	7.0×10^{-6}
	^{234}U	8.3×10^{-6}
	^{238}U	1.7×10^{-5}

Source: Adapted from LMES 2000a (Remedial Investigation/ East Fork Poplar Creek).

D.2.5 Risk Estimates for Potential Radiation Exposures to the Public for the Alternatives

The additional proposed actions under consideration in this Y-12 SWEIS include HEU Storage Mission Alternatives, and the Special Materials Mission Alternative. Each of these actions will be discussed in the following subsections relative to their respective impact on the risk estimates for potential radiation exposure to the public.

D.2.5.1 *Alternative 1B (No Action - Planning Basis Operations Alternative)*

No Action - Planning Basis Operations Alternative does not include the construction or significant upgrade/expansion of any new or existing DP facilities. The Y-12 Plant would continue to use the existing storage facilities and the existing special materials operation facilities to perform the HEU Storage Mission and the Special Materials Mission, respectively. Under this alternative, the major production activities during the 2001-2010 time period will involve weapons production, weapons dismantlement, quality evaluation, special production, and enriched uranium recovery.

Production operations and enriched uranium recovery operations were significantly decreased during the 1990's because of major upgrades and the 1994 stand-down of the Y-12 Plant. As such, a review was conducted to determine what historical data were available that would most accurately represent the operations and emissions for the projected workload in the 2001-2010 time period (LMES 2000a). The 1987 Y-12 Plant emissions data were determined to be the most appropriate for use in this assessment.

During 1987, 50 percent of the environmental emissions were attributed to production operations and the remaining 50 percent were from enriched uranium recovery operations. The projected work load for 2001-2010 assumes that weapons production, quality evaluation, and special production will be approximately 30 percent of the 1987 level experienced for production operations, and that the enriched uranium recovery operations will be 100 percent of the 1987 level experienced for recovery operations. Thus, the radiological airborne emissions data were collected for 1987, the results were multiplied by 65 percent, and the modified values served as the basis for the modeling conducted to estimate airborne emissions for the 2001-2010 workload under No Action - Planning Basis Operations Alternative (Appendix E).

Airborne Emissions. A total of 0.14 Ci of uranium was released from the Y-12 Plant during 1987 (Rogers 1988). Sixty-five percent of this amount, 0.0908 Ci, is assumed to be released per year from the Y-12 Plant under No Action - Planning Basis Operations Alternative. Given these assumptions, the modeling results indicate that the TEDE to the hypothetical maximally exposed individual was 4.5 mrem/year. Although this dose is higher than the 1998 baseline dose of 0.53 mrem/year, it is still well below the NESHAP standard of 10 mrem/year. The 50-year collective TEDE resulting from CAP88 modelling for No Action - Planning Basis Operations Alternative to the population residing within 80 km (50 mi) of the Y-12 Plant was 33.7 person-rem. That is approximately 0.01 percent of the dose the same population would receive from natural sources of radiation. Thus, no adverse health impacts to the public would result from increased operations under No Action - Planning Basis Operations Alternative.

In 1987, 12 perimeter ambient air monitors were operated at the Y-12 Plant. Uranium, fluoride, SO_2, and total suspended particulates data were collected. The results of this monitoring are presented and summarized in the report *Environmental Surveillance of the U.S. Department of Energy Oak Ridge Reservation and Surrounding Environs During 1987* (MMES 1988). Ambient uranium isotope concentrations measured were within the guidelines established in DOE Order 5480.1. Table D.2.5-1 lists the range of concentrations for each isotope.

TABLE D.2.5–1.—*Ranges of Uranium Isotopic Concentrations at Perimeter Air Monitoring Stations During 1987*

Isotope	Minimum (μg/m^3)	Maximum (μg/m3)
^{234}U	0.13	24
^{235}U	0.013	0.72
^{238}U	0.0098	0.39

Source: LMES 1995a.

Waterborne Emissions. The existing *Radiological Monitoring Plan* was not in place and effective until 1995 (LMES 1995a). As such, radiological data for liquid discharges in 1987 was limited to two sampling locations. The first location, Bear Creek kilometer 12.4 (near the former S-3 ponds area), was sampled weekly in response to a 1983 complaint and order from the Tennessee Department of Health and Environment (TDHE). The second location, influent to New Hope Pond, was sampled in order to determine the effectiveness of Y-12 Source area controls and to determine the appropriate closure recommendations for the pond.

The results of the sampling for each of these locations is summarized in Table D.2.5-2. Only the radionuclides that were detected are included along with their associated ingested water DCG.

As is evidenced in Table D.2.5-2, the maximum detected values for ^{241}Am, ^{237}Np, and ^{226}Ra exceed the associated ingested water DCG. All other radionuclides were below their associated DCG.

These data are not directly comparable to 1998 data due to a difference in sampling location, sample collection methods, and subsequent *Resource Conservation and Recovery Act* (RCRA) closure activities. As such, the surface water data as presented in the baseline is also considered as representative of the No Action - Status Quo Alternative (see Section D.2.4.2).

TABLE D.2.5–2.—*Results of 1987 Radiological Surface Water Sampling*

Radionuclide	Maximum (pCi/L)	Minimum (pCi/L)	Average (pCi/L)	4 percent Ingested Water DCG
		Upper Bear Creek, kilometer 12.4		
Gross alpha	1,000	6.7	496.5	NA
Gross beta	2,000	9.3	776.1	NA
^{237}Np	18	0.23	<2.43	1.2
^{235}U	40	<0.58	<11.17	24
U total (mg/L)	1.69	0.019	0.969	20
		New Hope Pond Influent		
^{241}Am	4.3	<0.27	<1.01	1.2
^{226}Ra	6.1	<0.4	<1.6	4
^{228}Th	4.1	0.15	0.97	16
^{234}U	19	<0.85	<10	20
^{235}U	19	<0.34	<2.3	24
^{238}U	10	0.3	<5.5	24
U total (mg/L)	0.029	0.007	0.017	20

Source: Adapted from DOE 1999c.

Sediment and Soil data. Soils and sediment data were not collected from locations representative of Y-12 effluents in 1987. Soil samples were collected as part of the ORR environmental surveillance activities to provide a measure of the quantity of radioactivity or other pollutants that were deposited from the atmosphere. No discussion or differentiation was made regarding the relative contribution of the various facilities to the measured concentrations. As such, the baseline sediment and soil data presented in Sections D.2.4.3 and D.2.4.4 are considered to be representative of No Action - Planning Basis Operations Alternative.

Groundwater Data. Groundwater data were collected and analyzed in 1987 for a limited suite of contaminants in accordance the existing RCRA permitting requirements. The focus was not on determining off-site transport of contaminants to potential receptors, but rather on monitoring of permitted facilities. Currently, a comprehensive groundwater monitoring program is conducted for Y-12 that includes monitoring to comply with the requirements of RCRA postclosure regulations, to support *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) remedial investigation/feasibility study efforts and records of decision, to comply with Tennessee Department of Environment and Conservation (TDEC) solid waste management regulations, and to support DOE Order 5400.1 requirements. As such, the data collected under this comprehensive program is considered appropriate for use in determining the potential impacts to the public for both No Action - Status Quo Alternative and No Action - Planning Basis Operations Alternative (see Section D.3.5).

In summary, airborne emissions of radiological contaminants would increase over current No Action - Status Quo Alternative emissions by a factor of 5.3 based on the projected activities to be undertaken in the No Action - Planning Basis Operations Alternative (Table D.2.5.1-2). However, the resulting impact to the public would remain well below all applicable exposure criteria. Surface water, soil/sediment, and groundwater concentrations are not expected to vary significantly from the No Action - Status Quo Alternative due to the increase in effectiveness and efficiency of current pollution control measures.

D.2.5.2 *Highly Enriched Uranium Storage Mission Alternatives*

There are three proposed alternatives for the HEU Storage Mission at Y-12: No Action - Planning Basis Operations Alternative, Alternative 2A (Construction and Operation of a New HEU Materials Facility), and Alternative 2B Upgrade Expansion to existing Building 9215 (see Section 3.2.2). The emission data for No Action - Planning Basis Operations Alternative is assumed to include all the emissions from the storage of HEU in existing facilities. The emissions for the HEU storage mission action alternatives are expected to be at or below the current levels due to administrative and engineering controls such as multiple levels of high-efficiency particulate filters at the new facilities. Risks to the public from environmental emissions would remain the same as were presented in Section D.2.5.1 for Alternative 1B (No Action - Planning Basis Operations Alternative).

D.2.5.3 *Special Materials Mission Alternatives*

There are two proposed alternatives for the Special Materials Mission at Y-12: No Action - Planning Basis Operations Alternative and Alternative 3A (Construction and Operation of a new Special Materials Complex) (see Section 3.2.3). The Special Materials Complex does not have radiological material. Under the No Action - Planning Basis Operations Alternative the new Special Materials Complex would not be constructed. The Y-12 Plant would continue to use the existing special materials operations facilities and the radiological impacts to the public would remain the same as under Alternative 1B (No Action - Planning Basis Operations Alternative) discussed in Section D.2.5.1.

The purpose of and the materials produced under the Special Materials Mission would not result in any increase in airborne radiological emissions. Surface water, soil/sediment, and groundwater concentrations of radionuclides would also not be affected.

D.3 HAZARDOUS CHEMICAL IMPACTS TO HUMAN HEALTH

D.3.1 Chemicals and Human Health

Chemicals are ever present in our environment. We use chemicals in our everyday tasks–as pesticides in our gardens, cleaning products in our homes, insulating materials in buildings, and as ingredients in medications. Potentially hazardous chemicals can be found in all of these products, but usually the quantities are not large enough to cause adverse health effects.

In contrast to home use, chemicals used in industrial settings are often found in concentrations that may affect the health of individuals in the workplace and in the surrounding community. The following sections describe both the carcinogenic and noncarcinogenic effects of chemicals on the body and how these effects are assessed.

D.3.1.1 *How Do Chemicals Affect the Body?*

Industrial pollutants may be released either intentionally or accidentally to the environment in quantities that could result in health effects to those who come in contact with them. Chemicals that are airborne, or released from stacks and vents, can migrate in the prevailing wind direction for many miles. The public may then be exposed by inhaling chemical vapors or particles of dust contaminated by the pollutants. Additionally, the pollutants may be deposited on the surface soil and biota (plants and animals) and subsequent human exposure could occur. Chemicals may also be released from industries as liquid or solid waste (effluent) and can migrate or be transported from the point of release to a location where exposure could occur.

Exposure is defined as the contact of a person with a chemical or physical agent. For exposure to occur, a chemical source or contaminated media such as soil, water, or air must exist. This source may serve as a point of exposure, or contaminants may be transported away from the source to a point where exposure could occur. In addition, an individual (receptor) must come into either direct or indirect contact with the contaminant. Contact with a chemical can occur through ingestion, inhalation, dermal contact, or external exposure. The exposure may occur over a short (acute or subchronic) or long (chronic) period of time. These methods of contact are typically referred to as exposure routes. The process of assessing all of the methods by which an individual might be exposed to a chemical is referred to as an exposure assessment.

An exposure assessment is the determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, route of exposure, and receptor population for each pathway evaluated. During the exposure assessment process, the assessor:

- Characterizes the exposure setting in an effort to identify the potentially exposed populations (receptors), their activity patterns, and any other characteristics that might increase or decrease their likelihood of exposure

- Determines exposure pathways based on the characterization of the exposure setting, identifying the unique mechanisms by which a population may be exposed to the contaminants

- Quantifies the exposure to a contaminant by estimating concentrations using environmental data to which a receptor may be exposed

- Calculates a chemical-specific intake (referred to as the chronic daily intake) and/or a radionuclide-specific dose for each exposure pathway

The result of an exposure assessment is a list of pathways by which a chemical may migrate or be transported to a receptor who can then be exposed. Exposure to a chemical is quantified as a rate of intake and is measured in quantity per body weight per time. Intake rates are typically expressed as mg/kg-day for chemicals and are calculated using the following general equation:

$$\mathbf{CDI = C \times IR \times EF \times ED / BW \times AT}$$

where, CDI = Chronic Daily Intake
C = Media-specific Concentration (e.g., mg/L, mg/m^3, mg/kg)
IR = Intake Rate (e.g., mg/day, m^3/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged - days)

Once an individual is exposed to a hazardous chemical, the body's metabolic processes typically alter the chemical structure of the compound in its efforts to expel the chemical from the system. For example, when compounds are inhaled into the lungs they may be absorbed depending on their size (for particulates) or solubility (for gases and vapors) through the lining of the lungs directly into the blood stream. After absorption, chemicals are distributed in the body and may be metabolized, usually by the liver, into metabolites that may be more toxic than the parent compound. The compound may reach its target tissue, organ, or portion of the body where it will exert an effect, before it is excreted via the kidneys, liver, or lungs. The relative toxicity of a compound is affected by the physical and chemical characteristics of the contaminant, the physical and chemical processes ongoing in the human body and the overall health of an individual. For example, infants, the elderly, and pregnant women are considered more susceptible to certain chemicals.

Chemicals have various types of effects on the body. Generally, when considering human health, chemicals are divided into two broad categories: chemicals that cause health effects but do not cause cancer (noncarcinogens) and chemicals that cause cancer (carcinogens). Note that exposure to some chemicals can result in the manifestation of both noncarcinogenic health effects and an increased risk of cancer.

D.3.1.2 *Chemical Noncarcinogens*

Chemical noncarcinogens are chemicals or compounds that when introduced to the human body via ingestion, inhalation, or dermal absorption may result in a systemic effect if the intake exceeds a level that can be effectively eliminated. For example, a noncarcinogenic chemical or compound may affect the central nervous system, renal (kidney) function, or other systems that have an effect on the body's metabolic processes. They may also cause milder effects such as irritation to the eyes or skin, or asthmatic attacks. The level of the effects are directly related both to the chemical and the level of exposure.

For many noncarcinogenic effects, the body is equipped with protective mechanisms that must be overcome before an adverse effect is manifested from a chronic chemical exposure. For example, where a large number of cells perform the same or similar function, the cell population may have to be significantly depleted before an effect is seen. The body can tolerate a range of exposure where there is essentially no change in expression of adverse effects. This is known as the "threshold" or "nonstochastic" concept and has been observed in multiple animal studies. The results of these animals studies are a set of guidelines that serve as the basis for the development of noncarcinogenic toxicity values. The No Observed Adverse Effect Level (NOAEL) is an estimate of the threshold dose and the Lowest Observed Adverse Effect Level (LOAEL) is the lowest dose where an adverse effect was seen.

The EPA applies uncertainty factors to the NOAEL or LOAEL to obtain the Reference Dose (RfD) for both subchronic and chronic exposures to noncarcinogenic chemicals. These uncertainty factors usually include a factor of 10 for extrapolating effects from animals to humans, 10 for including the most sensitive humans, and another 10 for incomplete data. Chronic RfDs are developed for protection from long-term exposure to a chemical (7 years to a lifetime); subchronic RfDs are used to evaluate short-term exposure (2 weeks to 7 years). In this assessment, only long-term, chronic exposures to contaminants are evaluated. RfDs used in this document were obtained from the EPA's *Integrated Risk Information System* (IRIS) (EPA 1999).

Noncarcinogenic effects are expressed as a comparison of a daily exposure level (chronic daily intake [CDI]) averaged over a specified period of time with an RfD. The ratio of the average daily exposure level of a single toxicant to the RfD for that toxicant is defined as an HQ.

HQ = CDI / RfD or HQ = Air concentration/RfC

where,
HQ = Hazard Quotient
CDI = Chronic Daily Intake
RfD = Noncarcinogenic reference dose
RfC = Noncarcinogenic reference concentration

The sum of more than one HQ for multiple toxicants and/or multiple exposure pathways is called a hazard index (HI). An HQ or an HI $\geq$ 1 is considered unacceptable. Note that because the HI is not a percentage or probability, the level of concern does not necessarily increase linearly as the HI approaches or exceeds unity.

In addition to the RfD, the EPA has calculated a Reference Concentration (RfC) for many chemicals. The RfC is an estimate of a continuous (24 hours per day, 365 days per year for 70 years) inhalation exposure to the human population without appreciable risk of deleterious noncancer effects during a lifetime. The RFC is to be used only under these exposure conditions and is not applicable to varying exposure parameters unless the appropriate corrections are made. The RfC is a chemical-specific concentration expressed in $\mu g/m^3$ that can be directly compared to a measured air concentration without necessitating the calculation of a CDI. Provided the ratio (HQ) of the measured concentration to the RfC is less than or equal to 1.0, no unacceptable adverse health effects are expected.

D.3.1.3 *Chemical Carcinogens*

Over the past century, many chemicals have been identified that cause cancer in humans. Examples of these carcinogens include asbestos in insulation, vinyl chloride in the rubber industry, and benzene in solvents. Cancers caused by industrial chemicals can occur in any organ in the body, including the respiratory tract, bladder, bone marrow, gastrointestinal tract, or liver. Unlike noncancer effects, cancer-causing agents are assumed to have no safe intake or dose levels.

Currently, chemicals are categorized as either confirmed human carcinogens, suspected human carcinogens, or confirmed animal carcinogens. For cancer agents (including all radionuclides), EPA provides toxicity information that can be used to determine the probability that cancer may occur. The toxicity factors used to assess exposures to carcinogens are referred to as cancer slope factors (CSFs). The CSFs represent the slope of the dose-response curve from various toxicity studies. Most of the CSFs for nonradionuclides were developed based on the data from chemical-specific 2-year animal studies.

The CSFs for chemicals are the upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. This slope factor is expressed in units of mg/kg-day. Because the slope factors are the 95th percentile upper confidence limit on the probability of a carcinogenic response, the carcinogenic risk estimate represents an upper confidence bound estimate. Therefore, a 5 percent probability exists that the actual risk will be higher than the estimate presented, and the actual risk may well be less than the estimate. Radionuclide CSFs are central tendency estimates based primarily on measured human data.

Cancer risk from exposure to a chemical or multiple chemicals (including radionuclides) is expressed as an ECR or, stated differently, cancer incurred in addition to normally expected rates of cancer development. The excess cancer risk for carcinogens is calculated by multiplying the calculated intake/dose for each contaminant by the appropriate slope factors.

$$\mathbf{ECR = CDI \times CSF \text{ or } ECR = CDI \times UR}$$

where, ECR = Excess Cancer Risk
CDI = Chronic Daily Intake
CSF = Cancer Slope Factor
UR = Inhalation Unit Risk

This estimate of ECR represents the potential of an individual developing excess cancer over a lifetime, above and beyond the normal, unavoidable incidence of cancer. For example, an excess cancer risk of 1.0×10^{-6} indicates one person in one million is predicted to incur cancer from exposure to this contamination level over a 70-year lifetime.

Consideration is given to exposure to multiple chemicals as well as multiple exposure pathways when calculating the risk of an individual developing cancer. This is accomplished via summing excess cancer risks for each chemical both within a given pathway and across pathways within an exposure scenario. Although chemical concentrations that represent an upper-bound excess lifetime cancer risk to an individual of between $l0^{-4}$ and 10^{-6} are under some circumstances considered acceptable (55 FR 46), risks above 10^{-6} are undesirable. The risk to an individual should not exceed 10^{-4}.

The EPA has derived unit risk factors to evaluate human exposure to chemicals via inhalation. The unit risk is the upper-bound (1.0 x 10^{-6}) excess lifetime cancer risk estimated to result from a continuous (24 hours per day, 365 days per year, for 70 years) exposure to a cancer-causing chemical at a concentration of 1 $\mu g/m^3$. The unit risk factor is to be used only under these exposure conditions and is not applicable to varying exposure parameters unless the appropriate corrections are made.

D.3.2 What are Some Y-12 Sources that May Lead to Chemical Exposure?

Airborne emissions of chemicals used at Y-12 occur as a result of plant production, maintenance, and waste management operations and steam generation. Most process operations are served by ventilation systems that remove air contaminants from the workplace. In 1997, a major effort was expended to prepare Y-12's first major source operating permit application for these sources under Title V of the *Clean Air Act*. Nonradionuclide emissions at Y-12 include chemical processing aids (hydrochloric, sulfuric, and nitric acids), cleaning and cooling aids (methanol), refrigerants (Freon 11, 12, 22, 13, and 502), and emissions from the steam plant (particulates, SO_2, carbon monoxide, volatile organic compounds [VOCs], and NO_2). More than 90 percent of the pollutants emitted from Y-12 are the result of steam plant operations. The level of pollutant emissions from Y-12 is expected to decline in the future because of the changing mission and downsizing of production areas.

Additionally, past operational or accidental releases of contaminants into the surrounding environment serve as on-going sources of potential chemical emissions. In particular, mercury used in the former lithium separation process was released to the storm sewer system and ultimately UEFPC during the period of 1950 to 1982. Although mercury is not presently used in any experimental or manufacturing processes at the Y-12 Plant, small amounts of mercury continue to escape the Y-12 Plant. Outdoor airborne mercury vapor at the Y-12 Plant is primarily the result of vaporization from mercury-contaminated soils and drains, fugitive emissions from former mercury-use area buildings, and releases from coal burning at the Y-12 Steam Plant. Current operational activities at the Y-12 Plant include a Special Materials Mission of which beryllium production operations are a key component. The existing special materials operations facilities are housed in buildings that are from 27 to 50 years old and must rely heavily on administrative controls and personal protective equipment to provide for the protection of workers, the public, and the environment from the hazards associated with beryllium and other special materials. In 1997, compliance tests were conducted to determine the rate of emissions of beryllium from those facilities housing beryllium operations. The results of these tests indicate that no measurable amount of beryllium is released to the atmosphere via the exhaust stacks.

Liquid discharges to surface water are sources for potential transport and migration of chemicals from Y-12. These discharges include process effluents and storm water as permitted under the existing Y-12 NPDES permit, and sanitary wastewater discharged to the City of Oak Ridge POTW under the Industrial and Commercial Users Wastewater Permit Number 1-91. Discharges to surface water allowed under the NPDES permit include storm drainage, cooling water, cooling tower blowdown, and treated process wastewaters, including effluents from wastewater treatment facilities. Sumps that collect groundwater inflow in building basements are also permitted for discharge to the creeks. Both sources are monitored to ensure compliance with existing permitting requirements. NPDES samples are collected and may be analyzed for pH, residual chlorine, oil and grease, ammonia, mercury, total toxic organics, inorganics, and PCBs depending on the outfall permitting requirements. Sanitary wastewater is sampled and analyzed for a variety of inorganic constituents, oil and grease, specified organics (benzene, methylene chloride, toluene, and trichloroethene) and other physical and chemical parameters.

Again, although mercury is not presently used in experimental or manufacturing processes at the Y-12 Plant, small amounts of mercury continue to escape the Y-12 Plant. The foundations of former separation plants and equipment drains and sumps still contain some residual mercury. Rain water and storm drainage have also washed mercury into pipings and building foundations at other locations around Y-12. Trapped in porous spaces along foundations and storm sewer outfalls, mercury continues to dissolve slowly into the water that flows through these conduits. This water flow eventually leads to outfalls and the UEPFC.

Soils and sediments provide another potential source of nonradiological contaminants. Operational and historical information as well as environmental sampling have confirmed the presence of chemical contaminants in both surface and subsurface soils at particular locations within the Y-12 area. In addition, sediment samples collected at in-stream locations and from floodplain areas indicate the presence of mercury and PCBs.

Groundwater is another potential pathway for exposure to hazardous chemicals and provides a means of contaminant transport and migration. A comprehensive groundwater monitoring program is in-place at Y-12 to address all DOE, state, and Federal regulatory requirements relative to groundwater surveillance and monitoring. The primary groundwater contaminants at Y-12 are nitrate, VOCs, trace metals, and radionuclides.

D.3.3 How Does DOE Regulate Chemical Exposures?

D.3.3.1 *Environmental Protection Standards*

DOE Order 5400.1 establishes environmental protection program requirements, authorities, and responsibilities for DOE operations to ensure compliance with applicable Federal, state, and local environmental protection laws and regulations, executive orders, and internal DOE policies. The Order specifically defines the mandatory environmental protection standards (including those imposed by Federal and state statues), establishes reporting of environmental occurrences and periodic routine significant environmental protection information, and provides requirements and guidance for environmental monitoring programs. Applicable Federal and state environmental acts/agreements include:

- RCRA
- CERCLA as amended by the *Superfund Amendments and Reauthorization Act* (SARA)
- *Federal Facility Compliance Agreement*
- *Endangered Species Act*
- *Safe Drinking Water Act*
- *Clean Water Act* (which resulted in the establishment of the NPDES and pretreatment regulations for POTW)
- *Clean Air Act* (Title III, Hazardous Air pollutants Rad-NESHAP, Asbestos NESHAP)
- *Toxic Substances Control Act* (TSCA)
- *Federal Insecticide, Fungicide, and Rodenticide Act*

Many of these acts/agreements include environmental standards that must be met to ensure the protection of the public and the environment. Most of the acts/agreements require completed permit applications in order to treat, store, dispose of, or release contaminants to the environment. The applicable environmental standards and reporting requirements are set forth in the issued permits and must be met to ensure compliance.

The *Emergency Planning and Community Right-To-Know Act*, also referred to as SARA Title III, requires reporting of emergency planning information, hazardous chemical inventories, and environmental releases to federal, state, and local authorities. The annual Toxic Release Inventory Report addresses releases of toxic chemicals into the environment, waste management activities, and pollution prevention activities associated with those chemicals.

D.3.3.2 *Regulated Occupational Exposure Limits*

Occupational limits for hazardous chemicals are regulated by the Occupational Safety and Health Administration (OSHA). The permissible exposure limits (PELs) represent the legal concentration levels set by OSHA that are safe for 8-hour exposures without causing noncancer health effects. Other agencies, including the National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) provide guidelines. The NIOSH guidelines are Recommended Exposure Limits and the ACGIH guides are Threshold Limit Values (TLVs). Occupational limits are further defined as time-weighted averages (TWAs), or concentrations for a conventional 8-hour workday and a 40-hour workweek, to which it is believed nearly all workers may be exposed, day after day, without adverse effects. Often ceiling limits, or airborne concentrations that should not be exceeded during any part of the workday, are also specified. In addition to the TWA and ceiling limit, short-term exposure limits may be set. Short-term exposure limits are 15-minute TWA exposures that should not be exceeded at any time during a workday, even if the 8-hour TWA is within limits. OSHA also uses action levels to trigger certain provisions of a standard, for instance appropriate workplace precautions, training, and medical surveillance, for workers whose exposures could approach the PEL.

D.3.4 Data Sources Used to Evaluate Public Health and Worker Consequences from Routine Operations

Airborne emissions, with the exception of mercury, are represented by modeled concentrations based on the purchases recorded and maintained in the Y-12 Hazardous Materials Inventory System (HMIS) (LMES 1998) and engineering calculations for emissions from the Y-12 Steam Plant. Modeled concentrations of noncarcinogenic and carcinogenic materials both on-site and at the plant boundary were calculated for an MEI and an 8-hour worker exposure. On-site emissions concentrations are not available for the Y-12 Steam Plant because the stack height used in the modeling effort negates the possibility for the modeled plume to disperse prior to the facility boundary. With the exception of mercury, these data are considered representative of emissions of nonradionuclides under current operations at Y-12. Mercury is the only nonradionuclide for which actual air measurements were available.

Outdoor airborne mercury vapor at Y-12 is primarily the result of vaporization from mercury-contaminated soils, fugitive emissions from former mercury-use area buildings, and releases from coal burning at the Y-12 Steam Plant. Four outdoor ambient mercury monitoring stations (boundary stations) are operated at Y-12. A monitoring station is located on the east and west ends of the plant and two stations are located near Building 9201-4, a former lithium isotope separation facility contaminated with mercury. The yearly average concentrations of mercury vapor will be used in lieu of modeled data for this contaminant.

Liquid discharges are represented by both the results of the effluent monitoring conducted to meet the requirements of the NPDES permit and routine surface water surveillance monitoring. The current Y-12 Plant NPDES permit, issued on April 28, 1995, requires sampling, analysis, and reporting at various effluent locations. Currently, the Y-12 Plant has outfalls and monitoring points in the following water drainage areas: EFPC, Bear Creek, and several unnamed tributaries on the south side of Chestnut Ridge that eventually drain to the Clinch River. The environmental surveillance monitoring is conducted as a best management practice and is above and beyond that required by the NPDES permit (DOE 1999c). Environmental surveillance monitoring was conducted in:

- EFPC near the junction of Scarboro and Bear Creek roads. The samples are analyzed for mercury, ammonia-N, inductively coupled plasma metals, and total suspended solids.

- Bear Creek at the western boundary of the Y-12 area of responsibility. Samples are analyzed for mercury, anions (sulfate, chloride, nitrate, nitrite), inductively coupled plasma metals, total phenols, and total suspended solids.

- NPDES location S19 at Rogers Quarry, the exit pathway for Chestnut Ridge regime. This location is an instream location of McCoy Branch and is sampled for inductively coupled plasma metals.

Additionally, a network of real-time monitors is located at in-stream locations along UEFPC and at key points on the storm drain system that flows to the creek. Samples are analyzed for inorganics.

Sediment data were not collected during 1998. As such, the most recent data (DOE 1998c) are presented below in Table D.3.4-1. These data were collected to determine whether mercury and PCBs are accumulating in sediments in EFPC and Bear Creek. Due to the limited number of samples collected (one in each location) and the limited set of analytes, these data are not considered to be representative of the sediment contaminant concentrations for these streams and floodplain areas. No comparison or risk calculations were performed for these sample data. As such, the results of the remedial investigation for the UEFPC Characterization Area (DOE 1998c) are presented as representative of hazards and risks associated with exposure to sediment contaminant concentrations.

TABLE D.3.4–1.—*1998 Results of Y-12 Sediment Monitoring*

Parameter	Station 17	Bear Creek Kilometer 9.4
Mercury (μg/g)	9.5	0.3
Total PCBs (μg/kg)	370 J[a]	350 J

[a] The J flag of the PCB data indicates an estimated value below the analytical method reporting limit.
Source: DOE 1998c.

Soil data are not collected as part of the annual surveillance activities at Y-12. Therefore, data collected and presented in the *Remedial Investigation Report for the Upper East Fork Poplar Creek Characterization Area* (DOE 1998b) are used to summarize the contaminants of concern in both surface and subsurface soils.

A comprehensive groundwater monitoring program is conducted for Y-12 that includes monitoring to comply with requirements of RCRA postclosure regulations, to support CERCLA remedial investigation/feasibility study efforts and records of decision, to comply with TDEC solid waste management regulations, and to support DOE Order 5400.1 requirements. The data from the Y-12 comprehensive groundwater monitoring program was compiled and evaluated in the risk assessment presented in the remedial investigation for the Characterization Area, (DOE 1998d) which was used to evaluate the potential for adverse health effects resulting from worker and public exposure to hazardous chemicals detected in groundwater.

D.3.5 Methodology for Estimating Hazardous Chemical Impacts

Concentrations of airborne hazardous chemicals were modeled for an MEI located at the Y-12 boundary and for a maximally exposed onsite worker. Exposure point concentrations were derived based on purchase data and are considered to be conservative estimates of actual emissions. Exposure assumptions for both the maximally exposed individual and the onsite worker are listed in Table D.3.5-1. Toxicity information (i.e., inhalation reference concentrations and unit risks) for the contaminants of concern as identified in the Air Quality Analysis (see Appendix E) was obtained from IRIS (EPA 1999). This toxicity information was used to calculate HQs and excess lifetime cancer risks for all contaminants of concern.

TABLE D.3.5–1.—*Exposure Assumptions for Evaluation of Risk/Hazard to Workers and the Public*

Parameter	Worker	MEI
Inhalation rate (IR)	20 m^3/day	20 m^3/day
Exposure time (ET)	8 hours/24 hours	24 hours/24 hours
Exposure frequency (EF)	250 days/year	365 days/year
Exposure duration (ED)	40 years	70 years
Body weight (BW)	70 kg	70 kg
Averaging time (AT)-noncarcinogens	ED x 365 days/year	ED x 365 days/year
Averaging time (AT)-carcinogens	70 years x 365 days/year	70 years x 365 days/year

Note: AT - averaging time; BW - body weight;.ED - exposure duration; EF - exposure frequency; ET - exposure time; IR -inhalation rate.

D.3.6 Risk Estimates and Health for Potential Chemical Exposures for the No Action - Status Quo Alternative

Airborne Emissions. The results of the air modeling of purchase data and engineering calculations for the Y-12 Steam Plant are presented in Tables D.3.6-1 through D.3.6-5. The contaminants and associated concentrations to which an onsite worker and an MEI located at the plant boundary might be exposed, based on the modeled purchase data, are listed in Tables D.3.6-1 through D.3.6-4. Modeled concentrations of Y-12 Steam Plant emissions data are listed in Table D.3.6-5 for the maximally exposed individual at the plant boundary. On-site emissions concentrations are not available for the Y-12 Steam Plant because the stack height used in the modeling effort negates the possibility for the modeled plume to disperse prior to the facility boundary. Toxicity values for both noncarcinogenic and carcinogenic exposures were obtained and HQs and excess cancer risks were calculated for the maximally exposed individual of the public and for a maximally exposed onsite worker. The results of these assessments are also presented in Tables D.3.6-1 through D.3.6-5.

TABLE D.3.6–1. —*Y-12 Facility Operations Maximum Boundary Hazardous Air Pollutants Noncarcinogenic Chemical Hazard Quotients*

Chemical	Maximum Boundary Concentration ($\mu g/m^3$)	Inhalation RfC - Chronic (mg/m^3)[a]	Hazard Quotient
Cobalt & Compounds	3.31×10^{-2}	*b*	*c*
Lead Compounds	3.43×10^{-2}	*b*	*c*
Methylene Bisphenyl Isocyanate	9.82×10^{-2}	6.00×10^{-4}	1.64×10^{-1}

[a]Toxicity values were obtained from the EPA's IRIS (EPA 1999).
[b]Toxicity values are not currently available.
[c]Not calculated due to lack of toxicity values.

TABLE D.3.6–2.—*Y-12 Facility Operations Maximum Boundary Hazardous Air Pollutants Carcinogenic Chemical Excess Cancer Risk*

Chemical	Maximum Boundary Concentration ($\mu g/m^3$)	Inhalation Unit Risk $(mg/m^3)^{-1}$[a]	Excess Cancer Risk
Cadmium & Compounds	1.42×10^{-5}	1.8×10^{0}	2.56×10^{-8}

[a]Toxicity values were obtained from the EPA's IRIS (EPA 1999).

The HQs and excess cancer risks for the chemicals and compounds that were determined to be of concern as a result of the air quality screening of purchase data (see Section 5.7.1) are listed in Tables D.3.6-1 through D.3.6-4. Two exposure scenarios were evaluated: maximally exposed individual (residential), and on-site worker (industrial). The hazard quotients and excess cancer risks for contaminant concentrations modeled to the maximally exposed individual of the public were all below levels of concern. Thus, no adverse health impacts to the public are anticipated from exposure to airborne nonradiological contaminants emitted from Y-12 Plant normal operations. The hazard quotient for the on-site worker exposed to the maximum on-site concentration of methylene biphenyl isocyanate was determined to be greater than 1.0. Therefore, methylene biphenyl isocyanate is considered to be a baseline contaminant of concern for on-site workers.

TABLE D.3.6–3.—*Y-12 Facility Operations Maximum On-Site Hazardous Air Pollutants Noncarcinogenic Chemical Hazard Quotients*

Chemical	Maximum On-site Concentration ($\mu g/m^3$)	Inhalation RfD - Chronic (mg/m^3)[a]	Hazard Quotient
Cobalt & Compounds	5.88×10^{1}	*b*	*c*
Lead Compounds	6.10×10^{1}	*b*	*c*
Methylene Bisphenyl Isocyanate	1.75×10^{2}	1.71×10^{-4}	6.68×10^{1}

[a]Toxicity values were obtained from the EPA's IRIS (EPA 1999).
[b]Toxicity values are not currently available.
[c]Not calculated due to lack of toxicity values.

TABLE D.3.6–4.—*Y-12 Facility Operations Maximum On-Site Hazardous Air Pollutants Carcinogenic Chemical Excess Cancer Risks*

Chemical	Maximum On-site Concentration ($\mu g/m^3$)	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$[a]	Excess Cancer Risk
Cadmium & Compounds	2.52×10^{-2}	6.30×10^{0}	5.92×10^{-6}

[a]Toxicity values were obtained from the EPA's IRIS (EPA 1999).

TABLE D.3.6–5.—*Y-12 Steam Plant Maximum Boundary Hazardous Air Pollutant Carcinogenic Chemical Concentrations*

Chemical	Maximum Boundary Concentration (μg/m^3)	Inhalation Unit Risk (mg/m^3)$^{-1}$	Excess Cancer Risk
Arsenic	7.71 x 10^{-5}	4.3 x 10^{0}	3.32 x 10^{-7}
Beryllium	1.16 x 10^{-5}	2.4 x 10^{0}	2.78 x 10^{-8}
Cadmium	1.00 x 10^{-5}	1.8 x 10^{0}	1.8 x 10^{-8}
Nickel	1.85 x 10^{-4}	*b*	*c*

[a]Toxicity values were obtained from the EPA's IRIS (EPA 1999).
[b]Toxicity values are not currently available.
[c]Not calculated due to lack of toxicity values.

Cadmium and compounds under the on-site exposure scenario were also determined to pose an excess cancer risk within the EPA's range of concern and are also considered a baseline contaminant of concern for the on-site worker.

No noncarcinogenic contaminants exceeded the preliminary air quality screening of Y-12 Steam Plant emissions data (Volume I, Chapter 5, Section 5.7). As such, no noncarcinogenic chemicals were included in the evaluation of public exposures. The carcinogenic contaminants and their associated excess cancer risks resulting from Y-12 Steam Plant emissions are presented in Table D.3.6-5. No excess cancer risks were determined to fall within the EPA's range of concern. Thus, no noncarcinogenic or carcinogenic contaminants of concern were determined to be associated with Y-12 Steam Plant emissions.

Average mercury vapor concentrations in 1998 for the four sites currently monitored are comparable to those reported for the last 2 years and are presented in Table D.3.6-6. In 1998, although ambient mercury concentrations at the two monitoring sites near Building 9201-4 were still elevated above natural background, results indicate that concentrations of mercury vapor are well below the ACGIH threshold limit value of 50 μg/m^3 and the EPA reference concentration of 0.3 μg/m^3 for chronic inhalation exposure. Average concentrations at the two boundary monitoring sites located at the east and west ends of Y-12 are comparable to levels measured at the reference site on Chestnut Ridge. The measured mercury vapor concentrations for 1998 are presented in Table D.3.6-6 along with the associated RfC and RfD. HQs were calculated for each location in an effort to demonstrate that the measured concentrations are below (i.e., HQ <1.0) both the threshold for continuous public and occupational exposure. The results indicate that mercury is not a concern for either the public or on-site workers.

Surface Water. More than 500 surface water surveillance samples were collected in 1998. The monitoring locations include:

- Station 17 in EFPC near the junction of Scarboro and Bear Creek Roads
- BCK 4.55 in Bear Creek which is the western boundary of the Y-12 Plant area of responsibility
- NPDES location S19 at Rogers Quarry which is the exit pathway from the Chestnut Ridge hydrologic regime
- Instream locations along the UEPFC and at key points on the storm drain system

TABLE D.3.6–6.—*Mercury Ambient Air Concentrations and Evaluation*

Ambient Mercury Monitoring Stations	1998 Average (mg/m^3)	Regulated Exposure Limits/Risk Factors		Hazard Quotients	
		RfC (mg/m^3)	RfD (mg/kg-d)	Maximally Exposed Individual	Worker 8 hours
Station 2 (east end)	$4.8x10^{-6}$	$3.00x10^{-4}$	$8.57x10^{-5}$	$1.60x10^{-2}$	$3.65x10^{-3}$
Station 8 (west end)	$7.4x10^{-6}$	$3.00x10^{-4}$	$8.57x10^{-5}$	$2.5x10^{-2}$	$5.63x10^{-3}$
Building 9422-13 (SW of Building 9201-4)	$4.4x10^{-5}$	$3.00x10^{-4}$	$8.57x10^{-5}$	$1.47x10^{-1}$	$3.35x10^{-2}$
Building 9805-1 (SE of Building 9201-4)	$5.7x10^{-5}$	$3.00x10^{-4}$	$8.57x10^{-5}$	$1.9x10^{-1}$	$4.34x10^{-2}$
Reference Site, 1988	$6.0x10^{-6}$	$3.00x10^{-4}$	$8.57x10^{-5}$	$2.00x10^{-2}$	$4.57x10^{-3}$
Reference Site, 1989	$5.0x10^{-6}$	$3.00x10^{-4}$	$8.57x10^{-5}$	$1.67x10^{-2}$	$3.81x10^{-3}$

Source: DOE 1998a

Comparisons with Tennessee water quality criteria indicate that only silver, mercury, zinc, and copper from samples, collected at Station 17 were detected at values exceeding a criteria maximum. Results are shown in Table D.3.6-7. Of all the parameters measured in the surface water as a best management practice, mercury is the only demonstrated contaminant of concern.

Table D.3.6–7.— *Surface Water Surveillance Measurements Exceeding Tennessee Water Quality Criteria at the Y-12 Plant, 1998*

Parameter Detected	Number of Samples	Concentration (mg/L)			Water Quality Criteria (mg/L)[a]	Number of Measurements Exceeding Criteria
		Detection Limit	Max	Aver		
Mercury	413	0.0002	0.0191	<0.001	0.00015	408
Silver	148	0.02	<0.02	<0.008	0.0041	1
Copper	148	0.02	0.0388	<0.01	0.0177	13
Zinc	148	0.05	0.15	<0.04	0.117	21

[a] The most restrictive of either the freshwater fish and aquatic life "criterion maximum concentration" or the "Recreation concentration for organisms only" is reported. The comparison is made for information purposes only.
Source: Adapted from DOE 1999c.

Sediment. The UEFPC risk assessment evaluated sediment samples collected both within and outside of the plant boundary. The risk assessment evaluated exposure via three scenarios: industrial, open recreational, and residential. The results for the industrial and open recreational scenario are considered applicable for the purpose of evaluating worker and public exposure in the SWEIS and are presented below.

- No contaminants of concern were identified for sediments within the plant boundary for the industrial receptor. Excess cancer risks in the range of 10^{-5} from PCBs and polycyclic aromatic hydrocarbon (PAHs) were the primary contributors to total risk outside the plant boundary. Cadmium (HI = 0.059) and mercury (HI = 0.043) were the primary contributors to unacceptable hazards for the industrial receptor outside the plant boundary.

- Cadmium (HI = 0.016), mercury (HI = 0.019), and PCB-1254 (HI = 0.075) resulted in unacceptable hazards to the adult under the open recreational land use both inside and outside the plant boundary. No carcinogenic contaminants of concern were identified within the plant boundary. Elevated ECRs outside the plant boundary were primarily from benzo[a]pyrene (ECR = 1.4 x 10^{-4}), several other PAHs with ECRs in the 10^{-5} range, and PCBs (ECR = 2.4x10^{-5}). Risks and hazards to a child receptor were the same as those for the adult.

Soils. The investigation of the UEFPC Characterization Area evaluated both exposure to surface and subsurface soils. Soil samples were aggregated for the eastern plant area, western plant area, central plant area, and outside the plant area. The scenarios evaluated for the three plant areas include an industrial and residential exposure. Residential and open recreational land use scenarios were evaluated for the outside the plant area aggregate. The results for the industrial and open recreational scenario are considered applicable for the purpose of evaluating worker and public exposure in the SWEIS and are presented below.

- *Eastern Plant Aggregate.* Dibenzo[a,h]anthracene (ECR = 1.5 x 10^{-4}), which is a PAH that was the primary contributor to surface soil risk for an industrial receptor.

- *Western Plant Aggregate.* Beryllium (ECR = 1.2 x 10^{-5}) and PCB-1260 (ECR = 1.3 x 10^{-5}) were the primary contributors to the industrial risks.

- *Central Plant Area Aggregate.* Dibenzo[a,h]anthracene (ECR = 3.1 x 10^{-5}) and PCB-1254 (ECR= 3.0 x 10^{-5}) were the primary contributors to industrial risks. PCB-1254 (HQ = 2.1) was the primary contributor to industrial hazards.

- *Outside the Plant Area Aggregate.* PCB-1242 (ECR = 1.2 x 10^{-4}) was the primary contributor to the open recreational land use surface soil risks while PCB-1254 (HI = 2.9) was the primary contributor to hazards.

The risk assessment for the UEFPC Characterization Area also evaluated exposure to subsurface soil (soil at a depth greater than 5 ft). The results indicate that no contaminants of concern were identified for the eastern or central plant area for the industrial receptor. For the western plant area, no noncarcinogenic contaminants of concern were identified. However, beryllium was determined to contribute significantly to the risks in the western plant area subsurface soil.

Groundwater. Exposure point concentrations for groundwater were developed for four exposure unit aggregates based on the geological formations and sampling locations. The aggregates are shallow clastics, intermediate clastics, Maynardville and Copper Ridge exit pathways wells, and offsite wells. Exposure scenarios included incidental ingestion by a worker and residential exposure via ingestion, inhalation, and dermal absorption.

Exposure point concentrations for groundwater were developed in the remedial investigation for UEFPC for four exposure unit aggregates based on the geological formations and sampling locations. Table D.3.6-8 lists the groundwater contaminants for each aggregate that either exceeded an HQ of 1.0 or had an excess cancer risk greater than 10^{-5}. Note that groundwater is not used at Y-12 as a potable water supply. Potential contact with contaminants in groundwater is limited to those individuals who routinely collect groundwater samples for various compliance, surveillance, and remedial investigation activities. These samplers are trained in the appropriate Environmental Safety and Health Procedures, are routinely audited for compliance with health and safety protocols, and are protected under occupational safety and health standards.

TABLE D.3.6–8.—*Groundwater Contaminants of Concern by Aggregate and Scenario*

Aggregate	Industrial Contaminants	
	HQ>1.0	Risk>10^{-5}
Shallow Clastics	Arsenic Nitrate (as N)	Arsenic 1,1-DCE
Intermediate Clastics	1,2-DCE Cadmium Manganese Nitrate (as N)	1,1-DCE Beryllium Carbon tetrachloride Vinyl choride
Exit Pathways	Cadmium Carbon tetrachloride	Benzene Beryllium Carbon tetrachloride Tetrachloroethene Vinyl choride

Source: DOE 1998c.

D.3.7 Summary: Contaminants of Concern for No Action - Status Quo Alternative Operations

Table D.3.7-1 summarizes the potential contaminants of concern for each of the media addressed in the preceding sections. The most prevalent contaminants of concern are mercury, beryllium, PAHs, and PCBs. Mercury is of concern for surface water and sediment. PAHs and PCBs, both of which are relatively insoluble in water, tend to precipitate or adhere to particulates, and are persistent in the environment, are also contaminants of concern for both sediment and soil. Several inorganic constituents (arsenic, beryllium, and manganese) are identified as contaminants of concern for groundwater. The presence of elevated concentrations of these inorganic constituents is attributable to both historical operations at Y-12 and emissions from the Y-12 Steam Plant. VOCs are present primarily as contaminants in groundwater.

Some of the chemicals used at Y-12 are of particular concern due to their extensive use in plant operations, the nature and extent of contamination from past operations, or the potential adverse health effects from exposure to these chemicals. These include mercury, beryllium, PCBs, PAHs and VOCs. Additional information regarding the historical use and current controls to mitigate exposure to these contaminants is discussed in the following text.

D.3.7.1 *Mercury*

Y-12 historically used mercury in the greatest quantity for lithium separation operations in the 1950s and 1960s. Over 20 million pounds of mercury were required for the three lithium production facilities. Releases of mercury occurred over the same time period into the EFPC and into air. The waterborne releases were largely the result of a process where mercury was washed with nitric acid. Most airborne mercury releases were the result of ventilation from the lithium process buildings designed to protect worker health. The Oak Ridge Health Studies mercury project team estimated that more than 280,000 lb of mercury were released into EFPC and over 74,000 lb were released to the air from 1950 to 1993 as a result of the lithium separation work (ChemRisk 1997a).

TABLE D.3.7–1.—*Contaminants of Concern Matrix*

Chemical	Air	Surface Water	Sediment	Soil	Groundwater
Arsenic					X
Benzene					X
Beryllium				X	X
Cadmium	X		X		X
Carbon					X
1,1-					X
1,2-					X
Lead	X				
Manganese					X
Methylene	X				
Mercury		X	X		
Nitrate (as N)					X
PAHs			X	X	
PCBs			X	X	
Tetrachloroethene					X
Vinyl chloride					X

Corrective actions conducted since 1985 by DOE have greatly reduced releases of mercury from former mercury-use facilities. These corrective actions include:

- Storm sewer cleaning and relining
- Storm sewer replacement
- Piping reroutes
- Mercury source removals
- Treatment of mercury-contaminated sump water

In keeping with DOE's priority to protect the public and the environment from dangers related to mercury and other hazardous substances from its sites, the identification and elimination of known mercury sources is an ongoing concern. Efforts continue to further understand the nature of the mercury released to UEFPC. Sources of mercury from surface runoff, erosion of the creek bank and sediments, and from the plant itself are under continual investigation. Experimental approaches and new investigations are currently in progress to assess the feasibility of other corrective actions.

D.3.7.2 *Beryllium*

Since the 1950s, the processing of beryllium metals and alloys has been an important part of the Y-12 mission. Beryllium-containing compounds have been used for research and development, testing, and manufacturing operations at multiple locations throughout the Y-12 Plant. Included in the beryllium operations have been melting and molding, grinding, and machine tooling of parts. Worker exposures have been through inhalation of beryllium dust or particles.

Y-12 implemented a Chronic Beryllium Disease Prevention Program in response to DOE requirements in DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*. Chronic beryllium disease is a disease of the lungs caused by the body's reaction to inhaled beryllium dust or fumes. The Y-12 prevention program was designed to reduce the number of workers exposed to beryllium, minimize the levels of exposure, and establish medical surveillance procedures to identify workers with early stages of chronic beryllium disease. The Department of Energy published a final rule to establish the Chronic Beryllium Disease Prevention Program in the *Federal Register* on Wednesday, December 8, 1999. This new rule became effective on January 7, 2000. The new rule has incorporated a revised action level of 0.2 $\mu g/m^3$ that corresponds to the new TWA proposed by the ACGIH.

To evaluate the beryllium-contaminated areas and to protect worker health, the Y-12 Industrial Hygiene Department has developed a sampling and analysis plan to identify the areas within the plant where beryllium was once used. Approximately 300 legacy areas were identified in 39 buildings. These beryllium legacy areas were defined to protect the workers at risk, including beryllium-sensitized individuals, to provide data for modernization projects and to reduce the number of beryllium-contaminated areas.

Ongoing activities at Y-12, in addition to the identification of beryllium legacy areas, include

- Initial and periodic exposure monitoring (currently includes monitoring of all beryllium workers)
- Hazard assessment
- Posting of beryllium work areas
- Medical Surveillance, Respiratory Protection
- Training
- Counseling for the sensitized workers
- Warning signs
- Waste disposal

D.3.7.3 *Polychlorinated Biphenyls*

The largest use of PCBs at Y-12 has been in the electrical systems (including transformers and capacitors), as PCB-containing cutting oils for the machining of enriched uranium, and in the electromagnetic separation process cooling system (Z-oil system). In addition, PCBs were used in the hydraulic systems throughout the plant (Chem Risk 1997b). Y-12 manages PCBs in accordance with state and federal regulations, LMES policies and procedures, and Y-12 Site Standards. These regulations include the strict control of the use, storage, disposal, decontamination, transport and spill clean-up of PCB-containing materials.

D.3.7.4 *Polycyclic Aromatic Hydrocarbons*

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of chemicals that are formed during the incomplete combustion of wood and fuel, including coal, oil, gas, and other organic substances. Exposure to PAHs may occur via inhalation, ingestion, and dermal contact. In any medium, PAHs most often exist as complex mixtures of compounds, and these compounds have been divided into carcinogenic and noncarcinogenic PAHs.

Carcinogenic PAHs	Noncarinogenic PAHs
benzo[a]pyrene	acenaphthene
benzo[a]anthracene	acenaphthylene
benzo[b]fluoranthene	anthracene
benzo[k]fluoranthene	benzo[g,h,i]perylene
chrysene	fluoranthene
dibenzo[a,h]anthracene	fluorene
indeno[1,2,3-cd]pyrene	methylnaphthalene
	naphthalene
	phenanthrene
	pyrene

PAHs detected in environmental media at Y-12 are believed to be associated mainly with the burning of coal at the Y-12 Steam Plant. Other potential Y-12 sources include accidental releases of various organic substances and/or gas and oil.

D.3.7.5 *Volatile Organic Compounds*

Volatile Organic Compounds (VOCs) detected at Y-12 that are of concern to human health are benzene, carbon tetrachloride, 1,1-dichloroethene, 1,2-dichloroethene, tetrachloroethene, and vinyl chloride. The majority of these compounds were historically used as solvents or degreasers at Y-12. Several are components of compounds used in the paint shops. Note that most of these compounds are no longer used at the facility and have been replaced by safer products. In addition, all chemicals purchased for use at the facility are now inventoried and their use is closely supervised under existing Industrial Hygiene and Environmental Safety and Health protocols.

D.3.8 Risk Estimates for Potential Chemical Exposures for HEU Storage Mission and Special Materials Mission Alternatives

The additional proposed actions under consideration in this SWEIS include: HEU Storage Mission Alternatives, and the Special Materials Mission Alternative. Each of these actions will be discussed in the following subsections relative to their respective impact on the risk estimates for potential radiation exposure to the public.

D.3.8.1 *Alternative 1B (No Action - Planning Basis Operations Alternative)*

No Action - Planning Basis Operations Alternative does not include the construction or significant upgrade/expansion of any new or existing DP facilities. The Y-12 Plant would continue to use the existing storage facilities and the existing special materials operation facilities to perform the HEU Storage Mission and the Special Materials Mission, respectively. Under the No Action - Planning Basis Operations Alternative, the major production activities during the 2001-2010 time period will involve weapons production, weapons dismantlement, quality evaluation, special production, and enriched uranium recovery.

Nonradiological airborne discharges from Y-12 mission facilities under No Action - Planning Basis Operations Alternative consist of those criteria and chemical pollutant emissions from the Y-12 Steam Plant and chemical emissions from Y-12 operations. No adverse direct or indirect air quality inputs are expected from normal operations associated with the continuation of Y-12 missions under No Action - Planning Basis Operations Alternative (see Section 5.7).

In 1987, 12 perimeter ambient air monitors were operated at the Y-12 Plant. Uranium, fluoride, SO_2, and total suspended particulates data were collected. The results of this monitoring are presented and summarized in the report *Environmental Surveillance of the U.S. Department of Energy Oak Ridge Reservation and Surrounding Environs During 1987* (MMES 1988). Fluoride and SO_2 concentrations were below all applicable state standards. Total suspended particulates did exceed state standards four times during 1987, but this was attributed to road dust in the area of the station before its relocation. Mercury was not monitored at these ambient air stations in 1987.

Available surface water historical data for the release of chemical contaminants as a result of process operations are limited to the reported NPDES monitoring data in the above mentioned report. In general, the data are reported as either less than or greater than the detection/reporting limits and actual measurements are not readily available. In addition, the sampling locations were monitored for primarily inorganic constituents and physical characteristics (i.e., temperature, turbidity, pH, etc.). The other compounding factors in using the historical data are that waste process treatment facilities have been upgraded and improved during the subsequent years and administrative and engineering controls have improved. Lastly, increased production and recovery operations during the 2001-2010 time period are not expected to result in any increased release of chemical contaminants to the environment compared to current operations. Therefore, the data for the 1998 baseline is considered representative for No Action - Status Quo Alternative.

D.3.8.2 *Highly Enriched Uranium Storage Mission Alternatives*

There are three proposed alternatives for the HEU Storage Mission at Y-12: No Action - Planning Basis Operations Alternative, Alternative 2A (Construction and Operation of a New HEU Materials Facility), and Alternative 2B (Upgrade Expansion to existing Building 9215) (see Volume I, Chapter 3). The emission data for No Action - Planning Basis Operations Alternative is assumed to include all the emissions from the storage of HEU in existing facilities. The impacts associated with the criteria and toxic pollutants presented would be the same as described for Alternative 2B (No Action - Status Quo Alternative) environmental consequences. Similarly, chemical emissions are considered to be the same as those for No Action- Status Quo Alternative (1998 baseline). Contributions from the current HEU Storage Mission facilities are reflected in the emissions from the Y-12 Steam Plant which supplies steam to the facilities (see Section 5.7). In addition, the environmental emissions for the HEU Storage Mission Alternatives are expected to be at or below the current levels due to administrative and engineered controls. Risks to the public from environmental emissions would remain the same or below those presented in Section D.2.5.1 for Alternative 1B (No Action - Planning Basis Operations Alternative).

D.3.8.3 *Special Materials Mission Alternatives*

There are two proposed alternatives for the Special Materials Mission at Y-12: No Action - Planning Basis Operations Alternative, Alternative 3A (Construction and Operation of a new Special Materials Complex) (see Chapter 3). Under No Action - Planning Basis Operations Alternative the Special Materials Complex would not be constructed. The Y-12 Plant would continue to use the existing special materials operations facilities and the chemical impacts to the public would remain the same as under Alternative 1B (No Action - Planning Basis Operations Alternative) discussed in Section D.2.5.1.

No criteria pollutant emissions would be generated from the new Special Materials Complex facilities. Chemical emissions with the exception of beryllium are considered to be the same as those in the 1998 baseline as the activities to be undertaken will not change only the location at which these activities are completed will change. Additional steam generation for heating requirements at the new complex would be off-set by a reduction in heating requirements of the old facilities.

The construction of the New Special Materials Complex includes a new Beryllium Facility. The transfer of beryllium operations to the new facility would result in a positive impact by reducing emissions at the Y-12 Plant. The new Beryllium Facility would be equipped with a 99.5 percent pre-filtration system through which process exhausts would be filtered prior to passing through a high-efficiency particulate air (HEPA) filtration system and subsequent exhausting through the building stacks. The new filtration system is estimated to reduce current baseline emissions of beryllium by 90 percent (LMES 2000c).

D.4 IMPACTS TO WORKER SAFETY

Y-12 worker risks from radiation and chemical hazards are closely controlled by health and safety requirements. In addition to these risks, workers at Y-12 have the potential for industrial accidents, injuries, and illnesses due to everyday operations. Due to these potential impacts, injury and illness rates are included in this SWEIS.

The Safety Program at Y-12 encompasses the DOE Orders described below and implements the Integrated Safety Management System as the facility safety structure. The objective of the Integrated Safety Management System is to provide a safe workplace to perform work safely while protecting the worker, the public, and the environment. Integrated Safety Management System principles include the line management responsibility for safety, clear lines of authority for ensuring safety, input and support from all workers, and the effective hazard controls to ensure the safety of work.

D.4.1 Department of Energy Regulation of Worker Safety

DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees,* regulates the health and safety of workers at all DOE sites. This comprehensive standard directs the contractor facilities to establish the framework for an effective worker protection program that will reduce or prevent injuries, illnesses, and accidental losses by providing DOE Federal and contractor workers with a safe and healthful workplace. Baseline exposure assessments are outlined in this requirement, along with day-by-day health and safety responsibilities.

Industrial hygiene limits for occupational chemical exposures at federal sites are regulated by 29 CFR 1910 and 29 CFR 1926, *Occupational Safety and Health Standards*, including the PELs set by OSHA. DOE requires that all sites comply with the PELs unless a lower limit (more protective) exists in the ACGIH TLVs.

The Y-12 Safety Program conducts investigations of plant accidents according to DOE Order 225.1A, *Accident Investigations,* and reports work-related fatalities, injuries, and illnesses according to DOE Order 231.1, *Environment, Safety and Health Reporting*.

D.4.2 Y-12 Injury/Illness Rates

The Y-12 worker nonfatal injury/illness rates presented in Table D.4.2-1 were used to calculate the 4-year average (1995-1998) injury/illness rate for 100 workers (or 200,000 hours). The average 4-year injury/illness rate and the 4-year average Y-12 worker population size were then used to calculate the total number of Y-12 worker nonfatal injury/illness per year for the entire Y-12 workforce under the No Action - Planning Basis Operations Alternative. It was assumed that the 4-year average rate would remain constant.

TABLE D.4.2–1.—*Y-12 Four-Year Average (1995-1998) Illness/Injury Rate per 100 Workers*

Data Items	1995	1996	1997	1998	4-Year Average
Annual Y-12 Worker Population	5,777	5,034	5,034	5,105	5,238
Annual Y-12 Nonfatal Occupational Injury/Illness Rate	8.03	9.14	9.53	7.68	8.58

Source: LMES 1999.

The estimated Y-12 worker population under each alternative was multiplied by the 4-year averaged nonfatal injury/illness rate (per 100 workers) to obtain the total number of nonfatal injuries/illnesses per year for the entire Y-12 workforce for each alternative (Table D.4.2-2).

TABLE D.4.2–2.—*Calculated Nonfatal Injuries/Illnesses per Year for Y-12 Workforce by Alternative*

Data Items	4-Year Average	No Action - Status Quo Alternative	No Action - Planning Basis Operations Alternative
Y-12 Worker Population	5,238	5,105	5,128[a]
Y-12 Nonfatal Occupational Injury/Illness (per 100 workers) 4-year average (1995-98)	8.58	8.58	8.58
Total Number of Nonfatal Occupational Injuries/Illnesses for the Y-12 Workforce	449	438	440

[a]Worker population is assumed to remain the same as the current level of 5,128.

D.5 PUBLIC HEALTH DATA PROFILES

The supplemental information in this section provides the context for the human health analysis and epidemiologic studies presented in this SWEIS. The following sections provide public health profiles pertaining to cancer incidence rates and mortalities for the United States, Tennessee, Anderson County, and Roane County, along with definitions necessary for the interpretation of results.

D.5.1 Definition of Terms used in Health and Epidemiologic Studies

Standardization: A statistical method to remove the effects of differences in age, gender, or other characteristics when comparing two or more population groups.

Standardized Mortality Ratio (SMR): The ratio of the number of deaths observed in a study population to the number that would be expected. Usually, the expected number of deaths is based on the U. S. or State of Tennessee (reference) population for these studies. The risk of death in the study group is the same as the risk in the reference group if the SMR is 1. The study population is at greater risk of death than the reference group if the SMR is greater than 1, and at less risk if the SMR is less than one.

Confidence Interval: A range around a variable, (e.g., rate) constructed so that this range has a specified probability of including the true value of the variable.

D.5.2 Public Health in the United States

According to the Centers for Disease Control (CDC 1999) the age-adjusted death rate (these rates are age-adjusted to eliminate the distorting effects of the aging population) for the United States in 1997 was the lowest on record, 479.1 deaths per 100,000 U.S. population. While death rates have been declining for the past 20 years, the leading causes of death in the U.S. have remained fairly consistent. Heart disease remains the number one cause of death, followed by cancer and strokes.

Life expectancy at birth for 1997 reached a record high of 76.5 years, an increase of 0.4 year compared with life expectancy in 1996. This is attributed to a decline in deaths from AIDS, heart disease, cancer, stroke, and homicide.

Table D.5.2-1 shows the leading causes of death and the age-adjusted death rates per 100,000 U.S. population for the year 1997 along with the percent change since 1979.

TABLE D.5.2–1.—*Age-Adjusted Mortality Rates*

Cause of Death	Age-adjusted Death Rate of 1997	Percent of Total Deaths (1997)	Percent Change Since 1979
Heart disease	130.5	31.4	-34.6
Cancer	125.6	23.3	-4.0
Stroke	25.9	6.9	-37.7
Chronic obstructive pulmonary disease	21.1	4.7	44.5
Accidents	30.1	4.1	-29.8
Pneumonia and influenza	12.9	3.7	15.2
Diabetes mellitus	13.5	2.7	37.8
Suicide	10.6	1.3	-9.4
Nephritis	4.4	1.1	2.3
Chronic liver disease and cirrhosis	7.4	1.1	-38.3

Source: CDC 1999.

For the first time in many years, the incidence and death rates for cancer in the United States have declined. A collaborative report from the American Cancer Society, National Cancer Institute, and CDC (CDC 1998) announced the downshift. The report used cancer incidence data from the CDC's Surveillance, Epidemiology and End Results program and mortality data from the CDC's National Center for Health Statistics.

Before the release of the new data, cancer incidence and death rates had shown a steady increase for 20 years. Incidence rates, or rates of new cancers, increased 1.2 percent per year from 1973 to 1990 and then started a downward trend, averaging a decline of 0.7 percent per year from 1990 to 1995.

The four leading cancers reported during 1990-1995 were lung, prostate, breast, and colon, accounting for over half of the newly diagnosed cancers. These four sites were also the top causes of cancer death. Lung cancer incidence and deaths are continuing to rise for women, largely attributed to the increase in smoking among women. This is in contrast to the lung cancer rates in men, which rose sharply from 1940 to1990, but have been declining over the past 10 years with the decline in cigarette smoking.

D.5.3 Comparison of U. S. and Tennessee Cancer Rates

Tennessee has a higher mortality rate for lung cancer and prostate cancer than the United States as a whole (Table D.5.3-1). Tennessee ranks 12^{th} highest overall in cancer mortality rates among the 50 states and

Washington, D.C. (CDC 1998). Age-adjusted cancer death rates have declined in Tennessee over the past 5 years, following the pattern for the United States as a whole.

TABLE D.5.3–1.—*Average Annual Age-adjusted Mortality Rates for Cancer-related Deaths per 100,000 Persons, 1991-1995*

Type of cancer	Tennessee	National
Lung	59.4	49.8
Breast	25.7	26.0
Colorectal	17.6	17.8
Prostate	26.9	26.1

Source: CDC 1998.

D.5.4 Anderson and Roane County Cancer Rates

The following cancer incidence and mortality data are included to augment the epidemiologic studies and reflect the cancers of concern in the reported studies. The data presented in Tables D.5.4-1 through D.5.4-6 are compiled by the Tennessee Cancer Registry, Tennessee Department of Health. The Tennessee population data is provided from the U.S. Bureau Census. Four year age-adjusted rates were used to compare Anderson and Roane Counties to the Tennessee rates. The U.S. rates are not compared in this data profile since national population data differs from that compiled by the State of Tennessee.

According to the CDC, the prostate-specific antigen test for prostate cancer was introduced in the late 1980s and early 1990s and caused an increase in the diagnoses of previously undetected prostate cancers. The CDC projects that since these prevalent cancers have been detected, the rate may be dropping to an equilibrium that more represents the actual incidence.

TABLE D.5.4–1.—*1989-1992 Age-adjusted[a] Cancer Mortality Rates with 95 Percent Confidence Interval (CI) and Number of Cases[b]*

Site		Anderson Co.	Roane Co.	Tennessee
Female Breast	**Rate**	16.7	14.3	24.5
	No. Cases	40	19	3,169
	95 percent CI	11.4-22.1	7.8-20.9	23.7-25.4
Leukemias	**Rate**	6.7	5.0	6.0
	No. Cases	26	12	1,443
	95 percent CI	4.0-9.3	2.1-7.8	5.7-6.3
Lung	**Rate**	52.6	64.2	56.5
	No. Cases	196	169	12,813
	95 percent CI	45.1-60.1	54.4-73.9	55.5-57.5
Nervous System	**Rate**	4.7	6.1	5.0
	No. Cases	15	15	1,096
	95 percent CI	2.2-7.1	3.0-9.3	4.7-5.3
Non-Hodgkins Lymphomas	**Rate**	6.3	8.4	5.9
	No. Cases	24	24	1,417
	95 percent CI	3.8-8.9	5.0-11.8	5.6-6.2
Myelomas	**Rate**	3.0	2.9	3.4
	No. Cases	12	8	812
	95 percent CI	1.3-4.7	0.9-5.0	3.1-3.6
Prostate	**Rate**	24.6	19.0	26.1
	No. Cases	37	19	2,507
	95 percent CI	16.5-32.6	10.3-27.7	25.1-27.2
Thyroid	**Rate**	0.6	-	0.3
	No. Cases	2	-	77
	95 percent CI	-0.2-1.4	-	0.2-0.4
Total Cancer Mortality	**Rate**	160.8	166.1	172.2
	No. Cases	620	440	40,493
	95 percent CI	147.9-173.7	150.4-181.8	170.5-173.9

[a]Age-adjustment methodology adjusts to the 1970 U.S. standard population.
[b]Data are as reported to the Tennessee Department of Health, Health Statistics and Research, Nashville, TN.
Source: CDC 1998.

TABLE D.5.4–2.—*1993-1996 Age-adjusted[a] Cancer Mortality Rates with 95 Percent Confidence Interval (CI) and Number of Cases[b]*

Site		Anderson Co.	Roane Co.	Tennessee
Female Breast	**Rate**	19.3	22.3	25.0
	No. Cases	46	34	3,576
	95 percent CI	13.4-25.1	14.6-29.9	24.1-25.8
Leukemias	**Rate**	6.3	8.0	6.3
	No. Cases	28	24	1,655
	95 percent CI	3.9-8.7	4.7-11.2	6.0-6.6
Lung	**Rate**	62.7	67.6	58.9
	No. Cases	258	195	14,601
	95 percent CI	54.9-70.5	58.0-77.2	57.9-59.8
Nervous System	**Rate**	7.8	3.2	5.0
	No. Cases	27	8	1,188
	95 percent CI	4.7-10.9	0.9-5.6	4.7-5.3
Non-Hodgkins Lymphomas	**Rate**	4.7	6.1	6.7
	No. Cases	23	17	1,759
	95 percent CI	2.8-6.7	3.2-9.1	6.4-7.0
Myelomas	**Rate**	4.4	2.7	3.4
	No. Cases	18	8	902
	95 percent CI	2.3-6.5	0.8-4.5	3.2-3.6
Prostate	**Rate**	24.5	21.1	26.3
	No. Cases	41	26	2,748
	95 percent CI	16.9-32.0	12.9-29.2	25.3-27.3
Thyroid	**Rate**	1.1	-	0.3
	No. Cases	5	-	86
	95 percent CI	0.1-2.2	-	0.2-0.4
Total Cancer Mortality	**Rate**	175.5	171.7	177.7
	No. Cases	738	503	45,723
	95 percent CI	162.6-188.5	156.4-186.9	176.1-179.4

[a]Age-adjustment methodology adjusts to the 1970 U.S. standard population.
[b]Data are as reported to the Tennessee Department of Health, Health Statistics and Research, Nashville, TN.
Source: CDC 1998.

TABLE D.5.4–3.—*1989-1992 Age-adjusted[a] Cancer Incidence Rates 95 Percent Confidence Interval (CI) and Number of Cases[b]*

Site		Anderson Co.	Roane Co.	Tennessee
Female Breast	**Rate**	110.1	74.0	85.4
	No. Cases	216	104	10,636
	95 percent CI	94.9-125.2	59.4-88.6	83.7-87.1
Leukemias	**Rate**	6.9	8.5	6.2
	No. Cases	25	18	1,366
	95 percent CI	4.0-9.7	4.4-12.6	5.9-6.6
Lung	**Rate**	68.9	74.7	58.5
	No. Cases	258	195	13,104
	95 percent CI	60.3-77.4	64.1-85.3	57.5-59.5
Nervous System	**Rate**	8.0	5.5	5.9
	No. Cases	25	12	1,232
	95 percent CI	4.7-11.2	2.3-8.7	5.6-6.3
Non-Hodgkins Lymphomas	**Rate**	11.5	11.0	10.9
	No. Cases	43	28	2,482
	95 percent CI	8.0-15.0	6.9-15.2	10.4-11.3
Myelomas	**Rate**	3.8	4.3	3.2
	No. Cases	15	11	742
	95 percent CI	1.9-5.8	1.7-6.8	2.9-3.4
Prostate	**Rate**	153.5	104.7	95.8
	No. Cases	248	119	9,314
	95 percent CI	134.2-172.9	85.7-123.6	93.9-97.8
Thyroid	**Rate**	1.1	0.4	1.7
	No. Cases	3	1	392
	95 percent CI	-0.2-2.5	-0.4-1.2	1.6-1.9
Total Incidence	**Rate**	394.3	349.3	317.3
	No. Cases	1,474	904	72,839
	95 percent CI	373.7-414.8	326.2-372.3	315.0-319.7

[a]Age-adjustment methodology adjusts to the 1970 U.S. standard population.
[b]Data are as reported to the Tennessee Department of Health Cancer Registry, Nashville, TN.
Source: CDC 1998.

TABLE D.5.4–4.—*1993-1996 Age-adjusted[a] Cancer Incidence Rates with 95 Percent Confidence Interval (CI) and Number of Cases[b]*

Site		Anderson Co.	Roane Co.	Tennessee
Female Breast	**Rate**	96.8	81.0	93.3
	No. Cases	204	124	12,659
	95 percent CI	83.1-110.6	66.4-95.7	91.6-94.9
Leukemias	**Rate**	5.4	6.2	7.1
	No. Cases	20	15	1,674
	95 percent CI	2.9-7.9	2.9-9.6	6.7-7.4
Lung	**Rate**	72.1	70.9	64.4
	No. Cases	288	204	15,681
	95 percent CI	63.7-80.6	61.1-80.7	63.4-65.4
Nervous System	**Rate**	6.7	4.2	6.2
	No. Cases	22	10	1,394
	95 percent CI	3.7-9.6	1.4-6.9	5.8-6.5
Non-Hodgkins Lymphomas	**Rate**	9.5	9.6	11.6
	No. Cases	39	23	2,885
	95 percent CI	6.4-12.6	5.5-13.7	11.2-12.1
Myelomas	**Rate**	4.3	3.3	3.6
	No. Cases	17	10	916
	95 percent CI	2.2-6.4	1.2-5.4	3.4-3.9
Prostate	**Rate**	100.6	86.1	93.2
	No. Cases	170	110	9,674
	95 percent CI	85.4-115.7	70.0-102.3	91.3-95.1
Thyroid	**Rate**	5.8	5.1	3.6
	No. Cases	21	13	868
	95 percent CI	3.3-8.3	2.3-7.8	3.4-3.9
Total Incidence	**Rate**	345.1	328.6	335.2
	No. Cases	1,367	921	82,730
	95 percent CI	326.4-363.8	306.9-350.3	332.9-337.5

[a]Age-adjustment methodology adjusts to the 1970 U.S. standard population.
[b]Data are as reported to the Tennessee Department of Health Cancer Registry, Nashville, TN.
Source: CDC 1998.

TABLE D.5.4–5.—*Four-Year Average Age-specific Childhood Cancer Mortality for Tennessee Residents*

		Age Group (1989 - 1992)				
County		**00-04**	**05-09**	**10-14**	**15-19**	**Total**
Anderson	Cases	2	3	0	2	7
	Population	17,072	18,717	18,970	18,740	73,499
	Age-Specific Rate	11.72	16.03	0.00	10.67	9.52
Roane	Cases	0	1	0	1	2
	Population	10,744	12,085	13,410	14,012	50,251
	Age-Specific Rate	0.00	8.27	0.00	7.14	3.98
Total	Cases	52	70	68	79	269
	Population	1,349,134	1,367,900	1,372,540	1,474,378	5,563,952
	Age-Specific Rate	3.85	5.12	4.95	5.36	4.83

Four-Year Average Age-specific Childhood Cancer Mortality for Tennessee Residents

		Age Group (1993 - 1996)				
County		**00-04**	**05-09**	**10-14**	**15-19**	**Total**
Anderson	Cases	0	1	2	2	5
	Population	17,829	19,578	19,406	18,758	75,571
	Age-Specific Rate	0.00	5.11	10.31	10.66	6.62
Roane	Cases	0	0	0	0	0
	Population	10,829	12,090	13,194	13,411	49,524
	Age-Specific Rate	0.00	0.00	0.00	0.00	0.00
Total	Cases	60	62	52	86	260
	Population	1,441,383	1,469,146	1,448,870	1,497,132	5,856,531
	Age-Specific Rate	4.16	4.22	3.59	5.74	4.44

Note: As reported to the Tennessee Department of Health Cancer Registry, Nashville, TN.
Source: CDC 1998

TABLE D.5.4–6.—*Four-Year Average Age-specific Childhood Cancer Incidence for Tennessee Residents*

		Age Group (1989 - 1992)				
County		**00-04**	**05-09**	**10-14**	**15-19**	**Total**
Anderson	Cases	4	1	2	1	8
	Population	17,072	18,717	18,970	18,740	73,499
	Age-Specific Rate	23.43	5.34	10.54	5.34	10.88
Roane	Cases	1	1	1	1	4
	Population	10,744	12,085	13,410	14,012	50,251
	Age-Specific Rate	9.31	8.27	7.46	7.14	7.96
Total	Cases	273	168	128	239	808
	Population	1,349,134	1,367,900	1,372,540	1,474,378	5,563,952
	Age-Specific Rate	20.24	12.28	9.33	16.21	14.52

Four-Year Average Age-specific Childhood Cancer Incidence for Tennessee Residents

		Age Group (1993 - 1996)				
County		**00-04**	**05-09**	**10-14**	**15-19**	**Total**
Anderson	Cases	0	4	2	3	9
	Population	17,829	19,578	19,406	18,758	75,571
	Age-Specific Rate	0.00	20.43	10.31	15.99	11.91
Roane	Cases	2	3	0	4	9
	Population	10,829	12,090	13,194	13,411	49,524
	Age-Specific Rate	18.47	24.81	0.00	29.83	18.17
Total	Cases	275	165	149	253	842
	Population	1,441,383	1,469,146	1,448,870	1,497,132	5,856,531
	Age-Specific Rate	19.08	11.23	10.28	16.90	14.38

Note: As reported to the Tennessee Cancer Reporting System.
Source: CDC 1998

D.6 EPIDEMIOLOGIC STUDIES

Several epidemiologic studies have been completed on Y-12 workers to evaluate potential health effects from radiation and chemical exposures. Y-12 workers have also been included in many site-wide Oak Ridge Operations (ORO) health studies. In addition to these reviews, community-wide health patterns have been studied in Anderson and Roane Counties. A synopsis of many of these studies is presented in this section.

D.6.1 Background

Epidemiology is the study of the distribution and determinants of disease in a population. In epidemiologic studies, the distribution of disease is considered in relation to time, place, and person. Populations may be characterized by age, race, and gender distributions, as well as by social characteristics related to health (e.g., income and education), occupation, susceptibility to disease, and exposure to specific agents. Determinants of disease include the causes of disease, and factors that influence the risk of disease. Epidemiologic studies often lead to an understanding of the causes of disease.

The study of the health effects associated with ionizing radiation was first published in the 1930s to evaluate the incidence of cancer among painters who had used radium to paint watch dials from 1910 to 1920. The research and manufacture of nuclear weapons and subsequent radiation exposure occurred beginning in the late 1930s. Since that time, because of the concern with potential adverse health effects, numerous epidemiologic studies have been conducted among workers involved in the manufacture and testing of nuclear weapons. More recently, concerns about the effects of radiological contaminants on public health have resulted in health studies among communities that surround DOE facilities.

D.6.2 Types of Epidemiologic Studies

Ecological Studies. Ecological studies compare associations between people living in geographical areas with disease frequency. A group of people, rather than the individual, is the unit of comparison. Groups can be chosen by neighborhood, city, county, or region where demographic information and incidence and mortality data are available. The differences in the rates of disease between geographical areas can be correlated to certain distinct factors, such as the proximity to a paper factory. An example of an ecological study is the comparison of lung cancer mortality rates among communities with respect to distance from chemical industries.

The major disadvantage of ecological studies is that the measure of exposure is based on the average level of exposure in the community, when what is really of interest is each individual's exposure. Ecological studies do not take into account other factors such as age, race, and individual behaviors that may also be related to disease. As such, these types of studies may lead to incorrect conclusions. For example, the cause of lung cancer in the example above may be explained by a higher percentage of cigarette smoking among individuals in a community with the chemical industries rather than the industrial pollutants themselves. These incorrect conclusions are called an "ecologic fallacy." Due to these limitations, ecological studies are helpful only as initial steps in an investigation to determine the cause of disease.

Cohort Studies. Cohort studies include an identified population that can be classified as being exposed or not exposed to an agent of interest. Occupational studies fit well with a cohort study because workers have an individual work history which can provide the data on exposure for the pattern of disease (or mortality) of interest. Characterization of the exposure may be qualitative (e.g., high, low, or no exposure) or very quantitative (e.g., chemicals in milligrams per cubic meter [mg/m^3]). Job titles and area measurements are often used to estimate exposure in the absence of personal data.

In the cohort study, individuals are tracked for a period of time, and cause of death recorded. In general, overall rates of death and cause-specific rates of death have been assessed for workers at Y-12, and data sources are available from the DOE Comprehensive Epidemiologic Data Resource (CEDR) Program (CEDR 2000). Death rates for the exposed population are compared with death rates of workers who did not have the exposure (internal comparison), or they are compared with expected death rates based on the U.S. population or state death rates (external comparison). If the death rates vary from what is expected, an association is said to exist between the disease and exposure.

Most cohort studies at Y-12 have been historical cohort studies or studies of past exposures. This type of study can be a problem if the exposure records are incomplete. Y-12 studies often have used internal and external estimates of radiation exposure by job classification to approximate missing exposure data. Cohort studies require extremely large populations and are expensive to conduct. While they are not appropriate for studying rare diseases, they may, however, provide a direct estimate of the risk of death from a specific disease and allow an investigator to evaluate many disease end points.

Case-Control Studies. Case-control studies begin with the identification of individuals with a disease (cases) and match them with individuals without the disease (controls). The choice of controls is important, because they must be individuals who are at risk for the disease and are representative of the population that generated the cases. Cases and controls are then compared by the proportion of individuals exposed to the agent of interest. Case-control studies are also called "retrospective studies" because they start with people with the disease and look back in their history for exposure. These studies are well suited for rare disease and are generally used to examine the relationship between a specific disease and exposure.

D.6.3 Community Health Studies

D.6.3.1 *Oak Ridge Health Studies*

The State of Tennessee and DOE signed an agreement in July 1991, allowing the Tennessee Department of Health to sponsor the Oak Ridge Health Studies. An independent group was formed to identify the important historical materials and emission sources from the Oak Ridge sites and to identify any adverse health effects caused by these materials to the surrounding communities. To provide direction and to ensure the independence of the studies, the Oak Ridge Health Agreement Steering Panel was formed, including a panel of experts and local citizens. Project oversight was provided through the Tennessee Department of Health.

A dose reconstruction feasibility study (Phase I) was initiated in 1992 and the contract was awarded to ChemRisk by the State of Tennessee. They reviewed documents and concluded that there was enough information available to reconstruct past releases and offsite doses caused by radioactive and hazardous materials. They also indicated that potential harm to the surrounding population may have occurred from releases of the following contaminants: (1) mercury releases from Y-12, (2) PCBs from all sites, (3) radioactive iodine from ORNL, and (4) radionuclide releases from ORNL. A full-dose, in-depth reconstruction study was initiated in 1994 to investigate these priority contaminants, the quantity released to the environment, and the potential adverse effects to the health of the surrounding population. The Steering Panel added further study of uranium releases because of the historical role of Oak Ridge's uranium work. The mercury, PCB, and uranium investigations are included in this document, since they are relevant to Y-12.

Mercury Health Studies. The Health Studies' investigators reported that the past estimated mercury releases for Y-12 were too low. According to the researchers' estimates, Y-12 released about 70,000 lbs of mercury into the atmosphere from vents and 280,000 lbs into the EFPC between 1950 and 1982. The total of these, about 350,000 pounds, exceeded by about 60,000 lbs previously published estimate by DOE's 1980s Mercury Task Force. The investigators evaluated the toxic effects from elemental mercury, inorganic mercury and organic mercury. The concluded that the greatest potential health risk from the elemental mercury releases was to children in the Scarboro community, living one-half mile from Y-12, and to farm residents along EFPC who may have inhaled enough to cause damage to the central nervous system between

1953 and 1959. The hazard from organic mercury, specifically methylmercury, was estimated to be most toxic to people who ate large amounts of fish from Poplar Creek, the Clinch River, or Watts Bar Lake during this period. Pregnant women who ate fish from these sources between the late 1950s and early 1960s risked brain damage to their fetuses. They estimated that the number of fetuses exposed at a potentially toxic level was likely nearer to 100 than 1,000.

PCB Health Studies. The Health Studies reported that the estimates of PCB releases from the ORR were difficult to quantify since PCBs were not considered hazardous prior to the early 1970s, so releases were not monitored. In 1977, the manufacture of PCBs was banned in the United States. People eating fish from the Clinch River were reported as being at the greatest risk for illness from the PCB releases from the ORR. The report cited the Y-12 releases into EFPC on the east side of the plant as being of particular concern since the creek flows directly through the Oak Ridge community after leaving the plant. The researchers concluded that some fishermen at the Clinch River and Watts Bar Reservoir have eaten enough fish from these sources to affect their health, but estimates of how many have been affected are not possible at this time. The investigators estimated that fewer than three excess cancers have been caused by PCBs from the ORR. They recommend further studies of fish and turtle consumption, PCB blood levels in people consuming fish, PCB levels in core samples from the Clinch River and the Watts Bar Reservoir, PCB levels in the soils near EFPC, and PCB levels in cattle grazing near the creek.

Uranium Health Studies. The Health Studies investigators reported that the DOE reports of uranium releases have been understated. The study estimates Y-12 released about 50,000 kg of uranium to the air from 1944 to 1995, more than seven times the 6,535 kg previously acknowledged by DOE. Using the new data, the investigators calculated health risks to nearby residents, using a conservative screening method so as not to underestimate the risks. The new risk for cancer for residents included residents of the Scarboro community. The analyses reported career screening indexes that were slightly lower than the investigator's decision guide for carcinogens, but with a great deal of uncertainty. In response to this information, investigators have recommended a more extensive screening of uranium on the ORR.

ATSDR PCB Studies. The ATSDR is a governmental agency established to conduct public health assessments of Federal facilities and to carry out any needed follow-up health activities. These activities include health studies, registries, medical monitoring, and health education. To help characterize environmental contamination in the Oak Ridge area, ATSDR screened more than 500 persons for PCB and blood mercury levels in September 1997. Blood samples were obtained from 116 persons who met the criteria and volunteered, including 13 residents of the Scarboro community. Participants were interviewed, and blood samples were obtained for PCBs and mercury in the blood. The study found the participants had PCB levels and blood mercury levels comparable to levels found in the general population. Only 5 (4 percent) of the persons tested had elevated PCB levels (> 20 μg/L). Four of the five had PCB levels between 20 and 30 μg/L and one had a serum PCB level of 103.8 μg/L, which is higher than levels generally found. As for blood mercury, only one individual had a total blood mercury greater than 10 μg/L, which is considered elevated. The remaining participants had total blood mercury levels similar to the general population.

Cancer Mortalities in Children. In response to a British study reporting increased leukemia and lymphoma in children living near nuclear plants in the United Kingdom, the National Cancer Institute initiated a study of cancer mortality in the areas surrounding U.S. nuclear facilities (Jablon 1991) cancer deaths were compared in counties surrounding nuclear facilities with control counties from the same region. They also compared cancer deaths before start-up of the nuclear facility with cancer deaths after start-up. The study areas included nine DOE facilities, including Oak Ridge Operations, 52 commercial nuclear electric plants, and one former commercial fuel reprocessing plant. Anderson County and Roane County were included in the review and were compared locally to Blount, Bradley, Coffee, Jefferson, and Hamblen counties in Tennessee and Henderson County in North Carolina. Three comparison counties were matched with each county studies. For childhood leukemia, when compared to the control counties, there were fewer leukemia deaths after start-up than before. For the DOE facilities, operations began before the study time period, the year 1950, but there was no facility with a significantly elevated childhood leukemia mortality. The same results were obtained for mortality due to leukemia for all ages. The relative risk (in this study, the comparison of ratios of the SMRs for the study and control counties) for the DOE sites for mortality due to all types of cancer, except leukemia, were significantly high (1.04) after start-up but smaller than the rate-ratio before start-up (1.06). The study did report a significant increased incidence of childhood leukemia for one commercial site, but it predated the start-up of the nuclear facility. The authors concluded that the results do not prove the absence of an effect, but if an effect is present, it is too small to be observed by these methods.

Tennessee Medical Management, Inc., compared Tennessee, Oak Ridge, Anderson County, and Roane County cancer mortality and incidence data with the expected deaths and incidence rates for the U.S. for 1990 and for the interval 1988 through 1990. Actual deaths in Oak Ridge, as well as cancer deaths, were fewer than expected. Anderson County deaths from all causes and cancer deaths were equivalent to expected rates, as were Roane County deaths. The study also compared new cancer cases. Anderson County showed a higher incidence of lung and bronchial cancer than expected, and fewer than expected leukemias, stomach and small intestine cancers, and colon cancers.

D.6.4 Site-wide Studies of Oak Ridge Workers

D.6.4.1 *Mortality of Nuclear Workers in Oak Ridge*

A 1997 report, titled *A Mortality Study of Employees of the Nuclear Industry in Oak Ridge, Tennessee* (Frome 1997), expanded on an earlier study of the health of workers employed at the nuclear plants in Oak Ridge. The previous study had only included white males employed exclusively at ORNL and had excluded workers moving between plants. This study included 106,020 workers, employed for at least 30 days at any of the Oak Ridge nuclear facilities between 1943 and 1984 whose records were without critical errors (e.g., unknown sex, race, date of birth, or employment dates). The objectives of the expanded study were to include individuals omitted from the earlier study to compare the mortality patterns of workers among the Oak Ridge facilities, to address errors of redundancy when workers employed at more than one facility were included in the analysis, and to conduct dose-response analyses for workers exposed to external radiation. The most significant excess cancer mortality associated with external radiation was found in lung cancer for white males, with an SMR of 1.18 (1,849 deaths). An SMR of 1.12 (1,568 deaths) was reported for nonmalignant respiratory disease. The study reported a strong socioeconomic effect with the lung cancer results, and baseline rates were higher for Y-12 workers and workers employed at more than one facility. The authors acknowledged that information on cigarette smoking for this cohort of workers was not available for analysis and may have been a confounder.

D.6.4.2 *Lung Cancer Mortality Study*

A case-control study (Dupree 1995) of 787 lung cancer deaths from four uranium processing operations, including Y-12, Fernald Feed Materials and Production Center, and the Mallinckrodt Chemical Works, was conducted to investigate the relationship between lung cancer and uranium dust exposure. The cases consisted of workers who were employed in the facilities for at least 183 days, died before January 1, 1983, and had lung cancer listed anywhere on the death certificate. Each case was matched with a control by facility, race, gender, and birth and hire dates within 3 years. Included in the history of the cohort was information on smoking, first pay code (to estimate socioeconomic status), complete work histories, and occupational radiation monitoring records. Annual radiation dose to the lungs from deposited uranium was estimated for each individual and annual external dose was determined for workers who had dosimetry measurements available. Smoking (ever/never used tobacco) and pay code (monthly/nonmonthly) were potential confounders considered in the analysis. The odds ratios for lung cancer mortality for seven cumulative internal dose groups did not demonstrate increasing risk with increasing dose. An odds ratio of

2.0 was estimated for those exposed to 25 rads or more, but the 95 percent confidence interval of -.20 to 20 exhibited great uncertainty in the estimate. The study also suggested workers hired at age 45 years or older showed an exposure effect.

D.6.5 Y-12 Worker-Specific Studies

D.6.5.1 *Y-12 Worker Cohort Study*

Polednak and Frome reported a study of 18,869 white male workers employed at Y-12 between 1943 and 1947 and followed through 1974. The cohort included workers exposed to internal (alpha) and external (beta) radiation through the inhalation of uranium dusts, electrical workers who performed maintenance in the exposure areas, and other workers who were not exposed. The study did not include personnel monitoring for exposures to uranium dust, but inferred monitoring results were matched with the work area and job. The SMR for lung cancer was elevated among workers employed for 1 year or more compared with workers employed less than 1 year and was more pronounced in workers hired at 45 years of age or older (SMR - 1.51; 95 percent CI 1.01-2.31). Among the workers employed after the age of 44, the SMR for lung cancer was greatest for electrical workers (SMR - 1.55, 7 observed), alpha chemistry workers (SMR - 3.02, 7 observed), and beta process workers (SMR - 1.51, 11 observed). SMRs were also elevated for mental psychoneurotic, personality disorders (SMR - 1.36, 36 observed), emphysema (SMR - 1.16, 100 observed), diseases of the bones and organs of movement (SMR - 1.22, 11 observed), and external causes of death (SMR - 1.09, 623 observed).

D.6.5.2 *Cancer Mortality Among Y-12 Rad Workers*

In 1988, a study was conducted of Y-12 white male workers employed for at least 30 days from 1947 to 1979 (Checkoway 1988). The study included exposures to alpha and gamma radiation from insoluble uranium compounds. A statistically significant increase in deaths from lung cancer (SMR - 1.36, 89 observed; 95 percent CI - 1.09-1.67) was observed when compared with the U.S. lung cancer rates, but not when compared with Tennessee lung cancer rates (SMR- 1.18, 95 percent CI - 0.95-1.45). Positive dose-response trends were seen for lung cancer mortality with respect to cumulative alpha and gamma radiation, with the most notable trend occurring for gamma radiation among workers who received greater than or equal to 5 rem of alpha radiation. When a 10-year latency assumption was applied, these trends diminished. The authors noted the observed dose-response trends, while based only on small numbers, point to a potential carcinogenic effect to the lung from relatively low-dose radiation. In addition, nonstatistically significant increases were observed for all cancers (SMR - 1.01, 196 observed), diseases of the blood-forming organs (SMR - 1.48, 3 observed), kidney cancer (SMR - 1.22, 6 observed), and other lymphatic cancers (SMR -1.86, 9 observed). Brain and central nervous system cancer mortality was also higher than expected, but without a dose-response trend.

D.6.5.3 *Cancer Mortality Among Minority Rad Workers*

Loomis and Wolf updated the Checkoway study to include the years through 1990 and to include African-American and white female workers and men of other races (Loomis 1996). The exposures for the cohort included low dose, internal, alpha radiation and external, penetrating radiation plus beryllium, mercury, solvents, and other industrial compounds. The authors reported a low total mortality for all Y-12 workers and a total cancer mortality as expected. For the entire cohort, nonstatistically significant excesses were observed for pancreatic cancer (SMR - 1.36, 34 observed), skin cancer (SMR - 1.07, 11 observed), breast cancer (females only, SMR - 1.21, 11 observed), prostate cancer (SMR - 1.31, 36 observed), kidney cancer (SMR - 1.30, 16 observed), brain cancer (SMR -1.29, 20 observed), cancers of other lymphatic tissues (SMR - 1.32, 22 observed), and diseases of the blood-forming organs (SMR- 1.23, 6 observed). The lung cancer mortality was statistically significant (SMR - 1.17, 202 observed; 95 percent CI 1.01-1.34), especially for white males (SMR - 1.20, 194 observed; 95 percent CI - 1.04-1.38). The lung cancer excess was greatest among those workers hired prior to 1954 (SMR - 1.27, 161 observed), with 5 to 20 years of employment and with 10 to 30 . Another finding was evidence of excess breast cancer mortality among the 1,073 female workers (SMR 1.21; 95 percent CI - 0.60-2.17). The authors suggested more work needed to be done on lung cancer mortality due to radiation exposure and to the potential link between beryllium and lung cancer.

D.6.5.4 *Health Effects of Mercury Exposure*

A study of mortality patterns of all workers employed at least 5 months at Y-12 between January 1, 1953, and April 30, 1958 was published in 1984 (Cragle 1984). Mercury was used during this time frame to produce enriched lithium. The group was divided into mercury-exposed and nonmercury-exposed by results of urinalysis supplied by the plant. Vital status follow-up was complete through the end of 1978 and SMRs were calculated. There were no differences in mortality patterns for the mercury-exposed, when compared to the nonmercury exposed. Excesses of lung cancer mortality were observed in both groups of workers and were not related to the mercury exposure (exposed SMR=1.34; 42 observed, 31.36 expected; nonexposed SMR=1.34, 71 observed, 52.9 expected). The authors stated that mortality is not the optimal end point to assess mercury-related health effects.

Another study of mercury workers (Albers 1988) assessed neurological function and mercury exposure. The clinical study examined 502 Y-12 workers, 247 of whom worked in the mercury process 20 to 35 years prior to the examination. Several correlations between increasing mercury exposure and declining neurological function were discovered. An exposure assessment was determined for each mercury worker during the time of employment in the mercury process. Workers with at least one urinalysis equal to or greater than 0.6 mg/L of mercury showed decreased strength, coordination, and sensation along with increased tremor and prevalence of Babinski and snout reflexes when compared to the 255 nonexposed workers. Clinical polyneuropathy was associated with the level of the highest exposure but not with the duration of exposure.

D.6.6 Ongoing Studies of Y-12 Workers and the Community

DOE, along with U.S. Department of Health and Human Services, has published a *Draft Agenda for Public Health Activities for Fiscal Years 1999 and 2000 at U.S. Department of Energy Sites* (DOE 1999b). Included in this report are several ongoing occupational health studies dealing with Y-12.

Public Health Assessment. The ATSDR is involved in an ongoing study of the public health impact from releases of hazardous materials from the ORR. This assessment will help identify and characterize both the current and past exposures of offsite populations to radiologic and chemical contaminants. Morbidity and mortality data to identify increased rates of health outcomes associated with these materials are also included in this study.

DOE Beryllium Worker Medical Surveillance Program. Y-12 beryllium workers are included in the DOE Beryllium Worker Medical Surveillance Program currently under way to detect and diagnose chronic beryllium disease. Information from this program is being used to evaluate worker protection and control measures, to monitor trends in chronic beryllium disease frequency, and to strengthen work planning to minimize worker exposures. A communication effort to educate workers about chronic beryllium disease is included.

DOE's Former Worker Program. Under DOE's Former Worker Program, Dr. Eula Bingham of the University of Cincinnati, in cooperation with the United Brotherhood of Carpenters Health and Safety Fund and several other groups, is directing the Former Construction Workers Project. Phase I of the project has identified approximately 800 former construction workers. Phase II will focus on medical screening of workers exposed to asbestos, beryllium, noise, silica, solvents, and heavy metals.

Mortality Among Female Nuclear Weapons Workers. NIOSH is sponsoring the State University of New York in a study of mortality among female nuclear weapons workers. This includes female workers from 12 DOE sites and will be the largest study of mortality among the 80,000 females employed by DOE. Risk estimates will be developed for exposure to ionizing radiation and chemical hazards.

Lung Cancer and Leukemia Case-Control Studies. NIOSH has two ongoing case-control studies combining multiple DOE sites, including Oak Ridge, to answer specific cancer questions. One study is attempting to define the relationship between lung cancer and external radiation exposure. The second study, the largest of its kind, is exploring the relationship between external radiation and leukemia risk among 250 workers with leukemia compared to similar workers without leukemia.

Chemical Laboratory Workers Mortality Study. NIOSH has an ongoing cohort mortality study assessing potential worker exposures to groups of chemicals and ionizing radiation and their relationship to mortality patterns. This is in response to other studies, outside DOE, indicating an increased risk of cancers among chemical laboratory workers.

D.7 ACCIDENT ANALYSIS

Accidents are defined as unplanned sequences of events that lead to the release of hazardous material within a facility or into the environment (DOE STD-3009-94), exposing workers and/or the public to hazardous materials or radiation.

There are two objectives of this SWEIS accident analysis. First, the analysis conservatively characterizes the risk posed by the operations, creating a context for the decision maker and putting the site in perspective for the public. Second, the analysis provides a basis for evaluating the incremental risk among the several alternatives.

D.7.1 Characterization of the Risk from Accidents

Characterization includes a consideration of the type of the accident (e.g., fire, explosion, spill, leak, depressurization, criticality, etc.), the initiator (e.g., human error, chemical reaction, earthquake, strong wind, flood, vehicle accident, mechanical failure, etc.), and the material at risk (e.g., uranium, toxic chemical, explosives, flammable gas, etc.). Characterization also considers the type of consequence of the accident (e.g., immediate fatalities, prompt reversible and irreversible health effects, latent cancers—some of which may lead to eventual death), and the magnitude of the consequences to different exposed populations (e.g., to workers only, to hypothetical members of the public off-site, etc.). Finally, characterization considers the likelihood that an accident will occur.

Because Y-12 is a complex site conducting many processes, there is a wide range of accident scenarios that can be postulated with a corresponding range of likelihoods and potential consequences, both credible and incredible. Existing safety analyses, hazard analyses, and other documentation were reviewed to identify a range of postulated accidents that include high frequency-low consequence accidents as well as low frequency-high consequence accidents. The list of accidents presented in this appendix is representative of primarily high consequence accidents at the Y-12 Plant. The accidents presented are generally controlled by the implementation of hazard control strategies that reduce the likelihood or consequences of the postulated accidents. For this SWEIS, accidents were analyzed that could result in injuries to the public or workers (such as fires or explosions), or from the release of hazardous materials from particular facilities and operations.

To characterize the accident risk at Y-12, a representative range of accidents and consequences, including accidents for which the public has shown concern, has been chosen for analysis. That is, the analysts have not attempted to identify every possible accident scenario, but instead have selected a range of accidents that are representative of the risk to the public and workers from site operations. The analysis thereby provides an objective context for the stakeholders to evaluate the risk posed by site operations and a context for the comparison among alternatives.

D.7.2 Evaluation Methodologies and Assumptions

The potential for facility accidents and the magnitudes of their consequences are important factors in evaluating the alternatives addressed in this SWEIS. The health risk issues are twofold:

- The potential accidents that could occur at Y-12 facilities and the risks that these postulated accidents could pose to workers or the general public.

- The reduction in existing public or worker health risks when HEU Storage Mission and Special Materials Mission Alternatives in this SWEIS are compared to the existing facilities. (These reduced risks may arise either from modernized, improved facility systems that better protect the workers or public, or from design and construction of facilities built to higher seismic resistance standards.)

Guidance for preparing an EIS (40 CFR 1500) requires the evaluation of impacts which have low probability of occurrence but high consequences if they do occur; thus, facility accidents must be addressed to the extent feasible in this SWEIS. Further, public comments received during the scoping process clearly indicated the public's concern with facility safety and consequent health risks and the need to address these concerns in the comparison-making process.

For the Y-12 Site No Action - Status Quo Alternative and No Action - Planning Basis Operations Alternative, potential accidents are defined in existing facility documentation, such as safety analysis reports, bases for interim operation, hazards assessment documents, and NEPA documents. The accidents include radiological and chemical accidents that result in high consequences but have a low likelihood of occurrence, and a spectrum of other accidents that have a high likelihood of occurrence and low consequences. The data in these documents shown in Table D.7.2-1 include accident scenarios, frequency ranges, materials at risk, source terms (quantities of hazardous materials released to the environment), and accident consequences. For proposed new or expanded facilities, the identification of accident scenarios and associated data would normally be based on analysis reports performed on completed facility designs. However, facility designs have not been completed for the HEU Storage Mission and Special Materials Mission Alternatives analyzed in this SWEIS.

Accordingly, the accident information developed for this SWEIS has been developed based upon the best available existing information for similar facilities.

This analysis also includes semiquantitative or qualitative estimates of the differences in likelihood for accident initiation at new facilities. For example, the proposed new HEU Materials Facility, built at a higher elevation, would have a reduced potential for flooding. Also, qualitatively discussed are the opportunities for risk reduction afforded by the potential incorporation of new technologies, processes, or protective features in the newly constructed facilities. These would improve public health and safety compared to the existing facilities.

D.7.2.1 *Radiological Accident Selection*

The accident scenarios chosen to represent the impacts for each alternative were selected using a screening process based on a larger set of accidents presented in existing safety documentation for similar facilities. The existing safety analyses, hazard analyses, and other documentation shown in Table D.7.2-1 were reviewed for applicable accident scenarios and data to identify postulated accidents that represent a range of accidents that include high frequency-low consequence accidents as well as low frequency-high consequence accidents. The accidents presented are generally controlled by the implementation of hazard control strategies that reduce the likelihood or consequences of the postulated accidents. The analytical process identified bounding accidents in each of several types of events (e.g., fire, explosion, spill, criticality, etc.) applicable to the EIS proposed actions and alternatives.

For a SWEIS alternative, each selected radiological accident was analyzed to estimate the risk (i.e., combination of an accident's frequency and the accident's consequences, occasionally expressed as the mathematical product) and consequences (e.g., cancer fatalities) to a collocated (noninvolved) worker, a member of the public at the Y-12 Emergency Response Boundary, and the population out to a distance of 80 km (50 mi) from the accident.

Accident analyses for the Y-12 facilities (Table D.7.2-1) were reviewed to determine the representative accidents for use in this appendix. In these referenced documents, preliminary hazard analyses (PHAs) are described that identify hazards, accident scenarios, and consequences relevant to the SWEIS. The authorization basis documents listed in Table D.7.2-1 are safety analysis reports (prepared in accordance with DOE STD-3009-94), bases for interim operation (prepared in accordance with DOE STD-3011-94), or hazard assessments. For consistency, the frequency and consequences associated with each accident scenario evaluated in this SWEIS were evaluated using the risk matrix from DOE STD-3011-94 shown in Table D.7.2-2. The Significance of the Scenario was the classification based on its location within the matrix. The scenario classes were designated as follows.

- Scenario Class IV - Negligible
- Scenario Class III - Marginal
- Scenario Class II - Serious
- Scenario Class I - Major

Scenario classes are associated with sectors of the risk matrix in such a way as to prioritize accident scenarios for review or for further analysis, primarily in terms of the risk that they present.

Consequences were determined based on parameters such as the bounding quantity of hazardous material involved in an accident, the release mechanism associated with the accident, and the release pathway taken by the hazardous material. Conservative assumptions were used to determine the magnitude of the consequences. Radiological and chemical consequences were classified using both qualitative and quantitative measures as shown in Tables D.7.2-3 and D.7.2-4. Note that the values in Tables D.7.2-3 and D.7.2-4 are intended for sorting purposes only and do not reflect any consideration regarding risk acceptability. Doses from postulated radiological accidents are given as CEDE and are stated in rem for individual doses or person-rem for population doses.

Estimates of frequency were made by assessing the frequency of the initiating event along with the conditional probabilities of all other events necessary for the propagation of the accident leading to a release of radiological or toxicological material. Failure rate data, historical accident data, and other sources of information were also used to determine the accident frequency. Uncertainties in parameter values were accommodated by erring in the conservative direction from best-estimate values. Hand calculations were used in many cases to estimate numerical quantities for source terms, and onsite and offsite MEI consequences. This number provides an expected number of LCF for the population given that the dose has been received.

TABLE D.7.2–1.—*Source Documents Reviewed for Applicable Accident Scenarios*

Item Number	Title	Report Number	Date Published
1	*Basis for Interim Operation, Building 9720-5*	Y/ENG/BIO-010, Rev. 0, Chg. 1	9/30/98
2	*Safety Analysis Report for the Nuclear Material Safeguarded Shipping and Storage Facility,Building 9720-5*	Y/SAR/010/IA	Approval Date: 3/6/98
3	*Basis for Interim Operation of Building 9204-2E*	Y/ENG/BIO-003, Rev. 2	3/8/98
4	*Basis for Interim Operation, Disassembly and Storage Organization, 9204-4 Facility*	Y/ENG/BIO-004, Rev. 2	8/98
5	*Basis for Interim Operation for Building 9212 Enriched Uranium Operation Complex*	Y/MA-7254, Rev. 5	12/16/98
6	*Basis for Interim Operation for 9215 Complex Enriched Uranium Operation*	Y/MA-7290, Rev. 1	3/98
7	*Final Safety Analysis Report for Y-12 Chemical Processing Systems, Buildings 9212 and 9206*	Y/MA-6290	4/82
8	*The Basis for Interim Operation for the Building 9206 Complex*	Y/MA-7462, Rev. 0	Submitted for Approval
9	*Safety Analysis Report for the Nuclear Material Management Storage Facility, Building 9720-38*	Y/ENG/SAR-084/IFA, Rev. 1	1/27/99
10	*Basis for Interim Operation, 9215 Complex Non-Enriched Uranium Operations*	Y/NA-1816, Rev. 0	6/11/99
11	*Basis for Interim Operation, Disassembly and Storage Organization, 9204-4 Facility*	Y/ENG/BIO-004, Rev. 3	Draft 11/2/98
12	*Safety Analysis Report for the 9204-2E Facility*	Y/SAR-003/IFA, Rev. 0	8/98
13	*Final Safety Analysis Report for Transportation and Certification of Enriched Uranium Weapons Parts*	Y/MA-6398	8/83
14	*Nonnuclear Safety Analysis Report and Operational Safety Requirements for Lithium Operations*	Y/ENG/SAR-OSR-001, Rev. 0	9/30/98
15	*Basis for Interim Operation Document for Building 9201-5N/5W*	Y/ENG-BIO-002, Rev. 1	8/20/98
16	*Remedial Investigation/Feasibility Study for the Disposal of Oak Ridge Reservation CERCLA Waste,* Appendix F	DOE/OR/02-1637&D2	1/7/98
17	*U. S. Department of Energy Defense Programs Safety Survey Report, Volume III, Appendix B Uranium Facilities*	N/A	11/93
18	*Hazard Assessment for the Development Organization Facilities*	EMPO-514/HA-015, Rev. 0	4/25/00
19	*Hazard Evaluation, Development Organization Activities in Buildings 9202, 9203, 9205, and 9731*	Y/DA-9469, Rev. 0	9/99
20	*Facility Hazards Assessment for the Building 9720-26 Material Control Organization*	EMPO-514/HA-021, Rev. 0	3/1/00
21	*Building 9401-3 Hazards Assessment*	EMP-514/HA-003, Rev. 0	6/18/99

TABLE D.7.2–2.—*Risk Matrix - Consequence versus Frequency*[a]

	$<10^{-4}$ Extremely Unlikely	10^{-4} to 10^{-2} Unlikely	$>10^{-2}$ Anticipated
High Consequence	II	I	I
Moderate Consequence	III	II	I
Low Consequence	IV	III	III

[a] Frequency (yr^{-1})
Source: DOE STD-3011-94.

TABLE D.7.2–3.—*Radiological Accident Consequence Levels*[a]

	Public	Workers
High Consequence	> 5 rem at site boundary	> 25 rem at 200 m or prompt death in facility
Moderate Consequence	> 0.1 rem at site boundary	> 0.5 rem at 200 m or serious injury in facility
Low Consequence	< 0.1 rem at site boundary	< 0.5 rem at 200 m and no serious injuries in facility

[a] Values are intended for sorting purposes only and do not reflect the acceptability of accident consequences.
Note: DOE STD-3011-94 uses 600m for evaluating worker dose. The fence line is as close as 450m for evaluating public exposures. This evaluation uses 200m as an appropriate distance to evaluate the exposure of a worker.
Source: DOE STD-3011-94.

TABLE D.7.2–4.—*Chemical Accident Consequence Levels*[a]

	Public	Workers
High Consequence	> ERPG-2 at site boundary	> ERPG-3 to collocated workers or prompt death in facility
Moderate Consequence	Not applicable	Serious injury in facility
Low Consequence	< ERPG-2 at site boundary	No serious injuries in facility

[a] Values are intended for sorting purposes only and do not reflect the acceptability of accident consequences.
Note: ERPG -Emergency Response Planning Guideline.
Source: DOE STD-3011-94.

D.7.2.2 *Chemical Accident Selection*

The chemical accident selection consisted of a multiple step review of facilities for chemical accidents. The first step of the review was a screening of the nuclear facility accident analyses for chemical accidents related to the nuclear facilities (non-nuclear facilities were addressed in the second step). This screening consisted of reviewing the safety documentation listed in Table D.7.2-1. A range of accidents that included high frequency-low consequences as well as low frequency-high consequences was identified. A review of this range of accidents resulted in the generation of two consolidated scenarios for evaluation in this SWEIS (Section D.7.3.2).

The second step was a review of the annual SARA Section 311 and Section 312 reports (Evans 1999a, Evans 1999b). The SARA reports list all regulated chemicals in Y-12 facilities and the quantities in each facility. Table D.7.2-5 lists the SARA-reportable chemicals at Y-12. Some of these chemicals were also identified during the first step of the chemical accident selection and the duplicate listings were eliminated. This list of chemicals resulting from the second step was further screened to identify chemicals that were also listed as highly hazardous chemicals by OSHA (29 CFR 1910.119) or as substances regulated by EPA under 40 CFR 68.130. Finally, the list of chemicals was screened to determine if any of the chemicals in the SARA reports met all of the following criteria (DOE 1999a):

- Has a TWA less than 2 ppm (for chemicals without TWAs, the Temporary Emergency Exposure Limit-0 [TEEL-0] was used)

- Is found in a readily dispersible form (i.e., a gas or liquid)

- Has a boiling point of less than 212 °F (100 °C) and a vapor pressure greater than 0.5 mm mercury

This screening of chemicals in non-nuclear facilities resulted in acetonitrile and chromic acid being analyzed in the consolidated fire and loss of containment scenarios for chemicals. Also, one chemical of local interest (mercury) was added to the toxic chemical fire scenario (Section D.7.3.2).

D.7.2.3 *Human Health Effects of Accidental Exposure to Hazardous Chemicals*

Human health effects resulting from exposure to hazardous chemicals vary according to the specific chemicals of interest and the exposure route and concentration. The most immediate risks to human health from exposure to chemicals in the environment arise from airborne releases of toxic gases, and it is this route of exposure upon which the accident analysis for the SWEIS is focused. (The effects of radioactive and toxic chemicals have been discussed previously in Section D.1.) In this analysis, exposures to toxic chemicals were compared to Emergency Response Planning Guidelines (ERPGs). ERPGs are community exposure guidelines derived by groups of experts in industrial hygiene, toxicology, and medicine. ERPGs are published by the American Industrial Hygiene Association (AIHA) after review and approval by their ERPG Committee. ERPGs are defined as follows (AIHA 1991).

- ERPG-1 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild, transient adverse health effects or perceiving a clearly defined objectionable odor.

- ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. (Note that there are ERPG-2 limits for a few chemicals that use a 10-min exposure period. The 10-min ERPG-2 limits are published for hydrogen fluoride.)

- ERPG-3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects. (Note that there are ERPG-3 limits for a few chemicals that use a 10-min exposure period. The 10-min ERPG-3 limits are published for hydrogen fluoride.)

Human responses to chemical exposure do not occur at precise exposure levels, but rather, vary over a wide range of concentrations. The values derived for ERPGs do not protect everyone, but are applicable to most individuals in the general population. Furthermore, the ERPG values are planning guidelines, not exposure guidelines. They do not contain the safety factors normally associated with exposure guidelines (AIHA 1991).

In developing an ERPG, emphasis is given to the use of acute or short-term exposure data. Human experience data are emphasized, but usually only animal exposure data are available. When it is believed that adverse reproductive, developmental, or carcinogenic effects might be caused by a single acute exposure, the data are considered in the ERPG derivation.

Unless one is provided information to the contrary by toxicologists, it is necessary to regard ERPGs as ceiling concentrations (i.e., the highest concentration acceptable for the time period). As such, the ERPG would be treated as an exposure that should not be exceeded within 1 hour. Any extrapolation from the

ERPG is not to be made without significant considerations; specifically, to make such an adjustment, the ERPG documentation for each chemical must be reviewed fully by toxicologists. The effects of exposure times longer than 1 hour may not be limited to those associated with the ERPG.

TABLE D.7.2–5.—*Superfund Amendments and Reauthorization Act Reportable Chemicals at Y-12*

Acetic Acid	Lithium Hydroxide
Acetylene	Magnesium Iron Silicate
Activated Carbon (carbon graphite, synthetic)	Magnesium Oxide
Aluminum Oxide	Mercury
Argon	Methanol (Methyl Alcohol)
Beryllium and Beryllium Compounds	Nickel and Nickel Compounds
Cadmium Oxide	Niobium Metal
Calcium Chloride	Nitric Acid
Calcium Hydroxide	Nitrogen
Calcium Carbonate	Oxygen
Carbon Dioxide (gas, solid)	Petroleum
Chlorine	Phosphoric Acid
Diatomaceous Earth	Portland Cement
Diesel (Fuel Oil No. 2)	Potassium Cyanide
Ferric Sulfate (solution)	Propane
Freon 11 (Trichlorofluoromethane)	Propylene Glycol
Freon 12 (Dichlorodifluoromethane)	Silica, Crystalline Quartz
Freon 22 (Chlorodifluoromethane)	Sodium Bisulfite
Freon 113 (Trichlorotrifluoromethane)	Sodium Carbonate, Monohydrate
Gasoline (unleaded)	Sodium Chloride
Helium	Sodium Hydroxide
Hydrochloric Acid	Sodium Hypochlorite
Hydrogen Fluoride	Sodium Metasilicate, Anhydrous
Hydrogen Peroxide	Sodium Zinc Polyphosphate
Isopropyl Alcohol	Sulfuric Acid
Lithium Chloride	Uranium and Uranium Compounds
Lithium Deuteride	Urea
Lithium Hydride	

Source: Evans 1999b.

In addition to ERPGs, this analysis incorporated the supplementary TEELs developed by the DOE Emergency Management Advisory Committee, Subcommittee of Consequence Analysis and Protective Actions. Published ERPG values were only available for about 70 chemicals. TEEL values (interim, temporary, or ERPG-equivalent exposure limits) are provided for an additional 297 chemicals. In the absence of ERPG or TEEL values, the hierarchy developed by the committee and published in the AIHA Journal was used (Craig 1995, Craig 1996).

D.7.2.4 *Safety Design Process*

One of the major design goals for the proposed newly constructed facilities is to achieve a reduced risk to workers and the public relative to that associated with existing facilities at Y-12. Significant changes between the design of proposed, new facilities and the current design criteria and safety standards should reduce total risk to the workers and to the public. These changes include design to more modern structural and safety criteria; smaller throughput, batch size and inventories of certain hazardous materials; and elimination of some forms of hazardous materials (such as anhydrous hydrogen fluoride). These changes will reduce potential health effects if an accidental release were to occur.

Areas within proposed new facilities will be designed to meet with current government regulations; DOE Orders; and consensus codes and standards. As a result, new facilities will be provided that are highly resistant to the effects of natural phenomena, including earthquake, flood, tornado, high wind, as well as credible events appropriate to the site, such as fire and explosions, and manmade threats to the structural integrity for containing hazardous materials.

The design process for new Y-12 nuclear facilities will comply with the requirements for safety analysis and evaluation in DOE Order 430.1A, *Life-Cycle Asset Management*; DOE Order 5480.23, *Nuclear Safety Analysis Reports*; and DOE Order 420.1, *Facility Safety*.

For new facilities, the safety analysis process begins early in conceptual design by identifying hazards with the potential to produce unacceptable safety consequences to workers or the public. As the design develops, hazard analyses are performed to identify initiators that have the potential to release hazardous material, hazardous energy, or cause injuries to workers or the public. The types of initiators considered include equipment failure, human error, chemical reaction, and natural phenomena hazards. These postulated events become focal points for design changes or improvements to prevent unacceptable accidents. These analyses continue as the design progresses to assess the need for safety equipment and to assess the performance of this equipment in accident prevention or mitigation. Eventually, the safety analyses are formally documented in an auditable safety analysis, hazard evaluation, or safety analysis report. The level of documentation depends upon the hazards presented by the new facility and is reflected in the use of a graded approach to safety analysis used by DOE.

D.7.2.5 *Analysis Methodology*

Introduction

The accident analyses in the source documents listed in Table D.7.2.1-1 were based on various assumptions (e.g., ground-level releases versus elevated releases, various stability classes, various release times, etc.) The consequences for the population doses for release accidents were recalculated using consistent assumptions (i.e., D stability, 2 m/s wind speed), and for the MEI (F stability and 1 m/s wind speed). A discussion of how the collocated workers and the public population doses were calculated using the MACCS code is provided below. A detailed description of the MACCS model is available in a three volume report: *MELCOR Accident Consequence Code System (MACCS)* (NUREG/CR-4691). The HGSYSTEM computer code was used to estimate the consequences of toxic gas release accidents. The HGSYSTEM code is discussed below. Hand calculations were performed using the Gaussion plume dispersion model to estimate concentrations for the other toxic chemical releases.

The closest potential public access to the Y-12 facilities is at the Y-12 Emergency Response Boundary. Distances from the Y-12 facilities to the Y-12 Emergency Response Boundary are listed below. This distance is used to estimate the dose to a maximally exposed member of the public since this is the closest to the facility that can be publicly accessed. It is unlikely that a member of the public would be present at this location at any time. Thus, the estimated dose provides a bounding limit to a maximally exposed individual.

Building	Distance (m)
9201-5	670
9202	700
9204-2	670
9204 - 2E	670
9204 - 4	670
9206	700
9212	450
9215	500
9401-3	1000
9720 - 5	1000
9720 - 26	1000
9720 - 38	1000

For radiological releases, the 200-m distance was selected for collocated (on-site) maximally exposed collocated worker receptors. The worker population doses presented include all workers onsite.

Radiological Population Dose

MACCS models the off-site consequences of an accident that releases a plume of radioactive materials to the atmosphere. Should such an accidental release occur, the radioactive gases and aerosols in the plume would be transported by the prevailing wind while dispersing in the atmosphere. The environment would be contaminated by radioactive materials deposited from the plume, and the population would be exposed to radiation. The objectives of a MACCS calculation are to estimate the range and probability of the health effects induced by the radiation exposures not avoided by protective actions.

In previous NEPA documentation (DOE 1994a) for Y-12, detailed MACCS modeling was performed for several hypothetical accidents. The results and assumptions for these MACCS models are documented in the report, *An Assessment of the Radiological Doses Resulting from Accidental Uranium Aerosol Releases and Fission Product Releases from a Postulated Criticality Accident at the Oak Ridge Y-12 Plant* (Fisher 1995). This assessment provides scalable results for releases of fission product gases resulting from a criticality accident and releases of HEU aerosols. This report contains detailed information for the site as well as a wind rose. This assessment provides scalable dose consequences for theoretical accidents and was used for estimating the radiological population doses presented in the accidents in this analysis. The assessment uses the local 1992 meteorological data and 1990 census population data in the calculations performed using the MACCS code (Fisher 1995).

The results presented by Fisher and Lenox (Fisher 1995) were verified by independent computations using 1998 meteorological data and the 1990 census data. The 1990 census data is the only data available in the detailed population grids necessary for the MACCS code. Some general conclusions may be drawn by looking at the population increases in the local area. Knox County, Tennessee, had a population of 335,749 in the 1990 census. Knox County’s population was estimated to be 366,864 in 1998 by the U.S. Census Bureau, an increase of approximately 9 percent. Knox County’s population in 2005 is projected to be 387,318. Anderson County, Tennessee, had a population of 68,250 in the 1990 census. Anderson County’s population was estimated to be 71,587 in 1996 by the U.S. Census Bureau, an increase of approximately 5 percent. The city of Oak Ridge, Tennessee, had a population of 27,310 in the 1990 census. Oak Ridge’s population was optimistically estimated to be approximately 28,000 in 1998 by the city of Oak Ridge, an increase of approximately 2 percent. The city of Oak Ridge’s population in the near future is not expected to significantly increase. Based upon these population estimates, the doses presented for the accidents could be increased 5 percent to account for the population growth and provide a bounding upper estimate for the population doses. However, without the population grid data to properly account for the location of people for the exposures, these estimates would not necessarily increase the accuracy of the population doses. Another factor is that very few people live close to the Y-12 Plant where the highest doses would be received and the city of Oak Ridge population has not significantly changed, thus the errors may not be as large as 5 percent but may be closer to 2 percent. Additionally, the assumptions used for the MEI doses in Fisher and Lenox were modified and then new doses were estimated. Fisher and Lenox assumed a 7-day evacution for the MEI doses. This was considered to be unrealistic for Y-12 Plant workers and members of the public at the Y-12 Emergency Response Boundary. In this analysis, a 2-hour evacuation was used in accordance with DOE and Nuclear Regulatory Commission (NRC) guidance. Also, the MEI doses assume fixed, conservative weather conditions of F-stability and 1 m/s wind speeds.

The increased likelihood (probability) of an LCF to a member of the public is generally assumed to be 5.0×10^{-4} times the dose in person-rem. Doses to noninvolved workers were calculated similarly, except that these workers were assumed to have an increased likelihood of LCF of 4.0×10^{-4} times the dose in person-rem. These values are based on the *1990 Recommendations of the International Commission on Radiological Protection* (ICRP 1991).

HGSYSTEM Code

The HGSYSTEM code is a suite of codes, including a modification of the HEGADAS dense gas dispersion code. HEGADAS was modified to better model the dispersion of anhydrous hydrogen fluoride after test results in Nevada showed that existing models did not properly match the results of the outdoor testing. The modification incorporated several attributes: (1) the ability to account for HF/H_2O/air thermodynamics and plume aerosol effects on plume density (both positive and negative effects); (2) the ability to model both pressurized (jet) and unpressurized (pool) releases; (3) the ability to predict concentrations over a wide range of surface roughness conditions; (4) the ability to predict concentrations at specific locations for user-specified averaging periods (sampling times) that are consistent with release duration; (5) the ability to consider steady-state, time-varying, and finite-duration releases; and (6) the ability to compute crosswind and vertical concentration profiles. After the HGSYSTEM development was completed, the computer model was validated against the data from the Nevada testing series.

Especially near the source of a release, actual short-term gas concentrations will depart markedly from average model values in response to random turbulent eddies and are therefore unpredictable. As the actual released material moves downwind, concentrations within the plume become more similar to HGSYSTEM model calculations. HGSYSTEM shows concentrations that represent averages for time periods of 15 minutes and predicts that average concentrations will be highest near the release point and along the center line of the release (this is typical plume modeling). The concentration is modeled as dropping off smoothly and gradually in the downwind and crosswind directions. HGSYSTEM is the only dispersion code that can model releases of anhydrous hydrogen fluoride and account for the unique thermochemistry of depolymerization and hydrolysis.

Moreover, HGSYSTEM models the dispersion of heavy gases assuming the terrain is flat. Thus, if a ridge is located between the release point and a potential receptor, HGSYSTEM models the scenario as though the ridge were absent. This is a conservative approach because potential receptors are offered some protection from heavy gases by intervening ridges. Under the most stable atmospheric conditions (most commonly found late at night or very early in the morning), there is little wind, reduced turbulence, and less mixing of the released material with the surrounding air. High gas concentrations can build up in small valleys or depressions and remain for long periods of time. HGSYSTEM does not account for gas accumulations in low-lying areas.

HGSYSTEM allows the user to enter only a single wind speed and wind direction and assumes that these remain constant throughout the release and travel. In reality, air flow changes speed and direction when confronted with changes in terrain such as slopes, valleys, and hills. HGSYSTEM cannot account for these effects. Because wind is likely to shift direction and change speed over both distance and time, any predictions of atmospheric concentration beyond 1 hour or further out than 10 km are not as reliable as predictions made within a few minutes or at shorter distances. In general, wind direction is least predictable when the wind speed is low and at the lowest wind speed modeled in the code. HGSYSTEM does not account for particulate settling and deposition. For releases of hazardous materials forming liquid pools, the HGSYSTEM code presumes the surface beneath a liquid leak or spill to be level, so that the liquid is assumed to expand evenly in all directions.

During fire accidents, combustion products rise rapidly while moving downwind until they cool to the temperature of the surrounding air. HGSYSTEM cannot account for this plume rise. HGSYSTEM models the release and dispersion of pure chemicals only, and the properties of chemicals in its chemical library are valid only for pure chemicals. HGSYSTEM also does not account for chemical reactions of any kind.

The limitations of HGSYSTEM do not detract from its use in this SWEIS for screening chemical accidents and bounding their daytime consequences. HGSYSTEM was chosen for its ability to model heavy gases, especially anhydrous hydrogen fluoride as well as chlorine, chemicals of concern at Y-12.

Frequency Analysis

Frequency (F) levels were assigned primarily based on operating experience. Accidents that could result from operator error or violation of administrative controls were assumed to be "Anticipated," $F > 10^{-2}$/yr. If knowledge existed of a similar accident in the operating history of the facility, the frequency was also assumed to be "Anticipated." Equipment failures were assumed to be "Anticipated." Events that resulted from a series of operator errors and/or equipment failures were considered "Unlikely," $10^{-4}/yr \le F \le 10^{-2}/yr$, unless the accident sequence was very complex, in which case a frequency of "Extremely Unlikely," $F < 10^{-4}$/yr, was assigned. If physical conditions associated with an operation did not support a particular accident sequence, the event was considered to be "Extremely Unlikely." The unmitigated frequencies cited in the following scenarios do not credit administrative controls, engineering design features, building construction, etc., that could prevent the postulated accidents. The accident initiators in most cases are either human error or mechanical equipment failure.

D.7.3 Accident Scenarios

The accident scenarios are divided into radiological accidents and chemical accidents. The radiological accidents involve exposure to radioactive materials with a dose to a receptor (a collocated worker or the public). The accidents are presented with a discussion of the consequences and the expected frequency of the accidents. Many of the process facilities have controls (for prevention or mitigation) that serve to reduce the frequency or consequences associated with the accident. This information is presented in a table for each section. Some of the postulated accidents, such as the seismic accident, do not have facility controls listed to prevent the accident, and the frequency of the accident is the same as the initiating frequency (based upon an assumed return period) of the projected earthquake. Events with major consequences such as fire-induced releases due to an aircraft crash are not separately analyzed due to the very small frequency (less than 10^{-7}/yr) and the consequences of these events such as an aircraft crash are bound by the results of the facility fire or site-wide earthquake (DOE 1996). The consequences of radiological accidents are presented with worker and public doses. The worker doses are presented for the population of site workers and for an MEI who is standing 250m from the facility for 2 hours. The public doses are also presented for the population and for an MEI who is assumed to be located at the site boundary for 2 hours following the accident. The public population dose calculations assume no evacuation to mitigate the consequences. The MEI (worker or public) would be downwind and in the highest predicted concentration of the released material. The accident consequences are unmitigated. Many accidents would be mitigated, for example, by building HEPA filtration, fire suppression systems, etc.

The chemical accidents are presented with the frequencies and exposure concentrations for the postulated accident scenarios. For toxic gas releases of chlorine gas and anhydrous hydrogen fluoride, the accident scenarios have release times based upon a credible cylinder valve leak accident using typical atmospheric conditions for Y-12.

D.7.4 Radiological Accidents

D.7.4.1 *Criticality Accidents*

A criticality accident is defined as the release of energy and radiation resulting from an inadvertent self-sustaining or divergent chain reaction. Criticality accidents have been evaluated for Y-12 facilities that store or process enriched uranium. All recorded criticality accidents have been initiated by human error. The four main categories of criticality initiating events are those resulting from administrative error (procedural non-compliance), solutions being introduced into unfavorable geometries, holdup in fissile material equipment, and natural phenomena events. The DOE Headquarters Office of Oversight recently completed a field inspection and review of criticality safety at several DOE sites including Y-12. While the team noted no imminent hazards, several recommendations were made to improve criticality safety including two safety issues that warranted a formal response from Y-12. These two safety issues are related to fissile material movements and annual operation reviews (DOE 2000a, DOE 2000b).

Administrative Errors (Procedural Noncompliances). The nuclear criticality safety evaluation (CSE) identifies the limits and conditions necessary to ensure that fissile material operations comply with the double contingency principle. Compliance with the double contingency principle ensures that no single failure, either administrative or passive design, can result in the potential for a criticality accident. The criticality safety requirement (CSR)/criticality safety analysis (CSA) is used to document the requirements identified in the CSE. From the CSR/CSA, criticality safety requirements are incorporated directly into procedures, postings, or other implementing documents.

This scenario is initiated from a human/manual-operator action that could result in a criticality event. The improper handling or storage of material can create the potential for a criticality event. Operations are conducted in accordance with administrative controls (e.g., operating procedures or CSA postings) that incorporate the required nuclear criticality limits and conditions.

Solutions in Unfavorable Geometries. Uranyl nitrate solutions are present in tanks and equipment at Y-12. Administrative programs are in place to control the geometry of process equipment and containers used in solution processing areas to a geometrically favorable diameter and depth. In this event scenario category, solutions can leak from safe tanks or piping onto floor surfaces, backflow through interfacing safe piping to unsafe geometries, be released to unsafe containers by an operator error during transfer, or collect in equipment removed for maintenance. Design and/or procedural requirements on the interfaces of other systems with systems containing enriched uranium solutions and work control practices provide for the incorporation of features that will prevent solution from moving from a safe geometry to an unsafe geometry.

Holdup in Fissile Material Equipment. Dry enriched uranium holdup material can be collected in equipment such as filters, gloveboxes, open cans, and ventilation ductwork during normal operations. This scenario can involve the buildup of material inside these areas to the point of a critical amount or the material being moderated by the introduction of water from roof leaks, fire sprinkler discharge, or other piping failures. The majority of unsafe geometry equipment has passive design features (e.g., drain holes) to prevent these events.

Natural Phenomena. Beyond-design-basis natural phenomena initiators could result in spilling of solutions and/or the rearrangement of containers or metal parts into a critical configuration. Flooding could result in moderation of enriched uranium in the storage containers in the Y-12 facilities. Double contingency is applied to the storage of all fissile material so that rearrangement or flooding from a natural phenomena initiator is not likely to initiate a criticality accident.

Properties of Hazardous Material. The principal product of a criticality accident is radiation which arises from:

- Prompt gamma photons and neutrons resulting from the fission reaction itself
- Gamma and beta radiation from the radioactive decay of fission products produced by the reaction
- Radiation from the radioactive decay of materials surrounding the fission reaction that have been activated by neutrons

The prompt radiation is traditionally viewed as the most significant because, in the first pulse of an accident, an individual can take no actions to limit the dose from this source. The prompt dose is solely a function of pulse size, duration, distance, and intervening shielding. In an actual moderated criticality accident, the prompt radiation will be predominately gamma photons because of walls, equipment, etc., that absorb neutrons.

Analysis for HEU Storage Mission Proposed Alternatives

Either a new HEU Materials Facility or an addition to Building 9215 (Alternative 2B) is proposed for the HEU Storage Mission at the Y-12 Plant. These new facilities are meant to expand and consolidate the storage of HEU in one modern facility built to current codes and standards. Additionally, the new HEU storage facility will make greater use of engineered controls in lieu of administrative controls when possible. Thus, the controls that prevent or mitigate accidents will be more reliable. The likelihood of accidents involving HEU will decrease with the new facility over the present storage facilities. The likelihood of these accidents is expected to be significantly lower by a factor of 2 to 5. These facilities would be built to provide necessary improvements in safeguards and security, environmental safety and health (ES&H), and maintenance costs. A flood-induced criticality accident is the only criticality accident significantly affected by the location of the new facilities. Stream flooding is not credible except at elevations below 971 ft. Some HEU is presently stored below this level. The proposed new HEU Materials Facility or addition to Building 9215 would be constructed at an elevation above the predicted PC-3 (10,000-year return period) flood level and the beyond-design-basis flood would no longer be a concern. In addition, design and construction would ensure that flooding from rainfall runoff or roof ponding would not occur.

Source Term Calculations

The potential fission yield from a nuclear criticality accident varies according to the type of fissile material (i.e., solution, moderated and reflected, or dry powder or metal). DOE-HDBK-3010-94 (DOE 1994b) suggests values for fission yields of 1×10^{18} fissions for a fully moderated and reflected solid system and 1×10^{17} fissions for a dry powder or metal system. A solution criticality accident is the worst-case event and would yield an initial pulse of 1×10^{18} fissions followed by additional pulses over a period of 8 hr for a total of 1×10^{19} fissions.

Consequences

The consequences associated with a solution criticality accident have been evaluated using the prompt dose calculations and those associated with the CEDE. The predicted prompt dose for a solution criticality accident with an initial pulse of 10^{18} fissions (taking no credit for attenuation due to concrete, steel, or other intervening shielding material that might provide a significant dose reduction) drops below 100 rem within 19 m from the accident, below 25 rem at 35 m, and below 1 rem at 142 m. Acute lethal exposures can be received by unshielded persons who are within 5 to 10 m of an accident. Because of the potential for operator fatality, the consequence rating is "High." No credit is taken for shielding that may be available to any criticality accident that occurs inside the building. Assuming a ground-level release of fission products, the fission product release and radiation dose predicted for a moderated or dry metal criticality accident would be 10 to 100 times less than that of a solution criticality accident.

Although there is a potential for significant harm to operators or nearby workers, none of the nuclear criticality accidents are expected to result in a radiation dose that would cause fatalities among collocated workers or challenge the off-site evaluation guideline of 25 rem CEDE for an MEI member of the public. The evaluation guideline, while not considered an acceptable public exposure, is well below a level generally accepted as a value indicative of no significant health effects (i.e., low risk of latent health effects and virtually no risk of prompt health effects). DOE strives to reduce risks through preventive and mitigative measures to the extent practicable. Table D.7.4-1 summarizes the results for a criticality accident at Y-12 based upon the causes listed above. The on-site population doses are based upon an accident at Building 9212 as the bounding case (collocated employees are located closer to the building).

TABLE D.7.4–1.—*Summary Results for Criticality Accident Scenarios*

Unmitigated Accident Frequency (yr^{-1})[a]	Estimated Source Term and Consequences	Unmitigated Scenario Class	Preventors/ Mitigators	Mitigated Scenario Class
$1 > F > 10^{-2}$	**Release:** 1.0 x 10^{19} fissions; **collocated worker:** MEI less than 8 rem, 870 person-rem, 0.35 LCF; **off-site public:** MEI less than 3 rem, 8.6 person-rem, 4 x 10^{-3} LCF	I	Administrative controls, engineered controls, criticality accident alarm system, emergency management	II

[a] Without preventive measures
Source: Fisher 1995.

Criticality accident alarm systems mitigate the consequences of a criticality by alerting personnel to evacuate the affected area. Personnel are trained, thus reducing their exposure to radiation from continuing or subsequent criticality. The criticality accident alarm systems cannot prevent personnel from receiving a prompt dose from a criticality, but they can mitigate further exposure.

D.7.4.2 *Fire Events Involving Radioactive Materials*

The release of radioactive material in the event of a fire has been evaluated for Buildings 9720-5, 9204-4, 9204-2E, 9212, 9215, 9206, 9720-38, and 9201-5 (see Table D.7.2-1). The released materials include enriched uranium (solids and chips), depleted uranium, as well as uranium in solvents, thorium organics, and oil. PHAs were performed to screen the potential fire events and determine the worst-case scenarios. Accident frequencies and consequences were compared with a risk matrix from DOE STD-3011-94. These scenario classes included high frequency-low consequence events as well as low frequency-high consequence events. Dominant accidents, those that were categorized as Scenario Classes I and II, were then evaluated further. Structures, systems, and components were identified that either reduce the frequency or the consequences for the dominant scenarios. External fire scenarios that could involve multiple buildings were also considered. However, based on the design, construction and location of the facilities, no credible scenarios involving multiple buildings were identified.

Properties of Hazardous Material

The primary hazardous materials of concern are uranium and uranium compounds. They represent the most radioactive hazard for which a large, airborne, respirable release is possible. The typical enriched uranium (93.5 percent ^{235}U) that is present has a specific activity of 7 x 10^{-5} Ci/g and an inhalation dose conversion factor of 1.23 x 10^{8} rem/Ci CEDE. Higher enrichments do exist in limited activities; however, they will not significantly impact the consequences of the postulated accidents. Depleted uranium is present in large quantities at Y-12. Depleted uranium has a specific activity of 4 x 10^{-7} Ci/g and an inhalation dose conversion factor of 1.20 x 10^{8} rem/Ci CEDE. The toxicological effects outweigh the radiological effects for depleted uranium. Thorium and small quantities of other radionuclides such as plutonium, niobium, technetium, cesium, cerium, and neptunium may also be present in the Y-12 facilities. Fires involving materials typically present in other industrial facilities (solvents, organics, oils) were screened out as typical industrial hazards unless they initiated a fire involving uranium/uranium compounds.

Release Mechanism

Building fires involving enriched uranium were assumed as the worst-case scenarios. No credit was taken for separation of materials, storage containers, or building structure to assure the analysis did not assume any mitigation. Because of security concerns, specific events/inventories are not identified in the tabular results.

Analysis for HEU Storage Mission Proposed Alternatives

Either a new HEU Materials Facility (Alternative 2A) or Building 9215 (Alternative 2B) addition to store HEU is proposed under the HEU Storage Mission Alternatives. The conceptual design analysis of either facility to store HEU indicates that the frequency of fire would be controlled by limiting combustible materials from the facilities. The new facility would be constructed entirely of concrete and the contents would provide minimal combustible material loading. The potential radiological dose from material released by a fire based on the expected maximum inventory is less than 25 rem at 350 m (distance to Y-12 Emergency Response Boundary). Considering the segmentation of the inventory, the use of fire barriers, and the noncombustible building construction, the consequences of any release would be expected to be below the results presented for the existing facilities by a factor of 2 to 5. Current storage facilities do contain combustible materials or were built using combustible materials. The lower combustible material loading both prevents major fires and mitigates the fuel available for a fire.

Source Term Calculations

The source term is the amount of airborne respirable material dispersed from the accident scene and is calculated as the product of the material at risk (MAR), the damage ratio of the container, the airborne release fraction, the respirable fraction, and the leak path factor for the building. The MAR was based on the area and duration of the fire assumed for the scenarios. The damage ratio and leak path factor depend on the fire and container (building) characteristics as well as the nature of the released material. A conservative upper bound of 1.0 was assumed for both the damage ratio and leak path factor.

Source terms used to calculate the potential on-site and off-site consequences of a large fire were based on either (1) a limiting facility inventory (an inventory administratively controlled below the amount required to exceed the 5-rem threshold for a “High” consequence level event), or (2) by assuming that a fire involved the maximum inventory that could be consumed in the worst-case building fire.

Consequences

The consequences of a radiological fire in the facilities at Y-12 include potential exposure to airborne releases of various forms of uranium and uranium compounds. The potential consequences of the dominant accident scenarios are presented in Table D.7.4-2.

TABLE D.7.4–2.—*Summary Results for Radiological Fire Scenarios* [Page 1 of 3]

Building/ Accident	Unmitigated Accident Frequency (yr^{-1})	Estimated Source Term And Consequences	Unmitigated Scenario Class	Preventers/ Mitigators	Mitigated Scenario Class
Building 9212/ Safe Bottle Storage Area Organics Fire	$10^{-4} \leq F \leq 10^{-2}$	**Release:** 60 g airborne EU; **collocated worker:** MEI 1.13 rem, 1,067 person-rem, 0.43 LCF; **off-site public:** MEI 0.67 rem, 15.3 person-rem, 0.008 LCF	II	Sprinklers	III
Building 9212/ Chip Fire	$10^{-2} < F \leq 1$	**Release:** 100 g airborne EU; **collocated worker:** MEI 0.19 rem, 180 person-rem, 0.071 LCF; **off-site public:** MEI 0.11 rem, 2.6 person-rem, 0.0013 LCF	I	HEPA filters	III
Building 9212/ Dry Vacuum Fire	$10^{-2} < F \leq 1$	**Release:** 29 g airborne EU; **collocated worker:** MEI 0.05 rem, 51 person-rem, 0.02 LCF; **off-site public:** MEI 0.03 rem, 0.71 person-rem, 4 x 10^{-4} LCF	III	Flame-resistance bags	IV
Building 9212/ B-1 Wing Fire	$10^{-4} \leq F \leq 10^{-2}$	**Release:** 500 g airborne EU; **collocated worker:** MEI 0.93 rem, 890 person-rem, 0.35 LCF; **off-site public:** MEI 0.55 rem, 13 person-rem, 0.006 LCF	II	Sprinklers and administrative controls	III
Building 9206/ Safe Bottle Storage Area Organics Fire	$0^{-4} \leq F \leq 10^{-2}$	**Release:** 189 g airborne EU; **collocated worker:** MEI 0.05 rem, 472 person-rem, 0.19 LCF; **off-site public:** MEI 0.30 rem, 7.0 person-rem, 2.4 x 10^{-3} LCF	II	Sprinklers	III

TABLE D.7.4–2.—*Summary Results for Radiological Fire Scenarios* [Page 2 of 3]

Building/ Accident	Unmitigated Accident Frequency (yr^{-1})	Estimated Source Term And Consequences	Unmitigated Scenario Class	Preventers/ Mitigators	Mitigated Scenario Class
Building 9206/ Exhaust system baghouse fire	$10^{-2} < F \leq 1$	**Release:** 21 g airborne EU; **collocated worker:** MEI 0.04 rem, 37 person-rem, 0.015 LCF; **off-site public:** MEI 0.02 rem, 0.54 person-rem, 2.7×10^{-4} LCF	III	Equipment design, administrative controls	IV
Building 9206/ Argon glovebox pyrophoric U-compound fire	1 $10^{-2} < F \leq 1$	**Release:** 7 g airborne EU; **collocated worker:** MEI 0.01 rem, 12 person-rem, 0.0050 LCF; **off-site public:** MEI 0.01 rem, 0.18 person-rem, 9×10^{-5} LCF	III	Oxygen monitor, pressure release valves, HEPA filters/ equipment design	IV
Building 9206/ Building fire	$10^{-2} < F \leq 1$	**Release:** 800 g EU/16.2 g DU airborne; **collocated worker:** MEI 1.49 rem, 1400 person-rem, 0.57 LCF; **off-site public:** MEI 0.56 rem, 21 person-rem, 0.01 LCF	I	Sprinklers, building/ equipment design, administrative controls	III
Building 9215/ Hydraulic oil pool fire	$10^{-2} < F \leq 1$	**Release:** 75 g airborne EU; **collocated worker:** MEI 0.14 rem, 130 person-rem, 0.053 LCF; **off-site public:** MEI 0.07 rem, 1.9 person-rem, 0.001 LCF	III	Hydraulic oil that prevents ignition	IV
Building 9204-2E/ building fire	$10^{-4} \leq F \leq 10^{-2}$	**Release:** 22 kg airborne EU; **collocated worker:** MEI 40.92 rem, 3300 person-rem, 1.3 LCF; **off-site public:** MEI 15.53 rem, 570 person-rem, 0.28 LCF	I	Fire protection/ inventory limits/ Non-combustible building	II
Building 9204-4/ building fire	$10^{-4} \leq F \leq 10^{-2}$	**Release**: < 200 g airborne EU; **collocated worker:** MEI 0.37 rem, 29 person-rem, 0.012 LCF; **off-site public:** MEI 0.14 rem, 5.2 person-rem, 0.0026 LCF	II	Fire protection/ inventory limits/ non-combustible building	III

TABLE D.7.4–2.—*Summary Results for Radiological Fire Scenarios* [Page 3 of 3]

Building/ Accident	Unmitigated Accident Frequency (yr^{-1})	Estimated Source Term And Consequences	Unmitigated Scenario Class	Preventers/ Mitigators	Mitigated Scenario Class
Building 9720-5/fire	$10^{-4} \le F \le 10^{-2}$	**Release:** 18.3 kg airborne EU; **collocated worker:** MEI 56.91 rem, 2700 person-rem, 1.1 LCF; **off-site public:** MEI 7.01 rem, 470 person-rem, 0.24 LCF	I	Fire protection, administrative controls	III
Building 9720-38/fire	$10^{-2} < F \le 1$	**Release:** 35 kg DU and 15 kg normal U airborne; **collocated worker:** MEI 1.21 rem, 50 person-rem, 0.020 LCF; **off-site public:** MEI 0.15 rem, 0.72 person-rem, 3.6 x 10^{-4} LCF	I	Administrative/ equipment/fire protection	IV
Building 9201-5/fire involving DU	$10^{-4} \le F \le 10^{-2}$	**Release:** 5.1 kg DU/DU alloy airborne; **collocated worker:** MEI 0.12 rem, 5.86 person-rem, 0.0023 LCF; **off-site public:** MEI 0.04 rem, 1.0 person-rem, 5 x 10^{-4} LCF	III	Administrative control of inventory	IV
Building 9201-5/DU chip dryout	$10^{-2} < F \le 1$	Same as above	III	Same as above	IV
Building 9201-5/Duct/filter fire (DU)	$10^{-4} \le F \le 10^{-2}$	Same as above	III	Same as above	IV
Building 9201-5/ Building fire (DU)	$10^{-4} \le F \le 10^{-2}$	Same as above	III	Same as above	IV
On-site transport of HEU	$10^{-2} \le F \le 1$	**Release:** 0.41 kg EU airborne; **collocated worker:** MEI 1.28 rem, 60 person-rem, 0.024 LCF; **off-site public:** MEI 0.37 rem, 11 person-rem, 0.0053 LCF	I	Administrative controls	II

Note: DU-depleted uranium; EU-enriched uranium; HEPA-high-efficiency particulate air
Source: Fisher 1995 and Table D.7.2.1–1.

D.7.4.3 *Release Due to Explosion*

The bases for interim operation for Buildings 9212, 9206, 9204-2E, 9215, 9204-4, 9720-5, and the safety analysis report for 9720-38 (see Table D.7.2-1) identified the hazardous material inventories that could be involved in a release resulting from an explosion. The explosion accidents in the facility accident analyses were screened for the higher consequence levels using a conservative consequence assessment. An accident was not considered for further analysis if it was estimated to be less frequent than 10^{-6}/yr or if the consequences were bounded by the consequences associated with a facility fire for Buildings 9204-2E, 9215, 9204-4, 9720-5, and 9720-38. The dominant postulated explosion scenarios identified in the accident analyses are associated with organic chemical and nitrate reactions resulting in the formation of nitrated organic compound (red oil) explosions and fume-off reactions; flammable gas leaks from hydrogen, natural gas, and oxygen; as well as chemical reactions, steam and dust explosions. Table D.7.4-3 presents a summary of results for the explosion or thermal scenarios that were categorized in Scenario Classes I and II.

TABLE D.7.4–3.—*Summary Results for Explosion Scenarios*

Accident	Unmitigated Accident Frequency (yr^{-1})	Estimated Consequences	Unmitigated Scenario Class	Preventers/ Mitigators	Mitigated Scenario Class
Organic/nitrate solvent reaction, red oil explosion	$10^{-4} \leq F \leq 10^{-2}$	Worker fatality; low consequences to collocated workers and the public.	I	Design features, administrative controls	II
Fume-off explosion	$10^{-2} < F \leq 1$	Worker injury; low consequences to collocated workers and the public.	I	Design features, administrative controls, personal protective equipment	III
Hydrogen gas explosion	$10^{-4} \leq F \leq 10^{-2}$	Worker fatality; low consequences to collocated workers and the public.	I	Design features, administrative controls	II
Natural gas explosion	$10^{-2} < F \leq 1$	Worker fatality; low consequences to collocated workers and the public.	I	Design features, administrative controls	II
Chemical reaction	$10^{-2} < F \leq 1$	Worker injury; low consequences to collocated workers and the public.	I	Administrative controls, personal protective equipment	III

Source: Table D.7.2–1.

The potential exists for a fire to develop as the result of an explosion. The effects of a fire developing after an explosion were assessed and were determined to be bounding for any explosion event. The explosion events are likely to occur in open areas with operators located in the immediate area. A nearby worker could be seriously injured or killed due to the physical effects of the explosion. These effects cannot be mitigated if the operator is in the immediate area; therefore, the consequences remain “High” to facility workers. However, significant quantities of radioactive material are not expected to become airborne.

Properties of Hazardous Material

The hazardous materials of concern are uranium and uranium compounds that present radiological hazards as the consequence of the postulated accidents. Thorium and small quantities of other radionuclides such as plutonium, niobium, technetium, cesium, cerium, and neptunium may also be present in the Y-12 facilities. The radiological doses from thorium and these small quantities of radionuclides are dominated by the dose resulting from an accidental release of enriched uranium.

Release Mechanism

The release mechanism was an explosion that involved the HEU materials in segmented locations in each analyzed facility. The HEU materials are present in small amounts in the potential accident locations often in nonrespirable forms and, in some cases, shielded from the force of the blast by equipment. No credit was taken for separation of materials, storage containers, or building structure.

Analysis for HEU Storage Mission Proposed Alternatives

Either a new HEU Materials Facility (Alternative 2A) or an addition to Building 9215 (Alternative 2B) is proposed for the HEU Storage Mission at the Y-12 Plant. These new facilities are meant to expand and consolidate the storage of HEU in one modern facility built to modern codes and standards. Additionally, the new HEU storage facility will make use of engineered controls in lieu of administrative controls when possible. Thus the controls that prevent or mitigate accidents will be more reliable. The likelihood of accidents involving HEU will decrease with the new facility over the present storage facilities. The likelihood of these accidents is expected to be significantly lower. The conceptual design analysis of the HEU Materials Facility or Building 9215 expansion to store HEU indicates that the frequency of an explosion would be controlled by excluding materials from the facilities that could cause an explosion. The new facilities would be constructed entirely of concrete and the contents would provide minimal combustible or flammable material loading. Considering the segmentation of the inventory, the use of fire barriers, and the lack of explosive materials, any release would be expected to be below the analytical results shown in Table D.7.3-3.

Source Term Calculations

The source term is the amount of airborne respirable material and is calculated as the product of the MAR, the damage ratio of the container, the airborne release fraction, the respirable fraction, and the leak path factor for the building. The MAR is based on the inventory in the area of the explosion assumed for the scenarios. The damage ratio and leak path factor depend on the explosion and container (building) characteristics as well as the nature of the released material. A conservative upper bound of 1.0 is assumed for both the damage ratio and the leak path factor.

Consequences

The consequences of an explosion in the facilities at Y-12 include potential exposure to small airborne releases of various forms of uranium and uranium compounds. All of the dominant explosion scenarios resulted in “Moderate” to “High” consequences to the worker but did not produce any significant radiological consequences to the collocated worker or off-site public. The potential consequences of the dominant accident explosion scenarios are presented in Table D.7.4-3. The explosion could be the initiator for a large building fire and this scenario was discussed in the preceding section.

D.7.4.4 *Beyond-Design-Basis Seismic Events*

To assure conservative consequence estimates, the beyond-design-basis seismic events with frequencies less than 5 x 10^{-4}/yr (2000-yr recurrence period) were considered. The accident forces associated with these events are determined from guidance in DOE Order 420.1, *Facility Safety* and DOE STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities.* In DOE Order 420.1 and DOE STD-1020–94, event frequencies provide a baseline for determining the natural phenomena resistance of structures, systems, and components important to safety. Seismic events of greater magnitudes

than those defined in the DOE requirements were selected for evaluation to assure that beyond-design-basis effects were being examined.

Further conservatism was included by a three-distinct-event criterion, where the natural phenomena initiator itself is considered the first distinct event. Two additional distinct events, defined as events which assume a pre-existing abnormal facility/equipment condition or an abnormal facility/equipment response, were postulated to maximize the consequences of the seismic event. The probability of fires following a beyond-design-basis seismic event is very high and assumed to be one for this analysis.

For the beyond-design-basis seismic events, structural collapse was postulated to be accompanied by the most significant internal events, including fire and explosions (the three-distinct-event criterion). This postulated sequence, coupled with the short distances to the Y-12 Emergency Response Boundary, results in overly conservative values for maximum doses to individuals at the boundary. Y-12 facilities that have the potential for such significant internal events are Buildings 9204-4, 9206, 9212, and 9215.

In general, a beyond-design-basis seismic event is a bounding accident scenario because it destroys building confinement and includes all significant individual fire and explosion scenarios.

Building 9204-4

For Building 9204-4, a beyond-design-basis seismic event was assumed to cause the facility to collapse. A ruptured flammable gas main was assumed to cause a plume of flammable gas to momentarily develop and immediately ignite. This served as an ignition source for oil fires. The event was assumed to affect the entire building. Energy sources included flammable gases and combustible oils.

Building 9206

For Building 9206, a beyond-design-basis seismic event was assumed to cause the facility to collapse, with a natural gas explosion, and accompanying fire. Energy sources included the flammable gases, combustible solids, and organic liquids.

Building 9212

For Building 9212, a beyond-design-basis seismic event was assumed to cause the building to progressively fail. A hydrogen explosion was postulated to occur, and a solvent fire was postulated to occur as well.

Building 9215

For Building 9215, a beyond-design-basis seismic event was assumed to cause the total building to collapse, followed by a propane explosion and a number of oil fires.

Analysis for HEU Storage Mission Proposed Alternatives

Either a new HEU Materials Facility (Alternative 2A) or an addition to Building 9215 (Alternative 2B) is proposed for the HEU Storage Mission at the Y-12 Plant. These new facilities are meant to expand and consolidate the storage of HEU in one modern facility built to current codes and standards. Additionally, the new HEU storage facility will make use of engineered controls in lieu of administrative controls when possible. Thus the controls that prevent or mitigate accidents will be more reliable. In comparison to the present storage facilities, the likelihood of a seismic event with forces greater than the planned design is expected to be significantly lower. The conceptual design analysis of the HEU Materials Facility or Building 9215 expansion to store HEU indicates that the new facilities would be designed and built to DOE PC-3 design standards and to current codes. That is, the performance goal for the annual probability of exceeding acceptable behavior (i.e., maintaining worker safety, confinement of hazards, safe operations) is 1 x 10^{-4}/yr. The proposed new facilities would be less subject to seismic force damage, and the resulting frequency for a design basis seismic event would be 5 x 10^{-4}/yr (a 2,000-year return period). The frequency of the beyond-design-basis seismic event would be less than 1 x 10^{-4}/yr. For comparison, the existing HEU storage buildings have a 5 x 10^{-4} /yr frequency estimate for a beyond-design-basis seismic event. Major consequences of a severe seismic event can include both a criticality accident and a fire. The frequency of a fire would be controlled by limiting combustible materials in the new facilities. The new facilities would be constructed primarily of reinforced concrete and the contents would provide an extremely low combustible material loading. Considering the segmentation of the inventory, the use of fire barriers as proposed in the HEU Materials Facility (and Building 9215 expansion), and the noncombustible building construction, any release as a result of the design basis seismic event would be expected to occur at a lower frequency. Off-site exposures to an MEI would be expected to be higher because the building will be closer to the Y-12 Emergency Response Boundary.

Consequence Calculations and Risk

The source terms for the release from each building and the consequences are presented in Table D.7.3-4. Because these are beyond-design-basis seismic events, no mitigation was considered.

TABLE D.7.4–4.—*Estimated Consequences of a Beyond-Design-Basis Seismic Event*

Building	Source Term	Collocated Worker	Public
9204-4	950 g of HEU	MEI: 2.0 rem Population: 140 person-rem, 0.056 LCF	MEI: 0.67 rem Population: 25 person-rem, 0.012 LCF
9206 Complex	6.2 kg of HEU	MEI: 11.5 rem Population: 10,944 person-rem, 4.4 LCF	MEI: 6.8 rem Population: 150 person-rem, 0.08 LCF
9212	6.8 kg of HEU	MEI: 13 rem Population: 12,000 person-rem, 4.8 LCF	MEI: 7.5 rem Population: 180 person-rem, 0.088 LCF
9215	1.9 kg of HEU	MEI: 3.6 rem Population: 3,400 person-rem, 1.3 LCF	MEI: 2.0 rem Population: 49 person-rem, 0.025 LCF

Source: Fisher 1995 and Table D.7.2.1-1.

D.7.4.5 *Evaluation Basis Tornado*

High winds and tornadoes have been evaluated for the Y-12 Site. The consequences that could result from these accident initiators were bounded by fire and criticality events. Evaluation basis tornado events were postulated separately for Buildings 9206 and 9212. The evaluation basis tornado event is defined as a tornado with a combined rotational and translational speed of 130 mph. This event has a 50,000-year return period (LMES 1995b).

This event could result in widespread roof and wall damage to the facilities. The effects of tornado missiles would result in scenarios similar to loss of confinement due to explosion. Loss of confinement would result in uranium-contaminated or uranium-containing solvent spills and fire. The source term for a spill of all contaminated solvent with subsequent burning of the spilled solvent is described in the fire scenario. The consequences of a tornado-initiated accident would be bound by the consequences estimated for fires. Additional release of uranium-bearing particulate material could be expected. The most significant radiological consequences would be from a criticality accident (Section D.7.3.1) or fires subsequent to the tornado. The frequency of a tornado event resulting in a significant radiological release was characterized using the DOE-STD-3011-94 criteria as “Extremely Unlikely” (DOE 1994a). The radiological consequences for the MEI off-site and the collocated worker result in a “Moderate” to “High” consequence classification for both Building 9206 and Building 9212.

A tornado-initiated release of material from the Environmental Management Waste Management Facility included under the No Action alternative in this SWEIS was postulated in the *Remedial Investigation/Feasibility Study* (RI/FS) report (DOE 1998a). The postulated release would be caused by the tornado scouring the top 6 in. of waste from the surface of any open cells and depositing this material over a 26 km^2 (10 mi^2) area of farmland. The assumptions of using a 26 km^2 (10 mi^2) area and farmland are considered conservative for the consequence dose calculations. A review of historical evidence indicates that most objects fall out from a tornado within 80 to 145 km^2 (50 to 90 miles) but some objects have reportedly been carried up to 210 miles. The latent cancer risk caused by the dispersal of material is estimated to be 2.2×10^{-4} with a population dose of less than approximately 0.4 person-rem. The report quotes an overall risk presented by the low frequency of occurrence (2×10^{-5}/yr), the 30-year life of the facility, and the latent cancer risk yields an overall risk estimate of 1.32×10^{-7} of an LCF. Additional information is available in the report.

D.7.4.6 *Flood*

In accordance with DOE STD-1020-94, the effects of a flood with a frequency of 5×10^{-4}, or a return period of 2,000 years, was evaluated. The flood hazard studies that were used to define the flooding conditions at the Y-12 Plant included the effects of stream flooding, upstream dam failures, snow loading, and intense local precipitation. Four buildings were identified as having a potential for flooding: Building 9720-5, Building 9204-4, Building 9204-2 and Building 9204-2E. Prevention of a criticality accident in the event of flooding is based on storing enriched uranium above the projected flood level or otherwise ensuring the storage arrangement meets the double contingency principle. Simply flooding the storage area will not result in a criticality accident unless several adjacent containers fail or leak. The proposed HEU Materials Facility or the Building 9215 expansion that would consolidate the HEU presently stored in Buildings 9720-5, 9204-4, and 9204-2E would be constructed above the 2,000-year return period flood level, above any potential flooding from intense local precipitation, and designed to prevent flooding from roof ponding.

Frequency

The estimated frequency of a flood that results in a criticality accident is less than 1×10^{-6}/yr.

Consequences

The consequences associated with a flood include moderation of fissile material and the potential for a criticality accident. The potential consequences to workers, collocated workers, and MEI off-site are the same as those discussed in Section D.7.3.1 for other criticality accidents.

D.7.4.7 *Wildfires*

A wildfire could be initiated by a lightning, an aircraft crash, a burning cigarette, the sun shining on a piece of glass, or even a "controlled burn" during windy conditions. Fires on the Oak Ridge Reservation are not common but they do occur. Records indicate that 9 wildfires have occurred on the Oak Ridge Reservation since 1966. The largest area burned by a wildfire was 400-500 acres. This wildfire occurred April 7, 1966 and originated in the Y-12 burning pits. Another significant wildfire occurred February 21, 1977. This wildfire burned uncontrolled on the Reservation on Pine Ridge, immediately west of a 500 kv transmission line. This wildfire resulted from brush piles being burned by a TVA contractor clearing the Watts Bar-Roane transmission line right-of-way on the northwest slopes of Pine Ridge. The total area burned by this fire was approximately 48.8 acres.

Although wildfires are not expected to reach Y-12 facilities, hot embers from such a fire could blow onto roof tops, potentially initiating a building fire. Depending on the proximity of the fire and wind conditions, ash and other byproducts from a wildfire could plug fresh air intakes and exhaust filters for the Y-12 facilities. Heavy smoke could cause the filters to become clogged or "loaded", which could lead to failure in the filtering system.

D.7.5 Chemical Accidents

D.7.5.1 *Toxic Chemical Release Due to Fire*

Releases of toxic materials from Y-12 facilities as a result of a large fire were evaluated. Accident frequencies and consequences were characterized using a risk matrix from DOE STD-3011-94. Dominant accidents, those that were categorized as Scenario Class I or II, were then evaluated further. Dominant scenarios were identified for Buildings 9202, 9204-2E, 9720-26, 9720-38 and 9206. Chemicals released as a result of these accidents are beryllium compounds, lithium hydride, acetonitrile, chromic acid, phosphoric acid, mercury, and depleted uranium.

Properties of Hazardous Material

The toxicological hazard from inhalation of depleted uranium is more severe than the radiological hazard. Other hazardous chemicals/ compounds are also present in varying amounts and chemical forms. Many chemicals that are used at the Y-12 Plant do not pose a risk to the public but do pose a significant risk to on-site facility workers. These chemicals (such as strong acids or caustic solutions, small quantities of flammable compounds, NaK heat transfer fluid, etc.) can cause serious thermal or chemical burns, lost-time accidents, maiming (loss of an eye or use of a limb), and are potentially lethal. In December 1999, a chemical explosion accident occurred within the skull caster furnace section of Building 9201-5 at the Y-12 Plant. The explosion occurred as workers were cleaning up a spill of sodium-potassium alloy (NaK). The NaK spill resulted from a combination of procedural errors during the replacement of the skull caster furnace crucible. NaK is pyrophoric and can be explosive under certain circumstances (e.g., when exposed to air it can form a potassium superoxide that is shock-sensitive and explosive when combined with hydrocarbons, such as mineral oil). As part of the preparation for removing the spilled NaK, the inside walls of the crucible containing the spilled NaK were repeatedly sprayed with mineral oil. Mineral oil has historically been used as a "bath" - that is, NaK or NaK oxides were placed in a bucket of mineral oil. Spraying mineral oil was apparently a practice that was used by workers at the Y-12 Plant in the past. This approach was made without any analysis of the potential hazards. The explosion occurred as a worker was attempting to break up the crust of the spilled NaK, using a steel rod. The explosion injured 11 workers, 3 of whom required hospitalization. As stated in the Type A Investigation Report of the explosion,Y-12 Plant management plans to discontinue the use of NaK systems across the Plant. They plan to collect and dispose of all NaK in the Y-12 Plant, including the material in Building 9201-5 and other areas at the Y-12 Plant. This accident, although serious in consequences to the involved workers, posed no risk to the public. Additional details regarding this accident can be found in the following document: *Type A Accident Investigation of the December 8, 1999, Multiple Injury Accident Resulting from the Sodium-Potassium Explosion in Building 9201-5 at the Y-12 Plant.*

Those fire accident scenarios which could result in an airborne release of hazardous material were compared to ERPG Values (or TEEL values if ERPG values are not established). An accident scenario was categorized as Scenario Class I or II if the accident could result in an off-site airborne hazardous material concentration exceeding the ERPG-2 guideline, or an on-site airborne hazardous material concentration exceeding the ERPG-3 guideline.

Release Mechanism

A fire that involves the maximum building inventory of hazardous materials was assumed to result in the worst-case scenario. Consequences of the dominant fire scenarios are presented in Table D.7.5-1.

Analysis for Special Materials Mission Proposed Alternative

A new Special Materials Complex is proposed for the Special Materials Mission (Alternative 3A) at the Y-12 Plant. This new complex of buildings and associated facilities is meant to consolidate production activities and the use of many special chemical compounds in one area of the Y-12 Plant while improving worker and public health and safety. This new materials complex would be built to modern codes and standards. Additionally, the new Special Materials Complex will make use of engineered controls in lieu of administrative controls when possible; thus, the controls that prevent or mitigate accidents will be more reliable. The likelihood of accidents involving the chemicals stored in the new complex will decrease with the new facility over the present process facilities. The likelihood of these accidents is expected to be significantly lower. The present locations that are being considered for the Special Materials Complex show that one of the candidate sites (Site 1) is located north of the Bear Creek Road and somewhat closer to the closest Y-12 Emergency Response Boundary and closer to the location of an MEI member of the public. This location would increase the likelihood of exceeding ERPG-2 (or TEEL-2) concentrations at the Y-12 Emergency Response Boundary if the same inventories of chemicals are stored at all of the candidate sites. However, the control of lower inventories could be used to reduce the potential for off-site exposure of the public below ERPG-2 (or TEEL-2) levels. It is possible that the lower inventories may not be conducive to efficient operations, but may be warranted to reduce the risk to the public of an off-site exposure greater than ERPG-2.

D.7.5.2 *Toxic Chemical Release Due to Loss of Containment*

Releases of toxic materials from Y-12 facilities as a result of loss of containment (spills) were evaluated. Accident frequencies and consequences were characterized with a risk matrix from DOE STD-3011-94. Dominant accidents, those that were categorized as Scenario Classes I and II, were then evaluated further. Dominant scenarios were identified for the 9206 Complex, Building 9401-3, and Building 9212. Chemicals released as a result of these accidents are nitric acid, sulfuric acid, and hydrogen fluoride.

Properties of Hazardous Material

The hazardous materials of concern are chemically toxic materials whose release as part of a loss of containment can result in potentially harmful airborne respirable concentrations of hazardous materials. Those release accident scenarios which could result in an airborne release of hazardous material were compared to the ERPG values (or TEEL values if ERPG values are not established). An accident scenario was categorized as Scenario Class I or II if the accident could result in an off-site airborne hazardous material concentration exceeding the ERPG-2 guideline, or an on-site airborne hazardous material concentration exceeding the ERPG-3 guideline.

TABLE D.7.5–1.—*Summary Results for Toxic Material Fire Scenarios*

Building/ Accident	Unmitigated Accident Frequency (yr^{-1})	Estimated Consequences	Unmitigated Scenario Class	Preventers/ Mitigators	Mitigated Scenarios Class
9202 Building Complex/ large building fire	$10^{-4} \leq F \leq 10^{-2}$	**MAR:** 181.4 kg beryllium compounds, 680.4 kg lithium hydride, and 453.6 kg acetonitrile thermal decomposition products; **collocated worker:** concentrates do not exceed ERPG-3 levels, 148 workers exposed to greater than ERPG-2 or TEEL-2 concentrations; **off-site public:** concentrations do not exceed ERPG-2 or TEEL-2	I	Limit on allowable hazardous material inventory	III
Building 9204-2E/ Fire on first , second, or third floor	$10^{-6} \leq F \leq 10^{-4}$	**MAR:** 113.4 kg chromic acid and 226.8 kg. phosphoric acid thermal decomposition products386 kg mercury; **collocated worker:** concentrations do not exceed TEEL-3 levels, 80 workers exposed to greater than TEEL-2 concentrations; **off-site public:** mercury concentrations may exceed TEEL-2	I	Fire prot. program; building structure; administrative controls	I
Building 9720-26/ Fire affects entire building	$10^{-4} \leq F \leq 10^{-2}$	**MAR:** 2,268,000 kg mercury; **collocated worker:** concentrations at 200m may exceed TEEL-3 levels, 80 workers exposed to greater than TEEL-2 concentrations; **off-site public:** concentrations may exceed TEEL-2	II	Fire protection program; building structure; very low loading of combustible materials; administrative controls	IV
Building 9720-38/ Fire affects entire building	$10^{-4} < F \leq 10^{-2}$	**MAR:** 1,350,000 kg DU; **collocated worker:** concentrations at 200m do not exceed TEEL-3, 190 workers exposed to greater than TEEL-2 concentrations; **off-site public:** concentrations do not exceed the TEEL-2	I	Thermally insulated containers used for some materials; restrictions on storage location of some materials	II
Building 9206/ DU wet chip fire	$10^{-2} < F \leq 1$	**MAR:** 115 kg DU; **collocated workers:** concentrations at 200m do not exceed TEEL-3 , 80 workers exposed to greater than TEEL-2 concentrations; **off-site public:** concentrations do not exceed TEEL-2	I	Administrative controls	I

Note: MAR-material at risk
Source: Table D.7.2-1

TABLE D.7.5–2.—*Summary Results* for *Toxic Material Loss of Containment Scenarios*

Building/ Accident	Unmitigated Accident Frequency (Yr^{-1})	Estimated Consequences	Unmitigated Scenario Class	Preventers/ Mitigators	Mitigated Scenario Class
9206 Complex/ Nitric acid tank failure due to external hazard accident	$10^{-4} \leq F \leq 10^{-2}$	**MAR:** 41,745 kg nitric acid; **collocated worker:** concentrations at 200 m do not exceed TEEL-3, potential worker injury, 80 workers exposed to greater than TEEL-2 concentrations; **off-site public:** concentrations do not exceed TEEL-2	II	Administrative controls	II
9206 Complex/ Nitric acid tank catastrophic failure	$10^{-2} < F < 1$	**MAR:** 41,745 kg nitric acid; **collocated worker:** concentrations at 200 m do not exceed TEEL-3, potential worker injury, 80 workers exposed to greater than TEEL-2 concentrations; **off-site public:** concentrations do not exceed TEEL-2	I	None	I
Multiple Buildings/ Spill of corrosive or reactive chemicals (equipment failure)	$10^{-2} < F \leq 1$	**MAR:** strong acid or reactive chemical; **collocated worker:** concentrations do not exceed TEEL-3potential worker injury or fatality; **off-site public:** concentrations do not exceed TEEL-2	I	Personal protective equipment, safety equipment	III
Building 9401-3/sulfuric acid tank failure due to external hazard accident	$10^{-4} \leq F \leq 10^{-2}$	**MAR:** 10,433 kg sulfuric acid; **collocated worker:** concentrations at 200 m do not exceed ERPG-3, potential worker injury, 80 workers exposed to greater than ERPG-2 concentrations; **off-site public:** concentrations do not exceed ERPG-2	II	Personal protective equipment, safety equipment	III
Building 9204-2/Sodium hydroxide tank failure due to external hazard accident	$10^{-4} \leq F \leq 10^{-2}$	**MAR**: 289,499 kg sodium hydroxide; **collocated worker**: concentrations at 200 m do not exceed ERPG-3, potential worker injury: 80 workers exposed to greater than ERPG-2 concentrations **off-site public:** concentrations do not exceed ERPG-2	II	Engineered design features, administrative controls	III

TABLE D.7.5–2.—*Summary Results for Toxic Material Loss of Containment Scenarios* (continued)

Building/ Accident	Unmitigated Accident Frequency (Yr^{-1})	Estimated Consequences	Unmitigated Scenario Class	Preventers/ Mitigators	Mitigated Scenario Class
Building 9212/ Release of hydrogen fluoride	$10^{-2} < F$	**MAR:** 600 kg hydrogen fluoride; **collocated worker:** concentrations at 400 m do not exceed ERPG-3, 310 workers exposed to greater than ERPG-2 concentrations, potential; **off-site public:** concentrations may exceed ERPG-2 levels 60m beyond the Y-12 Emergency Response Boundary, but will not reach the nearest residential area	I	Engineered design features, administrative controls	III
Building 1405/ Release of chlorine gas	$10^{-2} < F$	**MAR:**907 kg chlorine gas; **collocated worker:** concentrations at 400 m do not exceed ERPG-3, 1000 workers exposed to greater than ERPG-2 concentrations, potential worker fatality; **off-site public:** concentrations exceed ERPG-2 out to 1000 m, up to 6500 members of public exposed	I	Engineered design features, administrative controls	III

Note: MAR-material at risk
Source: Table D.7.2–1.

Release Mechanism

The release accidents were evaluated to determine the worst case scenario. In very high consequence scenarios (releases of hydrogen fluoride and chlorine) with widespread off-site public exposure, the accident scenarios have release times based upon a credible cylinder valve leak accident using typical atmospheric conditions for Y-12. Alternative, more realistic release scenarios were also evaluated. Table D.7.5-3 shows the consequences of the dominant loss of containment accident scenarios. Figures D.7.5-1 and D.7.5-2 show the extent of the potential plume radius for the loss of containment for anhydrous hydrogen fluoride and chlorine, respectively.

Analysis for HEU Storage Mission and Special Materials Mission Alternatives Under No Action - Planning Basis Operations Alternative

None of the proposed new facilities considered in this SWEIS would affect the dominant loss of containment accidents for the toxic chemicals at the Y-12 Plant. A note to the reader: Ownership and operation of the water treatment facilities presently at Y-12 have been transferred to the city of Oak Ridge. While this transfer does not eliminate the risk of a chlorine release to the Y-12 Plant workers or the public, it does terminate Y-12 control of these facilities.

FIGURE D.7.5–1.—*Estimated Radii of Emergency Response Planning Guidelines-2 and -3 Plumes for a Postulated Anhydrous Hydrogen Fluoride.*

FIGURE D.7.5–2.——*Estimated Radii of Emergency Response Planning Guidelines-2 and -3 Plumes for a Postulated Chlorine Release*.

APPENDIX E: AIR QUALITY

E.1 NONRADIOLOGICAL AIR QUALITY

This appendix supplements the analytical results in the Y-12 Site-Wide Environmental Impact Statement (SWEIS) main text. Modeling inputs and assumptions support the results presented in the nonradiological air quality section of Chapter 5, Environmental Consequences. Site-specific emissions from Y-12 are modeled in accordance with the guidelines presented in the U.S. Environmental Protection Agency (EPA) Guideline Air Quality Models (40 CFR 51).

The primary emission source of criteria pollutants at Y-12 is the Steam Plant (Building 9401-3). Impacts are estimated from criteria pollutant emissions associated with the No Action - Status Quo Alternative using the calculated heat input capacity of the Y-12 Steam Plant. The maximum criteria pollutant concentrations from operation of the Y-12 Steam Plant are calculated at boundary receptors. Modeling inputs include emission rates for the Y-12 Steam Plant operating at the calculated heat input capacity, 5 years of meteorological data (1992–1996), and receptors located at 100-m (328-ft) intervals on the Y-12 site boundary. The resulting criteria pollutant concentrations are compared to National Ambient Air Quality Standards (NAAQS) (40 CFR 50) and Tennessee Department of Environment and Conservation (TDEC) regulations (TDEC 1999).

Impacts from hazardous air pollutants (HAPs) resulting from the combustion of coal and Y-12 facility operations are estimated by comparison of the chemical emission rates with a Threshold Emission Value (TEV) based upon "industry-recognized" guidelines. The guidelines are as follows:

- American Conference of Governmental Industrial Hygienists (ACGIH) (threshold limit values [TLVs]), (ACGIH 1997)
- Occupational Safety and Health Administration (OSHA) (permissible exposure limits [PELs]), (ACGIH 1997)
- National Institute for Occupational Safety and Health (NIOSH) (recommended exposure limits [RELs]), (ACGIH 1997)
- Deutsche Forschungsgemeinschaft, Federal Republic of Germany, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (ACGIH 1997)

These sources provide guideline upper values or (for OSHA standards) enforceable limits of pollutant concentrations to which workers at their job sites (health workers) may be exposed over an 8-hour day during their working years.

E.2 CRITERIA POLLUTANTS

Air Quality Dispersion Model

The EPA Industrial Source Complex (ISC3) air quality dispersion model was used to estimate the criteria pollutant concentrations from the Y-12 Steam Plant. This model was selected as the most appropriate model to perform the air dispersion modeling analysis from continuous emission sources because it is designed to support the EPA regulatory modeling program and is capable of handling multiple sources, including different source types. This model was also used to estimate hazardous air pollutant concentrations from Y-12 facility emissions.

The criteria pollutants modeled using ISC3 include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxide (NO_x), and particulate matter equal to or less than 10 microns in diameter (PM_{10}). Concentrations of lead

and ozone were provided from monitoring data where available.
The estimated emission rates for the Y-12 Steam Plant are based upon actual fuel consumption for February 6, 1996, the coldest day in the last five years at Y-12 (according to local meteorological data). The Y-12 Steam Plant boilers are fired either by coal or by natural gas. Each boiler has a capacity of approximately 95,256 kg/hr (210,000 lb/hr) of steam. A coal pile and coal handling system are also part of the Y-12 Steam Plant. The coal handling system consists of a hopper feeder, a crusher, and conveyor belts. Each boiler is equipped with two pulverizing mills. The flue gas from each boiler is ducted through an air preheater. Flue gas then passes through a reverse air baghouse. The heat from combustion of fuel and flow of hot gases across water-filled tubes in the boiler produces steam. The combustion converts fuel to heat energy to change the boiler water to steam (LMES 1997).

Criteria pollutant emissions from the Y-12 Steam Plant were calculated using the heat input capacity of 522 Mbtu/hr for the facility, based on actual fuel usage on February 6, 1996. If the Y-12 Steam Plant were to operate at this heat capacity using coal as the fuel source for an entire year (8,760 hours), then coal usage is calculated to be 190,530 tons (381 million lb). If natural gas is used as the fuel source for an entire year, 5.6 million m^3 (199 million ft^3)of natural gas is burned. Actual fuel usage for 1996 was 93,240 tons (186 million lb) of coal and 977 million m^3 (34,493 million ft^3) of natural gas. Table E.2-1 presents the emission factors and calculated emission rates based upon the Y-12 Steam Plant operating at the calculated heat input capacity of 522 Mbtu/hr.

The emission rates presented in the table represent the maximum daily Y-12 Steam Plant operation for the last five years. These emission rates are considered a reasonable upper bound for operation of the facility for the purpose of estimating maximum criteria pollutant concentrations from operations at Y-12.

The concentrations highlighted in gray-scale in Table E.2–2 are the maximum modeled concentrations resulting from the five years of meteorological data (1992-1996). These concentrations were scaled according to the actual emissions to obtain the maximum pollutant concentrations at the Y-12 Site boundary based upon the emission rates presented in Table E.2–1.

Source Parameters

Source parameters for each of the two Y-12 Steam Plant stacks were obtained from the Title V permit application, *Major Source Operating Permit Applications for the U.S. Department of Energy Oak Ridge, Y-12 Plant* (LMES 1994). The two stacks were treated as a single source for modeling purposes, each located at the same Universal Transverse Mercator (UTM) coordinates, but retaining their respective physical characteristics. Table E.2–3 presents the Y-12 stack parameters used as modeling input.

Receptors

Receptors used for modeling the Y-12 Steam Plant include 211 discrete receptors located at 100-m (328-ft) intervals along the Y-12 Site boundary. Elevations provided for each of the 211 discrete receptors allowed the ISC3 model to calculate concentrations at receptors on elevated terrain. Figure E.2-1 presents the Y-12 Plant boundary for purposes of this SWEIS.

TABLE E.2–1.—*Y-12 Steam Plant Emission Rates and Emission Factors for Criteria Pollutant Emissions*

Source	Fuel	Fuel Usage (tons/day)	UnitCapacity (MBtu/hr)	Carbon Monoxide		Nitrogen Dioxide		Sulfur Dioxide		Particulate Matter		VOC	
				EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)
Boilers 1- 4	Coal	522	522	0.5	1.37	34	93.17	38S	215.56	7A	1.81	0.04	0.11

Source	Fuel	Fuel Usage (MCF/day)	UnitCapacity (MBtu/hr)	Carbon Monoxide		Nitrogen Dioxide		Sulfur Dioxide		Particulate Matter		VOC	
				EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)
Boilers 1- 4	Natural Gas	0.545	24	40	0.114	550	1.57	0.6	0.00172	5	0.000143	1.7	0.25

Source	Fuel	UnitCapacity (Mbtu/hr)	Carbon Monoxide ER (g/sec)	Nitrogen Dioxide ER (g/sec)	Sulfur Dioxide ER (g/sec)	Particulate Matter ER (g/sec)	VOC ER (g/sec)
Boilers 1- 4	Coal & Natural Gas	546	1.484	94.74	215.56	1.81	0.115

Note: EF = Emission Factor; ER = Emission Rate.
Sulfur content of coal (2.07 percent).
Ash content of coal (9.45 percent).
Heating value: coal = 12,000 Btu/lb; natural gas = 1050 Btu/ft^3.
Baghouse efficiency = 99 percent.
Source: EPA 1995.

Meteorological Data

Sequential hourly meteorological data from the 60-m (197-ft) level from tower MT6, located in the western portion of Y-12, for the five-year period (1992 - 1996) were used as model input. The meteorological data include flow vector, wind speed, ambient temperature, stability class, and mixing height. The meteorological data at the 60-m (197-ft) level were used since this level closely matches the height of the Y-12 Steam Plant stacks, which are 58-m (190-ft) tall. Figure E.2–2 presents the annual wind roses for tower MT6 for each of the five years of meteorological data. In addition, upper air data from the National Weather Service Station 13897 located at Nashville, TN, were used to generate hourly mixing height data used as input to the EPA model ISC3.

Table E.2–2.—*Y-12 Steam Plant Maximum Modeled Concentrations for a 1 Gram per Second Emission Rate*

Averaging Time	Maximum Y-12 Boundary Concentrations (Fg/m^3)				
	1992	**1993**	**1994**	**1995**	**1996**
1 Hour	2.66	2.76	2.68	2.72	2.90
3 Hours	2.43	2.14	2.32	2.03	1.95
8 Hours	1.67	1.31	1.70	1.50	1.46
24 Hours	0.81	0.71	0.64	0.79	0.76
Annual	0.091	0.081	0.096	0.088	0.086

TABLE E.2–3.—*Y-12 Steam Plant (Building 9401-3) Source Parameters*

Stack	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	UTM-E[a] (m)	UTM-W[a] (m)	Base Elevation (m)
West	57.9	3.81	8.84	427.6	746,909.25	3,985,445.25	294.132
East	57.9	4.572	6.096	427.6	746,909.25	3,985,445.25	294.132

[a] UTM-E - Universal Transverse Mercator East coordinates.
[b] UTM-W - Universal Transverse Mercator West coordinates.
Source: LMES 1997.

Model Assumptions

Model assumptions included using the regulatory default options that are identified in Appendix A of the *Guideline on Air Quality Models* (Revised) (40 CFR 51):

- Final plume rise
- Stack-tip downwash
- Buoyancy-induced dispersion
- Calms processing routine
- Missing data processing routine
- Default wind speed profile exponents
- Default vertical potential temperature gradients
- Rural dispersion
- Receptors on elevated terrain
- Complex terrain

Source: DOE 1999.

FIGURE E.2–1.—*The Y-12 Site-Wide Environmental Impact Statement Area of Analysis.*

Source: Computer Modeling Results.

FIGURE E.2–2.—*Annual Wind Rose Data for Tower MT6 at Y-12.*

For modeling purposes it is assumed that the Y-12 Steam Plant operates 8,760 hours per year during a non-leap year and 8,784 hours per year during a leap year.

E.3 CHEMICAL POLLUTANTS

The objective of the chemical pollutant screening is to determine those routine chemical emissions (those occurring daily from ongoing normal operations at Y-12) which may pose a potential risk to human health. Title III of the 1990 *Clean Air Act* (CAA) Amendments addresses the emissions of 189 HAPs and mandates that EPA develop technology-based (Maximum Achievable Control Technology [MACT]) standards for the control of these pollutants from approximately 174 source categories. After implementation of MACT standards, EPA is required to further evaluate "residual risk" from HAP emissions and, if required, develop more stringent standards to protect human health and the environment with an "adequate margin of safety."

A screening was performed to select only those chemicals that, due to the quantity of emissions or the toxicity of the chemical, may be chemicals of concern. Those chemicals that exceed the screening criteria were then further evaluated in the Human Health and Worker Safety analysis of this SWEIS (Appendix D) to determine potential human health risks.

The chemicals were categorized into two groups, noncarcinogenic chemicals and carcinogenic chemicals, to address the differences in health effects. Each group was evaluated using a screening technique comparing each chemical's estimated emission rate to a health risk-based TEV. Current dose-to-risk conversion factors and the "best available technology" were used in assessing impacts to human health (Appendix D). Consistent with the human health impacts assessment methodology, appropriate health risk values were used in the chemical screening process to derive chemical-specific TEVs. Because of the different health effects (noncarcinogenic and carcinogenic), two methods were applied to derive chemical-specific TEVs.

The combustion of coal at the Y-12 Steam Plant produces emissions of noncarcinogenic and carcinogenic HAPs as well as criteria pollutants. Calculated emission rates are based upon operation of the Y-12 Steam Plant at the rated heat input capacity of 522 MBtu/hr, AP-42 emission factors for pulverized coal boilers (uncontrolled HAP emissions), and baghouse efficiency at 99 percent (except for mercury, which assumed no emission controls) (LMES 1997). Table E.3–1 presents AP-42 emission factors for HAP emissions from the Y-12 Steam Plant. The Steam Plant is assumed to operate 8,760 hours per year at the rated heat input capacity.

TABLE E.3–1.—*Emission Factors for HAP Emissions from the Y-12 Steam Plant*

Pollutant	Emission Factor (lb/1 x 10^{12} Btu)
Arsenic	538
Beryllium	81
Cadmium	44-70
Chromium	1020-1570
Lead	507
Manganese	808-2980
Mercury	16
Nickel	840-1290

Source: EPA 1995.

E.3.1 Noncarcinogenic Chemical Screening

The screening analysis for noncarcinogenic chemicals uses the four "industry-recognized" guidelines (ACGIH 1997) to determine the most conservative guideline concentration applicable to each chemical. The minimum guideline concentration from those references (henceforth referred to as the Occupational Exposure Limit [OEL]), divided by 100 (a conservative margin of safety for identifying those chemicals of potential public concern) was used as the screening criterion for the noncarcinogenic chemicals. Each screening criterion divided by the maximum 8-hour concentration at the site boundary from modeling a 1 gram per second emission rate results in the TEV. The TEV represents the emission rate that would result in an 8-hour chemical concentration equal to the screening guideline (i.e., OEL/100). The maximum annual and 8-hour concentration at the site boundary was calculated using the ISC3 model and the input parameters described in Table E.2–3 for Y-12 Steam Plant emissions and Table E.3.1–1 for Y-12 Site emissions.

TABLE E.3.1–1.—*Source Parameters for Centrally Located Stack at Y-12 Site*

Stack	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	UTM-E[a] (m)	UTM-W[b] (m)	Base Elevation (m)
Central Stack	10	0.3048	0.50	293.0	747120.8278	3985944.6028	286.000

[a] UTM-E - Universal Transverse Mercator East coordinates.
[b] UTM-W - Universal Transverse Mercator West coordinates.
Source: LMES 1997.

Noncarcinogenic Chemical Screening -Y-12 Steam Plant Operations

The noncarcinogenic HAP emission rates for the Y-12 Steam Plant were compared with the respective TEVs. If the HAP emission rates for the Y-12 Steam Plant were greater than the respective TEV, then the chemical concentration resulting from the Y-12 Steam Plant HAP emission was considered a chemical of concern. If the HAP emission rate was less than the TEV, then the chemical was not considered a chemical of concern and therefore, not a threat to human health. Table E.3.1–2 presents the screening results for the Y-12 Steam Plant noncarcinogenic HAP emissions.

TABLE E.3.1–2.—*Y-12 Steam Plant Noncarcinogenic Hazardous Air Pollutant Emissions*

Building Number	CAS Number	Chemical	Emissions (gms/yr)	Emission Rate (gms/sec)	OEL/100 (Fg/m^3)	TEV (gms/sec)	Result
Y-9401-3	7440-47-3	Chromium	3.26×10^4	1.03×10^{-3}	5	2.94	FALSE
Y-9401-3	7439-92-1	Lead	1.05×10^4	3.33×10^{-4}	0.5	0.294	FALSE
Y-9401-3	7439-96-5	Manganese	6.18×10^5	1.96×10^{-3}	2.00×10^{-2}	1.18×10^{-2}	FALSE
Y-9401-3	7439-97-6	Mercury	3.32×10^4	1.05×10^{-3}	0.25	0.147	FALSE

Source: LMES 1997, ACGIH 1997.

The FALSE in the result column in the table indicates that none of the noncarcinogenic HAP emissions from the Y-12 Steam Plant exceeded the TEV and therefore, are not considered chemicals of concern.

Noncarcinogenic Chemical Screening - Y-12 Site Operations

Noncarcinogenic chemical emissions from Y-12 Site operations were evaluated using the same screening criteria as that used for the Y-12 Steam Plant noncarcinogenic chemical emissions. An annual chemical concentration was calculated for the site boundary while an 8-hour concentration was calculated for evaluation of impacts to the on-site worker. A 1 gram per second emission rate was modeled from a stack located centrally within the Y-12 Site complex of facilities. Table E.3.1–1 presents the stack parameters used in the modeling analysis of Y-12 Site operations.

Chemical emissions from Y-12 Site operations were not available since there are no regulations requiring an emissions inventory. Therefore, to estimate chemical emissions from Y-12 Site facilities, an inventory of purchased chemicals during 1998, representing 189 HAPs identified by EPA, was obtained from the 1998 Lockheed Martin Energy Systems, Inc. (LMES), Hazardous Material Information System (MMES 1998) transaction data summaries. Pure chemical HAP quantities as well as HAP ingredients contained within purchased chemicals are included in the total quantities for each HAP. Quantities of HAPs containing metals as solids were deleted from consideration since there is little chance for emission of solids.

Chemical emission rates for each noncarcinogenic chemical were calculated by dividing the 1998 purchased amount in grams by 2,000 hours (converted to seconds, to obtain an emission rate in grams per second). The 2,000 hours represent a 40-hour work week multiplied by 50 work weeks per year as the number of hours during which the chemicals are emitted. Using 2,000 hours per year results in a conservative emission rate since some facilities actually emit for 16 or 24 hours per day for 260 days per year (LMES 1997). Also for conservative reasons it was assumed that 100 percent of the purchased chemicals are released to the atmosphere from the facilities. Modeling options for ISC3 were selected such that concentrations are calculated on a Monday to Friday, 8-hour workday basis only.

Sequential hourly meteorological data from the 10-m (33-ft) level from tower MT6 located in the western portion of Y-12 for the five-year period (1992 -1996) were used as model input. These meteorological data were used since the 10-m (33-ft) level closely matches the release heights of the Y-12 process facilities. In addition, upper air data from the National Weather Service Station 13897 located at Nashville, TN were used to generate hourly mixing height data used as input to the EPA model ISC3. The results of the modeling are presented in Table E.3.1–3.

TABLE E.3.1–3.—*Maximum Modeled Concentrations from a Centrally Located Stack at Y-12 for a 1 Gram per Second Emission Rate*

Averaging Time	**Maximum Y-12 Boundary Concentration (Fg/m^3)**				
	1992	**1993**	**1994**	**1995**	**1996**
8-Hour	21.81	36.74	45.10	19.21	27.62
Annual	0.37	0.39	0.31	0.28	0.28
Averaging Time	**Maximum On-Site Concentration (Fg/m^3)**				
	1992	**1993**	**1994**	**1995**	**1996**
8-Hour	646.45	540.94	693.53	679.77	689.80
Annual	39.99	38.36	34.95	35.92	38.68

Source: Modeling results.

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 1 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m³)	OEL/100 (Fg/m³)	TEV (g/s)	Result
00071-55-6	1,1,1-Trichloroethane[a]	44500	4.45×10^{7}	6.18	1080	1.08×10^{4}	2.39×10^{2}	FALSE
000120-82-1	1,2,4-Trichlorobenzene	0.0028	2.80	3.89×10^{-7}	No OEL			
000106-88-7	1,2-Butylene Oxide	3.0915	3.09×10^{3}	4.29×10^{-4}	No OEL			
000096-12-8	1,2-Dibromo-3-Chloropropane	0.4535	$4.54 \times 10^{+02}$	6.30×10^{-05}	No OEL			
000123-91-1	1,4-Dioxane	5.2329	5.23×10^{3}	7.27×10^{-4}	72	7.20×10^{2}	16.0	FALSE
000095-95-4	2,4,5-Trichlorophenol	0.005	5.00	6.94×10^{-7}	No OEL			
000094-75-7	2,4-D	0.0299	29.9	4.15×10^{-6}	1	10.0	0.22	FALSE
000121-14-2	2,4-Dinitrotoluene	0.0272	27.2	3.78×10^{-6}	No OEL			
000091-94-1	3,3-Dichlorobenzidine	0.0002	0.20	2.78×10^{-08}	No OEL			
00067-64-1	Acetone[a]	800	8.00×10^{5}	0.11	590	5.90×10^{3}	1.31×10^{2}	FALSE
000075-05-8	Acetonitrile	339.734	3.40×10^{5}	4.72×10^{-2}	34	3.40×10^{2}	7.54	FALSE
000107-02-8	Acrolein	0.0159	15.9	2.21×10^{-6}	0.23	2.30	5.10×10^{-2}	FALSE
000079-10-7	Acrylic Acid	0.0441	44.1	6.13×10^{-6}	5.9	59.0	1.31	FALSE
007647-01-0	Ammonia[a]	870	8.70×10^{5}	0.12	14	1.40×10^{2}	3.10	FALSE
000062-53-3	Aniline	0.0049	4.90	6.81×10^{-7}	7.6	76.0	1.69	FALSE
007440-36-0	Antimony & Compounds	11.3562	1.14×10^{4}	1.58×10^{-3}	0.5	5.00	0.11	FALSE
000156-62-7	Calcium Cyanamide	0.0999	99.9	1.39×10^{-5}	0.5	5.00	0.11	FALSE
000075-15-0	Carbon Disulfide	4.2912	4.29×10^{3}	5.96×10^{-4}	3	30.0	0.67	FALSE
000108-90-7	Chlorobenzene	0.0999	99.9	1.39×10^{-5}	46	4.60×10^{2}	10.2	FALSE

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 2 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m³)	OEL/100 (Fg/m³)	TEV (g/s)	Result
000126-99-8	Chloroprene	0.3778	3.78×10^{2}	5.25×10^{-5}	18	1.80×10^{2}	3.99	FALSE
007440-48-4	Cobalt & Compounds	610.6878	6.11×10^{5}	8.48×10^{-2}	0.02	0.20	4.43×10^{-3}	TRUE
000057-12-5	Cyanide & Compounds	5.7417	5.74×10^{3}	7.97×10^{-4}	5	50.0	1.11	FALSE
000111-42-2	Diethanolamine	8.9172	8.92×10^{3}	1.24×10^{-3}	2	20.0	0.44	FALSE
000100-41-4	Ethylbenzene	1299.8033	1.30×10^{6}	0.18	434	4.34×10^{3}	96.6	FALSE
000075-00-3	Ethyl Chloride	0.0928	92.8	1.29×10^{-5}	264	2.64×10^{3}	58.5	FALSE
000107-21-1	Ethylene Glycol	4226.3023	4.23×10^{6}	0.59	26	2.60×10^{2}	5.76	FALSE
000096-45-7	Ethylene Thiourea	0.0104	10.4	1.44×10^{-6}	No OEL			
	Glycol Ethers	6411.5776	6.41×10^{6}	89.0				
000110-54-3	Hexane	41.8665	4.19×10^{4}	5.81×10^{-3}	176	1.76×10^{3}	39.0	FALSE
007647-01-0	Hydrochloric Acid (aerosol)[b]	1337.7	1.34×10^{6}	0.18	7	70.0	1.55	FALSE
007664-39-3	Hydrofluoric Acid	70.8546	7.09×10^{4}	9.84×10^{-3}	2	20.0	0.44	FALSE
000123-31-9	Hydroquinone	4.7944	4.79×10^{3}	6.66×10^{-4}	2	20.0	0.44	FALSE
000540-84-1	Isooctane	14.4923	1.45×10^{4}	2.01×10^{-3}	No OEL			
007439-92-1	Lead Compounds[c]	633	6.33×10^{5}	8.79×10^{-2}	0.05	0.50	1.11×10^{-2}	TRUE
000058-89-9	Lindane	1.8143	1.81×10^{3}	2.52×10^{-4}	0.5	5.00	0.11	FALSE
007439-97-6	Mercury	367.3306	3.67×10^{5}	5.10×10^{-2}	0.025	0.25	5.54×10^{-3}	TRUE
000067-56-1	Methanol	20833.4148	2.08×10^{7}	2.89	260	2.60×10^{3}	57.6	FALSE
000071-55-6	Methyl Chloroform	210.2718	2.10×10^{5}	2.92×10^{-2}	1080	1.08×10^{4}	2.39×10^{2}	FALSE
000078-93-3	Methyl Ethyl Ketone	65.7404	6.57×10^{4}	9.13×10^{-3}	590	5.90×10^{3}	1.31×10^{2}	FALSE

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 3 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m^3)	OEL/100 (Fg/m^3)	TEV (g/s)	Result
000108-10-1	Methyl Isobutyl Ketone	19.3795	1.94 x 10^{4}	2.69 x 10^{-3}	82	8.20 x 10^{2}	18.2	FALSE
000080-62-6	Methyl Methacrylate	9.1898	9.19 x 10^{3}	1.28 x 10^{-3}	210	2.10 x 10^{3}	46.6	FALSE
000101-68-8	Methylene Bisphenyl Isocyanate	1813.2026	1.81 x 10^{6}	0.25	0.05	0.50	1.11 x 10^{-2}	TRUE
000075-09-2	Methylene Chloride	1840.4272	1.84 x 10^{6}	2.56 x 10^{-1}	174	1.74 x 10^{3}	38.6	FALSE
000084-74-2	N-butyl Phthalate	3.364	3.36 x 10^{3}	4.67 x 10^{-4}	5	50.0	1.11	FALSE
007697-37-2	Nitric Acid[c]	246	2.46 x 10^{5}	3.42 x 10^{-2}	5	50.0	1.11	FALSE
000098-95-3	Nitrobenzene	0.0572	57.2	7.94 x 10^{-6}	5	50.0	1.11	FALSE
000095-48-7	O-cresol	0.4082	4.08 x 10^{2}	5.67 x 10^{-5}	No OEL			
000106-46-7	P-dichlorobenzene	16.8102	1.68 x 10^{4}	2.33 x 10^{-3}	60	6.00 x 10^{2}	13.3	FALSE
000106-42-3	P-xylene	5.6891	5.69 x 10^{3}	7.90 x 10^{-4}	434	4.34 x 10^{3}	96.2	FALSE
000087-86-5	Pentachlorophenol	0.005	5.00	6.94 x 10^{-7}	0.5	5.00	0.11	FALSE
000127-18-4	Perchloroethylene[a]	31200	3.12 x 10^{7}	4.33	170	1.70 x 10^{3}	37.7	FALSE
000108-95-2	Phenol	6.354	6.35 x 10^{3}	8.83 x 10^{-4}	19	1.90 x 10^{2}	4.21	FALSE
007723-14-0	Phosphorus (Red or Black)	0.7795	7.80 x 10^{2}	1.08 x 10^{-4}	0.1	1.00	2.22 x 10^{-2}	FALSE
000100-42-5	Styrene	0.0513	51.3	7.13 x 10^{-6}	85	8.50 x 10^{2}	18.8	FALSE
001634-04-4	Tert-butyl Methyl Ether	0.038	38.0	5.28 x 10^{-6}	144	1.44 x 10^{3}	31.9	FALSE
000127-18-4	Tetrachloroethylene	17.235	1.72 x 10^{4}	2.39 x 10^{-3}	170	1.70 x 10^{3}	37.7	FALSE
000108-88-3	Toluene	7400.2662	7.40 x 10^{6}	1.03	188	1.88 x 10^{3}	41.7	FALSE
000079-01-6	Trichloroethylene	6.701	6.70 x 10^{3}	9.31 x 10^{-4}	269	2.69 x 10^{3}	59.6	FALSE

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 4 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m^3)	OEL/100 (Fg/m^3)	TEV (g/s)	Result
000108-05-4	Vinyl Acetate	13.5963	1.36×10^4	1.89×10^{-3}	35	3.50×10^2	7.76	FALSE
000075-01-4	Vinyl Chloride	0.0054	5.40	7.50×10^{-7}	13	1.30×10^2	2.88	FALSE
001330-20-7	Xylene	7376.8969	7.38×10^6	1.02	434	4.34×10^3	96.2	FALSE

[a] Shelton 1999, Smith 1999.
[b] Assumes 3 percent emission rate of purchases.
[c] DOE 1999.
Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate; OEL - A time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect; TRUE - Emission rate exceeds the TEV; FALSE - Emission rate is less than the TEV.
Source: MMES, 1998, ACGIH 1997.

TABLE E.3.1–5.—*Maximum Boundary and On-site Noncarcinogenic Chemical Concentrations from Y-12 Site Operations*

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	Maximum Boundary Concentration [a] (Fg/m^3)	Maximum On-site Concentration[b] (Fg/m^3)
007440-48-4	Cobalt & Compounds	610.6878	$6.11 \times 10^{+5}$	8.48×10^{-2}	3.31×10^{-2}	58.8
007439-92-1	Lead Compounds	633	$6.33 \times 10^{+5}$	8.79×10^{-2}	3.43×10^{-2}	61.0
007439-97-6	Mercury	367.3306	$3.67 \times 10^{+5}$	5.10×10^{-2}	1.99×10^{-2}	35.4
000101-68-8	Methylene Bisphenyl Isocyanate	1813.2026	$1.81 \times 10^{+6}$	2.52×10^{-1}	9.82×10^{-2}	$1.75 \times 10^{+2}$

[a] Annual average concentrations.
[b] 8-hour average concentration.
Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate.
Source: MMES 1998, ACGIH 1997.

A total of 57 noncarcinogenic HAPs were identified from the Hazardous Material Information System (MMES 1998). These HAPs are presented in Table E.3.1–4 along with emission rates, OEL screening criteria, and TEV. No OEL is available for nine of the HAPs. The maximum quantity for those HAPs with no OEL is 14.4923 kg (32 lb), which results in an emission rate of 2.01×10^{-3} grams per second, an emission rate that is of concern for only the most highly toxic chemical. The fact that these HAPs have no OEL means that the HAP is likely to meet one or more of the following conditions:

- It is not used routinely.
- It is not present or used in regulated quantities.
- It is controlled according to general OSHA requirements (personal protective equipment, labeling, Material Safety Data Sheet recommendations, etc.).
- It is not designated for regulation (based on interagency regulatory committee determination).
- It is determined nontoxic to the environment or human health.
- It is used for research and development or market research only.

Only four noncarcinogenic HAPs exceeded the screening criteria. Table E.3.1–5 presents maximum annual site boundary and on-site maximum 8-hour concentrations representing exposure to the general public and on-site work, respectively, for those HAPs that exceed the screening criteria.

E.3.2 Carcinogenic Chemical Screening

Those carcinogenic chemicals released from the Y-12 Steam Plant from burning coal and from Y-12 Site operations were screened according to the criteria described below.

For each chemical, a concentration was calculated representing a cancer risk of 1.0×10^{-8} for an exposed individual. This number represents an incremental cancer risk of 1.0×10^{-6} (e.g., one person in one million would develop cancer if exposed to this concentration over a lifetime). This level of concern is established in the CAA (42 U.S.C. §7401). For the purposes of screening, the 1.0 x 10^{-6} cancer risk was divided by 100 as a conservative margin of safety, thereby establishing 1.0 x 10^{-8} as the cancer risk screening level.

The calculated concentration representing a cancer risk of 1.0 x 10^{-8} for an exposed individual at the site boundary was divided by the maximum annual average concentration obtained from modeling a 1 gram per second emission rate. The annual average concentration is used since the 1.0 x 10^{-8} risk level represents a long-term exposure risk to an individual. The result is the TEV, an emission rate that results in a concentration with a cancer risk of 1.0 x 10^{-8}, a chemical concentration below which no health effect is expected. The TEV was compared to the calculated emission rate. If the calculated emission rate was greater than the respective TEV, then the chemical concentration resulting from the carcinogenic chemical emissions is considered a chemical of concern. If the calculated emission rate was less than the TEV, then the chemical was not considered a chemical of concern and therefore, no a potential threat to human health.

The unit risk factors, defined in terms of risk per exposure to a unit concentration of chemical (risk/Fg/m^3), used to calculate the concentration at the 10^{-8} risk level were obtained from the EPA Integrated Risk Information System (IRIS) (EPA 1999) estimate of carcinogenic risk from inhalation exposure. Only those HAPs for which unit risk factors are available were categorized as carcinogenic HAPs.

Carcinogenic Chemical Screening - Y-12 Steam Plant Operations

The results of the carcinogenic screening analysis for the Y-12 Steam Plant are presented in Table E.3.2-1. In each case, the calculated emission rate is greater than the TEV, indicated by a TRUE in the results column. The site boundary carcinogenic chemical concentrations from the Y-12 Steam Plant are presented in Table E.3.2-2 and are further evaluated in the Human Health and Worker Safety analysis of this SWEIS (Appendix D).

Carcinogenic Chemical Screening - Y-12 Site Operations

Sixteen carcinogenic HAPs from Y-12 Site operations are identified and presented in Table E.3.2-3. Carcinogenic chemical emissions from Y-12 Site operations were evaluated using the same screening criteria as that used for the Y-12 Steam Plant carcinogenic chemical screening. One carcinogenic HAP from Y-12 Site operations exceeded the respective TEV indicated by TRUE in the results column.

TABLE E.3.2–1.—*Y-12 Steam Plant Carcinogenic Screening Results*

Building Number	CAS Number	Chemical	Emissions		10^{-8} Risk Level (Fg/m^3)	TEV (g/s)	Result
			(gms/yr)	(gms/sec)			
Y-9401-3	7440-38-2	Arsenic	1.12 x 10^{+4}	3.55 x 10^{-4}	2.33 x 10^{-6}	2.43 x 10^{-5}	TRUE
Y-9401-3	7440-41-7	Beryllium	1.68 x 10^{+3}	5.33 x 10^{-4}	4.17 x 10^{-6}	4.35 x 10^{-5}	TRUE
Y-9401-3	7440-43-9	Cadmium	1.45 x 10^{+3}	4.60 x 10^{-4}	5.56 x 10^{-6}	5.80 x 10^{-5}	FALSE
Y-9401-3	7440-02-0	Nickel	2.68 x 10^{+4}	8.50 x 10^{-3}	4.17 x 10^{-5}	4.35 x 10^{-4}	TRUE

Source: LMES 1997.

TABLE E.3.2–2.—*Y-12 Steam Plant Maximum Boundary Carcinogenic Chemical Concentrations*

Building Number	CAS Number	Chemical	Emissions		Maximum Boundary Concentration (Fg/m^{3})
			(gms/yr)	(gms/sec)	
Y-9401-3	7440-38-2	Arsenic	1.12 x 10^{+4}	3.55 x 10^{-4}	3.40 x 10^{-5}
Y-9401-3	7440-41-7	Beryllium	1.68 x 10^{+3}	5.33 x 10^{-4}	5.10 x 10^{-5}
Y-9401-3	7440-02-0	Nickel	2.68 x 10^{+4}	8.50 x 10^{-3}	8.14 x 10^{-4}

Source: LMES 1997.

TABLE E.3.2–3.—*Y-12 Site Screening Evaluation of Noncarcinogenic Chemical Emissions*

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	Unit Risk Factor	10^{-8} Risk Level (Fg/m³)	TEV (g/s)	Result
000107-06-2	1,2-Dichloroethane	0.0036	3.60	5.00×10^{-7}	2.60×10^{-5}	3.85×10^{-4}	9.86×10^{-4}	FALSE
000088-06-2	2,4,6-Trichlorophenol	0.019	19.0	2.64×10^{-6}	3.10×10^{-6}	3.23×10^{-3}	8.27×10^{-3}	FALSE
000107-13-1	Acrylonitrile	0.0001	0.10	1.39×10^{-8}	6.80×10^{-5}	1.47×10^{-4}	3.77×10^{-4}	
007440-38-2	Arsenic & Compounds	0.0007	7.00×10^{-1}	9.72×10^{-8}	4.30×10^{-3}	2.33×10^{-6}	5.96×10^{-6}	FALSE
000071-43-2	Benzene	1.6759	1.68×10^{3}	2.33×10^{-4}	7.80×10^{-6}	1.28×10^{-3}	3.29×10^{-3}	FALSE
000092-87-5	Benzidine	0.0002	2.00×10^{-1}	2.78×10^{-8}	6.70×10^{-2}	1.49×10^{-7}	3.83×10^{-7}	FALSE
007440-41-7	Beryllium & Compounds	0.001	1.00	1.39×10^{-7}	2.40×10^{-3}	4.17×10^{-6}	1.07×10^{-5}	FALSE
007440-43-9	Cadmium & Compounds	0.2613	2.61×10^{2}	3.63×10^{-5}	1.80×10^{-3}	5.56×10^{-6}	1.42×10^{-5}	TRUE
000056-23-5	Carbon Tetrachloride	0.047	47.0	6.53×10^{-6}	1.50×10^{-5}	6.67×10^{-4}	1.71×10^{-3}	FALSE
000067-66-3	Chloroform	0.7419	7.42×10^{2}	1.03×10^{-4}	2.30×10^{-5}	4.35×10^{-4}	1.11×10^{-3}	FALSE
000106-89-8	Epichlorohydrin	10	1.00×10^{4}	1.39×10^{-3}	1.20×10^{-6}	8.33×10^{-3}	2.14×10^{-2}	FALSE
000050-00-0	Formaldehyde	2.924	2.92×10^{3}	4.06×10^{-4}	1.30×10^{-5}	7.69×10^{-4}	1.97×10^{-3}	FALSE
000118-74-1	Hexachlorobenzene	0.0272	27.2	3.78×10^{-6}	4.60×10^{-4}	2.17×10^{-5}	5.57×10^{-5}	FALSE
000067-72-1	Hexachloroethane	0.0272	27.2	3.78×10^{-6}	4.00×10^{-6}	2.50×10^{-3}	6.41×10^{-3}	FALSE
000062-75-9	N-nitrosodimethylamine	0.0045	4.50	6.25×10^{-7}	1.40×10^{-2}	7.14×10^{-7}	1.83×10^{-6}	FALSE
007440-02-0	Nickel Compounds	0.0001	1.00×10^{-1}	1.39×10^{-8}	2.40×10^{-4}	4.17×10^{-5}	1.07×10^{-4}	FALSE

Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate; OEL - A time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect; TRUE - Emission rate exceeds the TEV; FALSE - Emission rate is less than the TEV.
Source: MMES 1998, ACGIH 1997.

TABLE E.3.2–4.—*Maximum Boundary and On-site Carcinogenic Chemical Concentrations from Y-12 Site Operations*

CAS Nu	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	Maximum Boundary Concentration[a] (Fg/m³)	Maximum On-Site Concentration[b] (Fg/m³)
007440-43-9	Cadmium & Compounds	0.2613	2.61×10^{2}	3.63×10^{-5}	1.42×10^{-5}	2.52×10^{-2}

[a]Anual average concentrations.
[b]8-hour average concentrations.
Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate.
Source: LMES 1997.

E.4 RADIOLOGICAL AIR QUALITY

E.4.1 Maximally Exposed Individual and Collective Population

E.4.1.1 *Radiological Assessment Methodology*

This section presents detailed information on the methodology and data used to assess the potential radiological doses associated with emissions of radionuclides from routine operations of current missions and proposed new facilities at Y-12. The radiological doses from routine operations were assessed for the maximally exposed individual (MEI) and the population within 80 km (50 mi) of Y-12. The radiological impacts of the operations for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative) were calculated by using the CAP-88 (CAA Assessment Package - 1988) computer model which is used for demonstrating National Emissions Standards for Hazardous Air Pollutants (NESHAP) compliance under 40 CFR 61, NESHAP. The CAP-88 model, input parameters, and results are described below.

E.4.1.2 *Model Description*

The CAP-88 computer model (DOE 1997) is a set of computer programs, databases, and associated utility programs for estimating dose and risk from radionuclide air emissions for purposes of demonstrating compliance under *National Emissions Standards for Hazardous Air Pollutants: Radionuclides* (Rad NESHAP) (40 CFR 61). CAP-88 contains modified versions of AIRDOS-EPA and DARTAB computer codes and the ALLRAD88 radionuclide data file. The AIRDOS-EPA computer code uses a steady-state Gaussian plume atmospheric dispersion model to calculate environmental concentrations of radionuclides. CAP-88 also uses Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977) food chain models to calculate radionuclide concentrations in foodstuffs (vegetables, meat, and milk) and subsequent intake by humans (DOE 1999).

Dose conversion factors are derived from data generated by the DARTAB model, an integral part of CAP-88, which follows the methodology on the International Commission for Radiation Protection (ICRP 1991). The effective dose equivalent (EDE) is calculated using the weighting factors given in ICRP Publication 26. Risks are based on lifetime risks from lifetime exposures, with a nominal value of 4×10^{-4} cancers/rem.

CAP-88 can model as many as 36 radionuclides released from up to six emission sources. The sources may be elevated stacks or uniform area sources. Receptors are located within a circular grid of distances and directions for a radius of 80 km (50 mi) around the emission point. The CAP-88-PC model is the PC version of the model CAP-88, which is run on a main frame computer.

E.4.1.3 *Data*

Source Parameters. Facility releases occur from stack exhausts or vents and are modeled as point sources. For purposes of this analysis, all the various major and minor emission sources at Y-12 can be grouped into three emission points:

- Monitored stacks
- Minor processes
- Lab hoods

For releases from these sources, the CAP-88-PC model calculates a momentum-type plume rise. Plume rise is calculated from the stack diameter and exhaust velocity. Table E.4.1–1 presents the emission source parameters assumed for the modeling provided from the Y-12 Site. The Y-12 emission points are located approximately at the center of Building 9212.

TABLE E.4.1–1.—*Source Characteristics Used in the Radiological Air Dispersion Modeling*

Source	Source Type	Release Height (m)	Stack Diameter (m)	Exhaust Velocity (m/s)	Release Temperature (EC)	Plume Rise
Monitored Stacks	Point	20	NA	NA	Ambient	Momentum
Minor Processes	Point	20	NA	NA	Ambient	Momentum
Lab Hoods	Point	20	NA	NA	Ambient	Momentum

Note: NA - Not Applicable.
Source: DOE 1999.

Emissions Data. Emissions from Y-12 occur as a result of plant production, maintenance, and waste management activities. The major dose contributing radionuclides emitted from Y-12 consist of ^{234}U, ^{235}U, ^{236}U, and ^{238}U, all of which are emitted as particulates. The particle size and solubility class for the uranium emissions are based on review of the operations and processes served by the exhaust systems to determine the quantity of uranium handled in the operation or process, the physical form of the uranium, and the nature of the operation or process (Swanks 1999).

The emission data for the calendar year 1998 (Swanks 1999) as reported in the NESHAP 1998 is used as Alternative 1A (No Action - Status Quo Alternative) for Y-12. Under Alternative 1B (No Action - Planning Basis Operations Alternative), the annual enriched uranium emissions and other effluents for the period 2001–2010 were assumed to be 65 percent of the 1987 levels (Garber 2000).

TABLE E.4.1–2.—*Radiological Air Emissions, 1987*

Radionuclide	Quantity (Ci/yr)
^{234}U	1.10×10^{-1}
^{235}U	4.30×10^{-3}
^{238}U	2.54×10^{-2}
Total	**0.14 Ci**

Source: MMES 1988.

TABLE E.4.1–3.—*Modeled Radionuclide Emissions for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative)*

Radionuclide	Solubility	AMAD[a]	Alternative 1A (No Action - Status Quo Alternative)[b](1998)(Ci/Yr)	Alternative 1B (No Action - Planning Basis Operations Alternative)[c] (Ci/Yr)
Am-241	W	1	6.00×10^{-9}	NDA
Am-243	W	1	1.40×10^{-8}	NDA
				NDA
Co-57	Y	1	6.95×10^{-10}	NDA
Co-58	Y	1	6.20×10^{-12}	NDA
Co-60	Y	1	9.29×10^{-7}	NDA
Cs-134	D	1	5.56×10^{-8}	NDA
Cs-137	D	1	6.25×10^{-6}	NDA
Eu-152	W	1	2.63×10^{-8}	NDA
Eu-154	W	1	3.33×10^{-8}	NDA
Eu-155	W	1	9.52×10^{-7}	NDA
H-3			3.41	NDA
I-125	D	1	1.50×10^{-7}	NDA
Np-237	W	1	3.71×10^{-8}	NDA
Np-239	W	1	1.00×10^{-8}	NDA
P-32	D	1	4.50×10^{-7}	NDA
Pb-212	D	1	5.41×10^{-7}	NDA
Pu-236	W	1	5.00×10^{-10}	NDA
Pu-238	W	1	5.33×10^{-8}	NDA
Pu-239	W	1	4.32×10^{-8}	NDA
Pu-240	W	1	2.00×10^{-9}	NDA
Pu-242	W	1	2.16×10^{-8}	NDA
Ra-226	W	1	4.00×10^{-9}	NDA
Ra-228	W	1	4.00×10^{-9}	NDA
Sr-90	D	1	2.16×10^{-6}	NDA
Tc-99	W	1	1.01×10^{-3}	NDA
Th-228	Y	1	1.01×10^{-9}	NDA
Th-229	Y	1	9.63×10^{-9}	NDA
Th-230	Y	1	2.25×10^{-08}	NDA
Th-232	Y	1	1.58×10^{-8}	NDA
U-232	Y	1	1.10×10^{-8}	NDA
U-233	Y	1	1.04×10^{-5}	NDA
U-234	Y	1	1.22×10^{-2}	7.15×10^{-2}
U-234	W	1	4.70×10^{-4}	NDA
U-234	D	1	8.36×10^{-4}	NDA
U-235	Y	1	4.10×10^{-4}	2.795×10^{-3}
U-235	W	1	1.50×10^{-5}	NDA
U-235	D	1	2.62×10^{-5}	NDA
U-236	Y	1	4.43×10^{-5}	NDA
U-236	W	1	2.00×10^{-6}	NDA
U-236	D	1	3.53×10^{-6}	NDA
U-238	Y	1	3.25×10^{-3}	1.651×10^{-2}
U-238	W	1	1.30×10^{-7}	NDA
U-238	D	1	2.32×10^{-7}	NDA

[a] Activity Medium Aerodynamic Diameter.
[b] DOE 1999.
[c] MMES 1988.
Note: NDA = no data available.

A total of 0.14 Ci of uranium was released from Y-12 during 1987 (Table E.4.1–2). Therefore, a total of 0.0908 Ci of uranium is assumed to be released each year from Y-12 under No Action - Planning Basis Operations Alternative for the period 2001–2010. The released uranium was assumed to be completely insoluble (Y solubility). The isotopic composition of the radionuclide emissions for No Action - Status Quo Alternative and No Action - Planning Basis Operations Alternative are presented in Table E.4.1–3.

The emission data for Alternative 1B (No Action - Planning Basis Operations Alternative) is assumed to include all the emissions from the storage of highly enriched uranium (HEU) in existing facilities. The emissions for the HEU storage mission action alternatives at Y-12 (i.e., construction of a new HEU Materials Facility at one of the two potential sites or construction of an upgrade to the existing Building 9215) are expected to be at or below No Action - Status Quo Alternative levels. This is due to administrative and engineered controls such as multiple levels of high-efficiency particulate air filters at new facilities. The proposed Special Materials Complex would not contribute to the radioactive emissions at Y-12 as the facilities do not handle radioactive materials.

Meteorological Data. On-site meteorological data recorded at the MT6 meteorological tower were used as input into the CAP-88-PC model. Table E.4.1–4 shows the key meteorological data that were used in assessing radiation doses for No Action - Status Quo Alternative. Meteorological data were derived from data collected during 1998 at the 60-m (197-ft) height on tower MT6. The data consist of frequency distribution of wind direction, wind speed class, and atmospheric stability category.

TABLE E.4.1–4.—*Meteorological Data for Tower MT6 (No Action - Status Quo Alternative)*

Data collection height	60 m
Minimum monthly data collection	90.7%
Precipitation	140.7 cm/yr
Average air temperature	15.9 EC
Average mixing layer height	1,000

Source: DOE 1999.

For modeling of Alternative 1B (No Action - Planning Basis Operations Alternative), a 10-year average (1990-1999) of the meteorological data was used (O’Donnell 1999). The average temperature is 14.6EC and the average rainfall (30-year average for ORR) is 137 cm/yr (Sharp, 2000).

Demographic Data. Demographic data include population, numbers of beef and dairy cattle, and the area of food crop harvesting. The estimated population surrounding the Y-12 Plant was based on 1990 population data. Table E.4.1–5 presents the population distribution used in the analysis.

All food products consumed by exposed persons within the Y-12 region are assumed to come from the local area or within an 80-km (50-mi) radius. The distribution of foodstuff presented in Table E.4.1–6 indicates the agricultural production or food consumption data used as input into the model. The model is run assuming that each person remains outside the house, unprotected during the entire year, and acquires food according to the rural pattern defined in NESHAP background documents.

TABLE E.4.1–5.—*Population Distribution Within 80 km (50 mi) of the Y-12*

	Distance (miles)										
Direction	**0-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**10-20**	**20-30**	**30-40**	**40-50**	**Total**
N	0	87	190	1,71	512	2,508	735	2,284	2,608	8,167	18,809
NNW	0	311	1,119	671	320	1,863	950	998	9,195	5,234	20,661
NW	0	15	17	277	273	2,102	4,316	2,174	2,848	8,426	20,448
WNW	0	3	0	222	182	899	3,408	1,540	2,483	4,821	13,558
W	0	0	0	0	32	1,533	9,435	2,006	14,60	12,382	40,010
WSW	0	0	0	0	0	1,529	11,953	8,875	5,521	4,930	32,808
SW	0	0	0	0	4	1,119	2,941	3,760	6,478	11,362	25,664
SSW	0	0	0	6	60	998	3,309	10,266	22,56	14,837	52,041
S	0	0	0	0	97	2,452	10,820	7,807	9,040	3,876	34,092
SSE	0	0	0	0	2	2,920	8,323	4,949	1,787	1,347	19,328
SE	0	0	0	15	222	4,407	9,524	29,185	1,198	815	45,366
ESE	0	0	0	0	168	8,028	31,387	36,292	8,771	11,975	96,621
E	0	0	0	0	7	3,321	83,371	103,179	22,90	21,722	234,501
ENE	0	0	0	0	0	2,318	30,485	54,882	16,29	18,052	122,031
NE	0	0	0	693	1,047	13,639	15,953	8,673	5,331	6,763	52,099
NNE	0	1	17	890	3,221	5,159	5,761	13,652	15,76	7,048	51,509

Source: O'Donnell 1999.

TABLE E.4.1–6.—*Food Consumption Data Within the Y-12 Region*

Foodstuff	**Fraction grown**		
	In local area	**Within 50-mile radius**	**Beyond 50-mile radius**
Vegetable and produce	0.70	0.30	0.00
Meat	0.40	0.60	0.00
Milk	0.44	0.56	0.00

Source: Swanks 1999.

E.4.1.4 *Results*

Calculated EDEs from radionuclides emitted to the atmosphere from different sources within Y-12 are listed in Tables E.4.1–7 and E.4.1–8. The total effective dose equivalent (TEDE) received by the hypothetical MEI for Y-12 was calculated as 0.53 mrem/yr for Alternative 1A (No Action - Status Quo Alternative) and 4.5 mrem/yr for Alternative 1B (No Action - Planning Basis Operations Alternative). These doses are well below the NESHAP standard of 10 mrem/yr. The MEI is located 1,080 m (3,543 ft) north-northeast of the Y-12 release point. The collective EDE to the population residing within 80 km (50 mi) of Y-12 for No Action - Status Quo Alternative was calculated as 4.3 person-rem and for the No Action - Planning Basis Operations Alternative, 33.7 person-rem.

TABLE E.4.1–7.—*Total Effective Dose Equivalents for the Maximally Exposed Individuals at Y-12 for No Action - Status Quo Alternative and No Action -Planning Basis Operations Alternative*

Source	Alternative 1A (No Action - Status Quo Alternative)[a] (mrem/yr)	Alternative 1B (No Action - Planing Basis Operations Alternative) (mrem/yr)
Y-12 Plant	0.53	4.5

[a] Source: DOE 1999.

TABLE E.4.1–8—*Effective Dose Equivalents for the Collective Population within 80 km (50 mi) of Y-12 for No Action - Status Quo Alternative and No Action -Planning Basis Operations Alternative*

Source	Alternative 1A (No Action - Status Quo Alternative)[a] (person-rem/yr)	Alternative 1B (No Action - Planing Basis Operations Alternative) (person-rem/yr)
Y-12 Plant	4.3	33.7

[a] Source: DOE 1999.

E.4.2 Workers

Introduction

This section presents the radiological doses associated with the workers for various operations at Y-12. For the analysis presented in this SWEIS the radiation or involved workers (Rad Workers) are either LMES employees or subcontractors whose job assignments place them in proximity to radiation-producing equipment and/or radioactive materials. These workers are trained for unescorted access to radiological areas and may also be trained Rad workers from another U.S. Department of Energy (DOE) site. These workers have the potential to receive an annual EDE of more than 100 mrem/year. All trained Rad workers wear dosimeters which measures the individual's external dose information. The nonradiation or noninvolved workers (Non-Rad workers) may be either LMES employees or subcontractors who are not currently trained as Rad workers but whose job assignment may require their occasional presence within a radiologically controlled area with an escort. They may be exposed to transient radiation fields as they pass by or through a particular area, but their job assignments are such that annual dose equivalents in excess of 100 mrem are unlikely. These workers are issued a dosimeter only when they are required to wear one to enter a posted area. Figure E.4.2–1 shows the major radiological emissions area at Y-12 associated with the various major Defense Programs (DP) Mission operations/facilities.

Doses

The average individual Y-12 worker dose (Rad and Non-Rad) and the average individual Y-12 Rad worker dose for 1989 (the representative analyses year) and 1998 (No Action - Status Quo Alternative) are presented in Table E.4.2–1. The average TEDE's for Rad workers for various operations within Y-12 are presented in Table E.4.2–2. The worker doses are recorded using dosimeters. Bioassay monitoring performed by Y-12 provide the individual's internal dose information. The information from dosimeters and bioassays is totaled annually to obtain TEDE for each worker.

FIGURE E.4.2–1.—*Y-12 Plant Major Radiological Emissions Area.*

Source: Tetra Tech, Inc.

TABLE E.4.2–1.—*Radiation Dose Data for Y-12 Employees (All Y-12 Workers and Y-12 Rad Workers)*

Year	No of Monitored Y-12 Workers	No. of Rad Workers	Average Individual Y-12 Worker Dose (TEDE)	Average Individual Y-12 Rad Worker Dose (TEDE)
1989	9241	2470	11.6	33.6
1998	5128	3563	8.0	11.4

Source: Y-12 1999.

Rad Workers

The average TEDE in 1998 (No Action - Status Quo Alternative) presented in Table E.4.2–2 for the Rad workers for each operation are used to calculate the cumulative dose for the Rad workers present at each operation area. The average individual Y-12 Rad worker dose in 1998 (No Action - Status Quo Alternative) and 1989 (No Action - Planning Basis Operations Alternative, representative analysis year) presented in Table E.4.2–1 for the Y-12 Site are used to calculate the cumulative doses for the Rad workers at Y-12 for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative). The average individual Y-12 Rad worker dose in 1989 is used for the No Action - Planning Basis Operations Alternative instead of 1987 data to calculate the cumulative dose because the method of measuring the TEDEs changed in 1989 (similar to 1998, No Action - Status Quo Alternative) as compared to the year 1987. In addition, the restructuring of operations in 1989 made tracking the 1987 dose received by workers difficult.

Y-12 Workers (Rad and Non-Rad)

The average individual Y-12 worker dose in 1998 (No Action - Status Quo Alternative) and 1989 (No Action- Planning Basis Operations Alternative, representative analysis year) presented in Table E.4.2–1 for the Y-12 Site are used to calculate the cumulative dose for all the workers (Rad and Non-Rad) in various operations at Y-12. The average individual Y-12 worker dose in 1989 is used for the Alternative 1B (No Action- Planning Basis Operations Alternative) instead of 1987 to calculate the cumulative dose because the method of measuring the TEDEs changed in 1989 (similar to 1998, No Action - Status Quo Alternative) as compared to the year 1987. The average individual Y-12 worker dose is used for the worker doses for various operations since the total dose for all the workers are not available in these operations.

Summary

The number of workers for each major DP operation are shown in Table E.4.2–3. Table E.4.2–4 presents the summary of the radiological doses for Rad and Non-Rad workers for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative) for each operation and Y-12 as a whole.

E.4.3 HEU Storage Mission

E.4.3.1 *Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative)*

The collective dose to the workers under the No Action Alternatives for the existing HEU Storage Mission is 0.74 person-rem (35 workers x 21 mrem/year).

E.4.3.2 *HEU Materials Facility*

The collective dose to workers due to initial relocation operations including material handling is 5.25 person-rem (35 workers x 150 mrem/yr) (LMES 2000a, LMES 2000b).

The collective dose to the workers due to the transportation of HEU is 0.075 person-rem and is addressed in Chapter 5 (Environmental Consequences) of this SWEIS. Finally, the collective dose to the workers during normal operations due to the storage of the HEU in the new HEU Materials Facility is 0.29 person-rem (14 involved workers x 21 mrem/yr), a decrease of 61 percent from the No Action Alternatives.

TABLE E.4.2–2.—*Total Effective Dose Equivalents for Workers for Various Operations at Y-12*

Division Acronym	Division Number/ Name Used	Collective TEDE (person - mrem)			Average TEDE (mrem)			Maximum TEDE (mrem)		
		1997	1998	1999 (through 6/30)	1997	1998	1999 (through 6/30)	1997	1998	1999 (through 6/30)
EUO	37 - Enriched Uranium Ops	4347	29,440	16,260	12.28	85.83	57.65	847	1295	829
DUO	24 - Depleted Uranium Ops	626	2458	15,236	2.7	10.92	52	60	108	1259
DSO	01-Disassembly Ops.	1725	1956	4042	9.48	10.63	20.51	92	131	686
FP	54 - Fire Protection	0	32	28	0	0.39	0.27	0	13	11
ACO	65 - Analytical Chemistry Org.	12	193	358	0.06	0.95	1.75	6	39	0.93
PCO	55 - Product Certification	74	482	882	0.6	3.2	5.58	20	113	82
MCO	08 - Material Control	*No data available*								
RCO	56-RADCON	1451	2871	3538	8.44	17.83	23.9	555	674	382
BOP	Balance of Plant	808	1580	1905	0.53	0.94	1.4	42	159	679
GMO	03 - General Manufacturing Org.	18	81	39	0.56	2.19	1.56	13	43	38
SMS	58 - Y-12 Plant Managers	0	11	13	0	0.55	0.76	0	11	9
SMO	18 - Special Materials Organization	15	14	11	0.27	0.25	0.16	15	4	3
FMO	35 - Facilities Maintenance Org.	1250	1756	942	1.56	2.19	1.19	70	96	69
DEV	15 - Development	99	206	86	0.85	1.76	0.83	33	41	13

Source: Oxley 2000.

TABLE E.4.2–3.—*Number of Involved (Rad) and Non-Involved (Non-Rad)Workers for Major Y-12 Defense Programs Production Operations*

Operation	Total Workers		Radiological Workers		Non-Radiological Workers	
	No Action - Status Quo Alternative	No Action - Planning Basis Operations Alternative	No Action - Status Quo Alternative	No Action - Planning Basis Operations Alternative	No Action - Status Quo Alternative	No Action - Planning Basis Operations Alternative
Enriched Uranium	393	492	192	240	201	252
Depleted Uranium	223	223	220	220	3	3
Assembly/Disassembly	160	160	150	150	10	10
Product Certification	150	158	125	132	25	26
Analytical Chemistry	163	180	126	143	37	37
Lithium	36	53	0	0	36	53
Special Materials Complex	45	45	0	0	45	45
Y-12 Plant	5128	5128	3563	3563	1565	1565

Source: Garber 2000.

TABLE E.4.2–4.—*Summary of the Radiological Doses for Rad and Non-Rad Workers at Y-12 for Major DP Production Operations Under the No Action - Status Quo Alternative and the No Action - Planning Basis Operations Alternative*

Facility	Rad Workers						All Workers (Rad and Non-Rad)					
	No Action - Status Quo Alternative			No Action - Planning Basis Operations Alternative			No Action - Status Quo Alternative			No Action - Planning Basis Operations Alternative		
	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)
Enriched Uranium	192	85.83	16.48	240	NA	NA	393	8	3.14	492	11.6	5.71
Depleted Uranium	220	10.92	2.40	220	NA	NA	223	8	1.78	223	11.6	2.59
Assembly/ Disassembly Quality Evaluation	150	10.63	1.59	150	NA	NA	160	8	1.28	160	11.6	1.86
Product Certification	125	3.2	0.4	132	NA	NA	150	8	1.2	158	11.6	1.83
Analytical Chemistry	126	0.95	0.12	143	NA	NA	163	8	1.30	180	11.6	2.09
Y-12 Plant	3563	11.4	40.62	3563	33.6	119.72	5128	8	41.02	5128	11.6	59.48

Note: According to the Y-12 DRS database, the collective population dose to the Y-12 Rad workers for No Action - Status Quo Alternative is 40.61 person-rem and collective population dose for all Y-12 workers for No Action - Status Quo Alternative is 41.24 person-rem.

References Appendix E

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