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U.S. Department of Energy

Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

Summary

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U.S. Department of Energy
National Nuclear Security Administration

COVER SHEET

***Responsible Agency*:** United States Department of Energy (DOE) National Nuclear Security Administration (NNSA)

***Title*:** Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

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Abstract: DOE's NNSA is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including production readiness required to maintain that stockpile. Since 1989, DOE has been without the capability to produce certified plutonium pits, which are an essential component of nuclear weapons. NNSA, the Department of Defense, and Congress have highlighted the lack of long-term pit production capability as a national security issue requiring timely resolution. While a small interim capacity is currently being established at the Los Alamos National Laboratory (LANL), classified analyses indicate that long-term support of the nuclear stockpile, which is a cornerstone of U.S. national security policy, will require a long-term pit production capability.

Pursuant to *National Environmental Policy Act* of 1969, as amended (42 USC 4321 et seq.), and DOE Regulations Implementing *National Environmental Policy Act* (10 CFR Part 1021), NNSA has prepared a Supplement to the Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility (hereafter, referred to as the MPF EIS) to support a Record of Decision (ROD) by the Secretary of Energy on: (1) whether to proceed with a Modern Pit Facility (MPF); and (2) if so, where to locate a MPF. This MPF EIS evaluates the environmental impacts associated with constructing a new MPF at the following sites: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site; (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas. The MPF EIS also evaluates an upgrade to the plutonium pit manufacturing capabilities currently being established at Technical Area 55 (TA-55) at LANL, and the No Action Alternative of relying on the small interim capacity at LANL. The MPF EIS evaluates a range of pit production capabilities consistent with national security requirements. Additional NEPA analysis will be required for

the specific siting of such a facility should the decision be made that a MPF is required. For this MPF Draft EIS, constructing and operating a MPF is the preferred alternative. A preferred site for a MPF has not yet been determined, but will be identified in the Final EIS.

Public Comments: In preparing this MPF Draft EIS, NNSA considered comments received during the public scoping period from September 20, 2002, through November 22, 2002. In addition, six public hearings were held to assist NNSA in defining the scope of the analysis. The first of these public hearings was held on October 8, 2002, in Amarillo, Texas. Hearings were also held in Carlsbad, New Mexico, on October 10, 2002, in Washington, DC, on October 15, 2002, in Las Vegas, Nevada, on October 17, 2002, in Los Alamos, New Mexico, on October 24, 2002, and in North Augusta, South Carolina, on October 29, 2002. Comments made at these hearings, as well as each comment received by fax, e-mail, and mail during the scoping period, were considered in the preparation of the MPF Draft EIS. A summary of the comments is included in this draft.

The comment period for this MPF Draft EIS will be from June 6, 2003 to August 5, 2003. Public meetings will also be held during this 60-day comment period. The dates, times, and locations of these meetings will be announced in the *Federal Register* and in local newspapers. All comments received during the comment period will be considered by NNSA in the Final EIS.

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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
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	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-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}

This document summarizes the Supplemental Environmental Impact Statement for the National Nuclear Security Administration's Modern Pit Facility (MPF) proposal. In addition to information concerning the background, purpose and need for the proposed action, and the National Environmental Policy Act process, this summary includes the requirements for the proposed MPF, the alternatives and planning assumptions, the Department of Energy's identified Preferred Alternative, and a comparison of environmental impacts among alternatives. The summary identifies the major conclusions, areas of controversy, and issues to be resolved.

S.1 INTRODUCTION AND BACKGROUND

S.1.1 Overview

The U.S. Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including production readiness required to maintain that stockpile. Since 1989, DOE has been without the capability to produce stockpile certified plutonium pits, which are an essential component of nuclear weapons. NNSA, the Department of Defense (DOD), and Congress have highlighted the lack of long-term pit production capability as a national security issue requiring timely resolution. While a small interim capacity is currently being established at the Los Alamos National Laboratory (LANL), classified analyses indicate projected capacity requirements (number of pits to be produced over a period of time), and agility (ability to rapidly change from production of one pit type to another, ability to simultaneously produce multiple pit types, or the flexibility to produce pits of a new design in a timely manner) necessary for long-term support of the stockpile will require a long-term pit production capability. In particular, identification of a systemic problem associated with an existing pit type, class of pits, or aging phenomenon cannot be adequately responded to today, nor could it be with the small capability being established at LANL (see Section S.2 for a more detailed discussion regarding the purpose and need for a Modern Pit Facility [MPF]).

Prudent risk management requires that NNSA initiate action now to assure readiness to support the stockpile and that appropriate pit production capacity is available when needed. Pursuant to the *National Environmental Policy Act* of 1969 (NEPA), as amended (42 United States Code [USC] 4321 *et seq.*), and the DOE Regulations Implementing NEPA (10 Code of Federal Regulations [CFR] Part 1021), NNSA is preparing this Supplement to the Programmatic Environmental Impact Statement (PEIS) on Stockpile Stewardship and Management (SSM) for a MPF in order to decide: (1) whether to proceed with a MPF; and (2) if so, where to locate a MPF. Hereafter, this document will be referred to as the Modern Pit Facility Environmental Impact Statement (MPF EIS).

S.1.1.1 Relevant History

Plutonium pits for the nuclear weapons stockpile were manufactured at the DOE Rocky Flats Plant in Golden, Colorado, from 1952-1989. In December 1989, due to environmental and safety concerns, production at Rocky Flats was shut down by DOE and no stockpile-certified pits have since been produced by this country. Today, the United States is the only nuclear weapons power without the capability to manufacture plutonium pits suitable for use in the nuclear weapons stockpile.[1] During the mid-1990s, DOE conducted a comprehensive analysis of the capability and capacity needs for the entire Nuclear Weapons Complex and evaluated alternatives for maintaining the Nation's nuclear stockpile in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS) (DOE/EIS-0236) (DOE 1996b). Issued in September 1996, the SSM PEIS assessed future stockpile requirements and looked extensively at pit manufacturing capability and capacity needs. The SSM PEIS evaluated reasonable alternatives for re-establishing interim pit production capability on a small scale. A large pit production capacity—in line with the capacity planned for other manufacturing functions—was not evaluated in the SSM PEIS "because of the small current demand for the fabrication of replacement pits, and the significant, but currently undefined, time period before additional capacity may be needed." In the SSM PEIS Record of Decision (ROD) (61 FR 68014) on December 26, 1996, the Secretary of Energy decided to re-establish an interim pit fabrication capability, with a small capacity, at LANL. That decision limited pit fabrication to a facility "sized to meet programmatic requirements over the next ten or more years." In the ROD, DOE committed to "performing development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity."

Subsequent to the SSM PEIS ROD, a number of citizen groups filed suit challenging the adequacy of the SSM PEIS. In August 1998, the SSM PEIS litigation was resolved. As a result of that litigation, DOE agreed to entry of a court order that required, "prior to taking any action that would commit DOE resources to detailed engineering design, testing, procurement, or installment of pit production capability for a capacity in excess of the level that has been analyzed in the SSM PEIS (50 pits per year [ppy] under routine conditions, 80 ppy under multiple-shift operations), DOE shall prepare and circulate a Supplemental PEIS, in accordance with DOE NEPA Regulation 10 CFR 1021.314, analyzing the reasonably foreseeable environmental impacts of and alternatives to operating such an enhanced capacity, and shall issue a ROD based thereon." This MPF EIS is being prepared in part to satisfy that obligation.

Following the SSM PEIS, in January 1999, DOE prepared the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (LANL SWEIS) (DOE/EIS-0238) (DOE 1999a), which evaluated site-specific alternatives for implementing pit production at LANL. Consistent with the SSM PEIS ROD, the LANL SWEIS evaluated alternatives that would implement pit production with a capacity up to 50 ppy under single-shift operations and 80 ppy using multiple shifts. In the ROD for the LANL SWEIS (64 FR 50797) issued on September 20, 1999, DOE decided to initiate actions that would allow for the production of up to 20 ppy at LANL, and deferred any decision to expand pit manufacturing beyond that level. Consistent with the 1996 SSM PEIS ROD and the 1999 LANL SWEIS ROD, NNSA has been establishing a small pit manufacturing capability at LANL. The establishment of the interim pit production capacity is expected to be completed in 2007.

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[1] NNSA has demonstrated the capability to manufacture development pits at the LANL TA-55 Plutonium Facility.

S.1.1.2 Function of the Pit in Nuclear Weapons

Nuclear weapons function by initiating and sustaining nuclear chain reactions in highly compressed material which can undergo both fission and fusion reactions. Modern nuclear weapons have a primary, which is used as the initial source of energy, and a secondary, which provides additional explosive energy release. The primary contains a central core, the "pit." Nuclear weapons cannot operate without a fully functioning pit.

S.1.1.3 Nuclear Weapons Stockpile

The size and composition of the U.S. nuclear weapons stockpile is determined annually by the President. The Secretaries of Defense and Energy jointly sign the Nuclear Weapon Stockpile Memorandum (NWSM), which includes the Nuclear Weapons Stockpile Plan (NWSP) as well as a long-range planning assessment. As such, the NWSM is the basis for all DOE stockpile support planning. The DOD prepares the NWSP based on military requirements and coordinates the development of the plan with NNSA concerning its ability to support this plan. The NWSP, which is classified, covers the current year and a 5-year planning period. It specifies the types and quantities of weapons required, and sets limits on the size and nature of stockpile changes that can be made without additional approval of the President. The NWSM directly specifies the number and types of weapons required to support the stockpile.

Section S.2 discusses the relevant factors, such as treaties and the Nuclear Posture Review (NPR), that shape national security policies related to the MPF Proposed Action.

S.1.2 Proposed Action, Environmental Impact Statement Scope, and Alternatives

NNSA proposes to site, construct, and operate a MPF for the purpose of producing plutonium pits to support long-term national security needs. A range of pit production capacities consistent with national security requirements is analyzed in this EIS (see Sections S.2 and S.3 for a discussion of pit production capacity and the range of capacities that are utilized in this EIS). This MPF EIS analyzes the reasonably foreseeable environmental impacts of, and alternatives to, operating at the various capacities. Consistent with this approach, the MPF EIS also evaluates the No Action Alternative of maintaining the plutonium pit capabilities at LANL that are currently planned to be in place by 2007, and an upgrade of the Technical Area (TA)-55, Plutonium Facility, Building 4 (PF-4), at LANL.

For the proposed MPF, this EIS analyzes all reasonable site locations. As described in detail in Appendix G, NNSA utilized a site screening process to determine a reasonable range of site alternatives for the MPF EIS. In this site screening process, all existing, major DOE sites were initially considered to serve as potential host locations for a MPF. The site screening analysis considered the following criteria: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA presence at the site, and infrastructure. The first two criteria were deemed to be "exclusionary" criteria; that is, a site either passed or failed on each of these two criteria. The sites that passed the exclusionary criteria were then scored against all criteria. Based upon results from the site screening analysis, the following were determined to be reasonable alternatives for a MPF: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site; (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas.

S.1.3 *National Environmental Policy Act* Strategy

Deciding whether to proceed with a MPF, and if so, where to locate a MPF, is a major Federal action that could significantly affect the quality of the human environment; therefore, an EIS is required. NNSA envisions this MPF EIS as a "programmatic document" that would support these two decisions. In addition, this MPF EIS analyzes a No Action Alternative and an Upgrade Alternative to the existing PF-4 at TA-55 at LANL. If the Secretary of Energy decides to proceed with a MPF, a second, tiered, project-specific EIS would be prepared after the MPF EIS ROD. That EIS would utilize more detailed design information to evaluate reasonable site-specific alternatives in the vicinity of the host site picked in the MPF EIS ROD. In the event that the tiered EIS considers alternative site locations beyond existing DOE site boundaries, such locations would be required to be consistent with the original host site selection criteria. That tiered EIS would ultimately support a ROD for the construction and operation for a MPF of a specific capacity and design at a specific location.

S.1.4 Other Relevant *National Environmental Policy Act* Reviews

Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management, DOE/EIS-0236 (SSM PEIS)

The SSM PEIS evaluated alternatives for maintaining the safety and reliability of the Nation's nuclear stockpile in the post-Cold War world (DOE 1996b). In the December 26, 1996, SSM PEIS ROD (61 FR 68014), the Secretary of Energy decided, among other decisions, to establish an interim, small pit fabrication capability at LANL "sized to meet programmatic requirements over the next ten or more years." In the ROD, DOE committed to "performing development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity." Consistent with the SSM PEIS ROD, a MPF would provide a larger plutonium pit capacity to meet long-term national security needs.

Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, DOE/EIS-0238 (LANL SWEIS)

The LANL SWEIS evaluated alternatives for the continued operation of LANL (DOE 1999a). Four alternatives were evaluated: (1) No Action, (2) Expanded Operations, (3) Reduced Operations, and (4) a Greener Alternative. The LANL SWEIS evaluated site-specific alternatives for implementing pit production at LANL consistent with the SSM PEIS ROD. A LANL SWEIS ROD was issued on September 20, 1999, to select the Expanded Operations Alternative (64 FR 50797) with a modification in the level of pit production. This alternative included the continuation of all activities presently undertaken at LANL, at the highest level of activity, and an increased pit production capability. In this ROD, DOE decided to implement actions that would allow for the production of up to 20 ppy at LANL, and deferred any decision to expand pit manufacturing beyond that level. The LANL SWEIS provides the framework for the No Action Alternative in the MPF EIS. That is, if the Secretary of Energy decides to not proceed with a MPF or upgrade the LANL plutonium pit capabilities, then NNSA would rely upon the planned capacity at LANL to meet long-term national security needs (i.e., the No Action Alternative).

Final Programmatic Environmental Impact Statement for the Storage and Disposition of Weapons-Usable Fissile Materials, DOE/EIS-0229 (S&D PEIS)

The S&D PEIS analyzed the potential environmental consequences of alternatives for the long-term storage (up to 50 years) and disposition of plutonium from U.S. nuclear weapon dismantlements (DOE 1996d). Three storage alternatives were evaluated: (1) Upgrade at Multiple Sites, (2) Consolidation of Plutonium, and (3) Collocation of Plutonium and Enriched Uranium. Six candidate sites were considered: Hanford Site, Nevada Test Site (NTS), Idaho National Engineering Laboratory, Pantex, Oak Ridge Reservation, and the Savannah River Site (SRS). On January 14, 1997, DOE issued a ROD (62 FR 3014) to upgrade the plutonium storage capabilities of Pantex, Hanford, and SRS and to continue to store plutonium at these facilities. Weapons-usable plutonium at Rocky Flats would be transported to Pantex and SRS. On August 13, 1998, DOE issued an amended ROD (63 FR 43386) to expand improvements to SRS storage facilities to allow for accelerated movement of plutonium from Rocky Flats. DOE further decided in the ROD that the Y-12 National Security Complex (Y-12) on the Oak Ridge Reservation would continue to store nonsurplus enriched uranium (for the long-term) and surplus enriched uranium (on an interim basis) in upgraded facilities pending final disposition. Based on these decisions, plutonium pits to be used in a MPF would be stored at Pantex and enriched uranium components for the MPF would be stored at Y-12.

Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, DOE/EIS-0243 (NTS SWEIS)

The NTS SWEIS evaluated alternatives for the continued operation of NTS (DOE 1996a). Four alternatives were evaluated: (1) No Action Alternative, (2) Discontinuation of Operations, (3) Expanded Use, and (4) Alternate Use of Withdrawn Lands. On December 13, 1996, DOE published a ROD (61 FR 65551) selecting the Expanded Use Alternative. In July 2002, DOE issued a *Supplement Analysis for the Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE/EIS-0243-SA-01) (DOE 2002b). This supplement analysis determined that there were no significant changes from actions foreseen in 1996. Furthermore, there were no new major proposals and projects. Accordingly, it was determined that no supplemental EIS for the 1996 NTS EIS is required. For purposes of the MPF EIS, the analyses and decisions in the NTS SWEIS ROD and Supplement Analysis represent the No Action Alternative at NTS. That is, if the Secretary of Energy decides to not proceed with a MPF, or decides to not locate a MPF at NTS, then NNSA would conduct business at NTS within the framework of the NTS SWEIS ROD and Supplement Analysis.

Final Environmental Impact Statement for the Continued Operation of Pantex and Associated Storage of Nuclear Weapons Components, DOE/EIS-0225 (Pantex SWEIS)

The Pantex SWEIS evaluated alternatives for the continued operation of Pantex (DOE 1996c). The SWEIS examined environmental impacts resulting from a reasonable range of activity levels by assessing the operations on 2,000, 1,000, and 500 weapons per year. The SWEIS also addressed environmental impacts resulting from the relocation of interim pit storage to other

DOE sites. On January 27, 1997, DOE issued a ROD (62 FR 3880) selecting the implementation of upgrades to enable continued operations, and continued interim pit storage, at Pantex, to enable increasing the storage level from 12,000 to 20,000 pits.

In April 2002, DOE completed a *Supplement Analysis for the Final EIS for the Continued Operation of Pantex and Associated Storage of Nuclear Weapon Components* (DOE/EIS-0225/SA-03) (DOE 2002a). This analysis looked at the SWEIS completed in 1996 and concluded that there is no need to supplement the Pantex SWEIS.

With respect to the MPF EIS, the decision to store up to 20,000 pits in upgraded storage facilities at Pantex is applicable to all alternatives analyzed in the MPF EIS; that is, regardless of any decisions in the MPF EIS, Pantex will continue to store plutonium pits for the Nation's nuclear weapon stockpile. Additionally, if the Secretary of Energy decides to not proceed with a MPF, or decides to not locate a MPF at Pantex, then NNSA would conduct business at Pantex within the framework of the Pantex SWEIS ROD and Supplement Analysis.

Final Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase, DOE/EIS-0026-S-2 (WIPP SEIS)

In 1980, the original *Final Environmental Impact Statement for the Waste Isolation Pilot Plant* (DOE/EIS-0200) was issued. Supplemental EISs (SEISs) were issued in 1990 and again in 1997. In addition, several Supplement Analyses (SAs) have been issued. In July 2002, DOE issued the WIPP EIS-SA (DOE/EIS-0026-S-2) (DOE 1997). This EIS-SA, supported by the earlier analyses, examined the alternatives associated with the treatment, storage, transportation and disposal of transuranic (TRU) waste at WIPP, located near Carlsbad, New Mexico. On September 6, 2002, DOE issued a revised ROD (67 FR 56989) to allow for shipments from various locations to WIPP. For purposes of the MPF EIS, the analyses and decisions in the WIPP SEIS and ROD represent the No Action Alternative at WIPP. That is, if the Secretary of Energy decides not to proceed with a MPF, or decides not to locate a MPF at WIPP, then DOE would conduct business at WIPP within the framework of the RODs for WIPP EISs and SEISs.

Nonnuclear Consolidation Environmental Assessment, DOE/EA-0792

In June 1993, DOE issued the *Nonnuclear Consolidation Environmental Assessment* (EA) (DOE 1993). This EA analyzed the proposed consolidation of the facilities within the Nation's Nuclear Weapons Complex that manufactured the nonnuclear components used in the Nation's nuclear weapons arsenal. Based on the findings of this EA, on September 14, 1993, DOE issued a Finding of No Significant Impact (FONSI) which resulted in defense activities being withdrawn from the Mound Plant in Miamisburg, Ohio, the Pinellas Plant in Pinellas, Florida, and the nonnuclear activities at the Rocky Flats Plant in Golden, Colorado (58 FR 36658). These activities were relocated and consolidated at the Kansas City Plant in Kansas City, Missouri and Sandia National Laboratories, New Mexico. This action also transferred the tritium handling activities performed at the Mound Plant to SRS. With respect to the MPF EIS, the decision based on this Nonnuclear Consolidation EA would apply equally to all MPF alternatives. That is, nonnuclear components for pits would be produced in existing facilities and shipped to the pit production facility for assembly into pits.

Supplement Analysis, Changes Needed to the Surplus Plutonium Disposition Program

On April 19, 2002, DOE issued an amended ROD (67 FR 19432) for both the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE/EIS-0283) (DOE 1999b) and the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229) (DOE 1996d). This ROD cancelled the immobilization component of the U.S. surplus plutonium disposition program for surplus weapons-usable plutonium described in these two EISs and selected the alternative of immediate implementation of consolidated long-term storage at SRS of surplus non-pit plutonium now stored separately at Rocky Flats. The ROD also explained that DOE's current disposition strategy involves a mixed oxide-only approach, under which DOE would dispose of up to 34 metric tons (37 tons) of surplus plutonium by converting it to mixed oxide fuel and irradiating it in nuclear power reactors. The Supplement Analysis concluded that changes to the mixed oxide facility in the F-Area at SRS to allow for the amended ROD would result in no additional impacts, and that no new or different bounding accident scenarios had been identified. Accordingly, it was determined that the original analysis was sufficient and that a SEIS was not required. Relative to the MPF EIS, the NNSA considered use of the plutonium disposition facilities at SRS, but eliminated this option from detailed study (see Section S.3.4.2).

Environmental Impact Statement for the Chemical and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, DOE/EIS-0350D (CMRR EIS)

DOE/NNSA is currently preparing an EIS for the Chemistry and Metallurgy Research Building Replacement Project (CMRR) at LANL (DOE 2003). The purpose of the CMRR EIS is to evaluate the potential environmental impacts associated with alternatives for replacing the existing Chemistry and Metallurgy Research Building (CMR) at LANL, which is scheduled to be shut down in approximately 2010. The preferred alternative is to construct a new CMRR Facility at TA-55, consisting of two or three buildings. On July 23, 2002, DOE/NNSA published a Notice of Intent (NOI) in the *Federal Register* (67 FR 48160). Public scoping meetings were held in August 2002. DOE/NNSA issued a Draft CMRR EIS in May 2003. The Final CMRR EIS is expected to be issued in late 2003 or early 2004. Under the No Action Alternative and the TA-55 Upgrade Alternative, direct analytical chemistry and metallurgical support would be provided by the existing CMR or the proposed CMRR (see Section S.3.4.5).

S.1.5 Public Scoping Process

Scoping is a process in which the public and stakeholders provide comments directly to the Federal agency on the scope of the EIS. This process begins with the publication of a NOI in the *Federal Register*. On September 23, 2002, DOE published a NOI to prepare the MPF EIS (67 FR 59577) and invited public comment on the MPF EIS proposal. Subsequent to this notice, DOE held public scoping meetings in Amarillo, Texas; Carlsbad, New Mexico; Las Vegas, Nevada; Los Alamos, New Mexico; North Augusta, South Carolina; and Washington, DC. In addition, the public was encouraged to provide comments via mail, e-mail, fax, and the Internet.

A neutral facilitator conducted the meetings to direct and clarify discussions and comments. Court reporters were also present to provide a verbatim transcript of the proceedings and record any formal comments. All scoping meeting comments, along with those received by mail or

Internet during the public scoping comment period, were considered by DOE in preparing this EIS. A summary of the comments received during the public scoping process, as well as DOE's consideration of these comments, is provided in Appendix E of this EIS.

Summary of Major Comments Received

Nearly 1,600 comments were received from individuals, interested groups, and Federal, state, and local officials during the public scoping period, including approximately 480 oral comments made during the public meetings. The remainder of the comments (1,106) was submitted at the public meetings in written form, or were submitted via U.S. mail, e-mail, or fax, over the entire scoping period.

Many of the oral and written comments questioned the need for a MPF. In particular, commentors questioned why the facility was needed since the NOI stated that no problems that would require pit replacements had been found to date. Commentors also quoted several previous DOE documents and DOE and other government officials who stated that both the nuclear and nonnuclear parts of pits in the stockpile were stable and reliable into the foreseeable future.

Other commentors cited a number of studies done by both DOE and independent researchers that demonstrated the stability of plutonium, a main component of a pit, over time; thus commentors felt that until conclusive evidence on pit aging is established, a MPF is not necessary.

Several commentors dismissed the need for the Proposed Action by stating that the PF-4, the current interim production plutonium facility at LANL, analyzed in the 1996 *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996b) for production of up to 80 ppy, already met the needs of pit refurbishment for the nuclear stockpile. Many commentors also noted that the NOI statement that "…DOE has been without the capability to produce plutonium pits…" is alarmist and false, considering the PF-4 capability.

Many commentors raised the issue of international treaties and decisions, particularly the Nuclear Nonproliferation Treaty, the Strategic Offensive Nuclear Reduction Treaty (Moscow Treaty), the Comprehensive Test Ban Treaty, and International Court of Justice Decision, July 1996 opinion, questioning whether a MPF would be consistent with international law. Commentors specifically stated that since the United States had agreed, under the Moscow Treaty, to reduce its number of operationally deployed strategic nuclear weapons to approximately 1,700-2,200, the PF-4 was more than sufficient to meet pit refurbishment needs; thus a MPF would not be necessary. Furthermore, commentors wanted clarity on why "agility," defined in the NOI as the ability to change and expand pit production types and plutonium pit designs simultaneously, was necessary at all considering the United States had committed, under the Moscow Treaty, to reduce its number of weapons.

Other issues raised regarding need included questions on why the several thousand pits in reserve at Pantex could not be used to replace any potentially deteriorating pits in the active nuclear stockpile. Others questioned why a MPF was necessary at all since DOE had created the Stockpile Stewardship Program to monitor the nuclear stockpile. They went on to question that if a MPF were built, why would it be necessary to have both the Stockpile Stewardship Program and a MPF.

A significant number of commentors also expressed concern about the costs associated with building a MPF. Commentors wanted to see the full costs associated with each phase of a MPF: design, construction, operation, transportation of materials, waste handling and final disposition of waste, security, decommissioning, destruction and return of land to its original condition.

Several commentors expressed concern about environmental, safety, and health risks associated with a MPF, particularly the transportation of pit materials and waste across the Nation's highways. DOE representatives were urged to thoroughly evaluate the potential consequences of the Proposed Action on local wildlife, water resources, air quality, the potential for accidents and their consequences, and the health and safety of residents near a prospective site and along transportation routes. Commentors suggested that the EIS quantify all radionuclide and chemical emissions associated with the MPF Alternative. Many were concerned that a MPF would not avoid the waste and contamination problems of the old pit facility at the Rocky Flats Plant, which ceased operations in 1989.

Many commentors also expressed concern about the safety and security of a MPF from terrorist actions both from on the ground and from the sky and wanted to know what measures DOE would implement to prevent such actions.

Many commentors expressed support for the No Action Alternative. More than 70 of the comments received were part of a write-in postcard campaign objecting to nuclear weapons. A number of commentors expressed support for a MPF. Other commentors also expressed favor or opposition to the MPF Alternative, reasons for which included security, cost, and workforce advantage.

Major issues identified through the scoping period are addressed in this EIS by analyses in the following areas:

- Land resources, including land use and visual resources
- Site infrastructure
- Air quality and acoustics
- Water resources, including surface water and groundwater
- Geology and soils
- Biotic resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species
- Cultural and paleontological resources, including prehistoric resources, historic resources, and Native American resources

- Socioeconomics, including employment and local economy, population, housing, community or local government public finances, and local transportation

- Radiological and hazardous chemical impacts during normal operations and accidents

- Waste management

- Transportation of nuclear materials

In addition to analyses in these areas, the EIS also addresses unavoidable impacts and irreversible and/or irretrievable commitment of resources, and impacts of long-term production. A complete listing of the comments that were received, as well as how each specific comment was considered in the analysis of this document, is also included in Appendix E.

S.1.6 Organization of this Environmental Impact Statement

This EIS consists of this summary plus two volumes. Volume I contains the main analyses, while Volume II contains technical appendixes that support the analyses in Volume I, along with additional project information. Volume I contains 11 chapters that include the following information:

Chapter 1—Introduction: MPF EIS background and the environmental analysis process.

Chapter 2—Purpose and Need: Reasons why DOE needs to take action and purposes to be achieved.

Chapter 3—Proposed Action and Alternatives: The way DOE proposes to meet the specified need and achieve the objectives. This chapter also includes a summary comparison of the potential environmental impacts of the EIS alternatives and identifies any preferred alternative.

Chapter 4—Affected Environment: Aspects of the environment that might be affected by the EIS alternatives.

Chapter 5—Environmental Impacts: Analyses of the potential impacts on the environment. Impacts are compared to the projected environmental conditions that would be expected if no action were taken.

Chapter 6—Regulatory Requirements: Environmental, safety, and health regulations that would apply for the EIS alternatives, and agencies consulted for their expertise.

Chapters 7-11: An index; list of references; a list of preparers; a list of agencies, organizations, and persons to whom copies of this EIS were sent; and a glossary.

Volume II contains eight appendixes of technical information in support of the environmental analyses presented in Volume I. These appendixes contain the following information: details of the pit production process and requirements; human health; accidents; transportation; summary of scoping comments; methodology; project studies and notices; and contractor disclosure.

S.2 PURPOSE AND NEED

This section discusses the reasons why the NNSA is proposing to construct and operate a MPF, as well as the goals to be achieved with MPF. This section also discusses relevant national security policies and their relationship to MPF.

S.2.1 Introduction and Need for a Modern Pit Facility

As explained in Section S.1.1, DOE's NNSA is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including production readiness required to maintain that stockpile. Plutonium pits are an essential component of nuclear weapons. Historically, plutonium pits for the nuclear weapons stockpile were manufactured at the DOE's Rocky Flats Plant in Colorado. At peak production, the Rocky Flats Plant produced a thousand or more pits per year. In 1989, due to environmental and safety concerns, pit production was shut down by the DOE at the Rocky Flats Plant, leaving the Nation without the capability to produce plutonium pits for the nuclear weapons stockpile. Today, the United States is the only nuclear weapons power without the capability to manufacture plutonium pits suitable for use in the nuclear weapons stockpile.[1]

Since approximately 1996, the NNSA has been establishing a small interim pit manufacturing capability at the LANL. While this small interim pit production capacity is expected to be completed in 2007, classified analyses indicate projected capacity requirements (number of pits to be produced over a period of time), and agility (ability to rapidly change from production of one pit type to another, ability to simultaneously produce multiple pit types, or the flexibility to produce pits of a new design in a timely manner) necessary for long-term support of the stockpile will require a long-term pit production capability. In particular, identification of a systemic problem associated with an existing pit type, class of pits, or aging phenomenon cannot be adequately responded to today, nor could it be with the small capability currently being established at LANL. Sections S.2.1.1 and S.2.1.2 discuss pit aging and accelerated aging testing. Sections S.2.1.3 and S.2.1.4 provide a discussion of capacity and agility requirements that would be addressed by the proposed MPF.

S.2.1.1 Pit Aging as a Driver

Modern nuclear weapons have a primary, which contains a central core, the "pit" (typically composed of plutonium-239). Many complex physical and chemical interactions occur during the split second that the primary operates.

However, as materials age, particularly those in nuclear weapons, they tend to change. Age-related changes that can affect a nuclear weapon's pit include changes in plutonium properties as impurities build up inside the material due to radioactive decay, and corrosion along interfaces, joints, and welds. The reliability of the U.S. nuclear weapons stockpile requires that pits will operate as designed.

Although the U.S. nuclear weapons stockpile is presently safe and reliable, these nuclear weapons are aging. The average age of the stockpile is currently about 19 years, and many

[1] NNSA has demonstrated the capability to manufacture development pits at the LANL TA-55 Plutonium Facility.

weapons have exceeded their original design life. In the past, individual weapons in the stockpile were replaced by new-design or upgraded weapons before they approached the end of their design life. However, because the United States has not produced any new nuclear weapons since 1989, some weapons are remaining in the stockpile much longer than previously. This may create issues about the performance capability of stockpile weapons because of uncertainties in the effects of pit aging past the design life. Planning and design of a MPF is a prudent risk management approach to assure readiness to support the stockpile.

S.2.1.2 Assessment of the Pit Lifetime

Pit lifetime is a fundamental uncertainty which NNSA is working to quantify. Currently deployed, enduring stockpile pits will reach their end-of-life (EOL) at some presently unknown future date. (In this context, EOL refers to the time when a weapon system with a particular pit can no longer be certified to meet military characteristics in required environments, due to aging [discussed above in Section S.2.1.1]). In order to determine when this EOL occurs, NNSA must understand aging in plutonium and the effect of aging-related changes on pit performance. The three most important potential aging effects in plutonium result from the radioactive decay of the various plutonium isotopes (and the impact of this decay on the chemistry, structure, and properties of the material), the thermodynamic phase stability of the plutonium alloy, and the corrosion of the plutonium during both storage and function. In many cases, these aging effects accumulate slowly over decades, and not necessarily in a linear fashion. Only when key properties have sufficiently changed would NNSA anticipate a measurable impact on weapons safety or performance. Through the process of accelerated plutonium aging experiments, model development of the age-related changes, and design sensitivity studies, weapons designers are working to specify the limits of acceptable change for each of these properties by evaluation of performance margins associated with each system. By combining these limits with the measured or predicted rates of change due to aging effects, NNSA expects to improve estimates for pit lifetimes.

A series of experiments are being conducted to measure the properties (fundamental structural, physical, chemical and mechanical properties, such as electrical resistivity and elastic constants, and metallic properties such as density, chemistry and strength) of the accelerated-aging plutonium samples as they age beyond the oldest plutonium in the stockpile. The results from accelerated aging experiments will be used in design analyses and further tests to assess the potential impact of aging on the performance of weapons. Based on information developed to date, which includes careful evaluation of the effects described above through extensive characterization of old pits, modeling, and preliminary design sensitivity calculations, initial estimates of minimum pit lifetimes have been derived. Evaluation of the oldest samples of plutonium metal, both metal of oldest absolute age (40 years) as well as the oldest samples most directly comparable to the enduring stockpile (25 years) have shown predictably stable behavior. Hence, the NNSA weapons laboratories have determined that pits will perform adequately for 45-60 years. Moreover, continuing research will strengthen the linkage between changes resulting from aging, key properties, and weapons performance as determined by prior nuclear tests.

During the public scoping period, some commentors questioned whether plutonium pits degrade over time. Many cited an article written by Raymond Jeanloz that appeared in *Physics Today* in

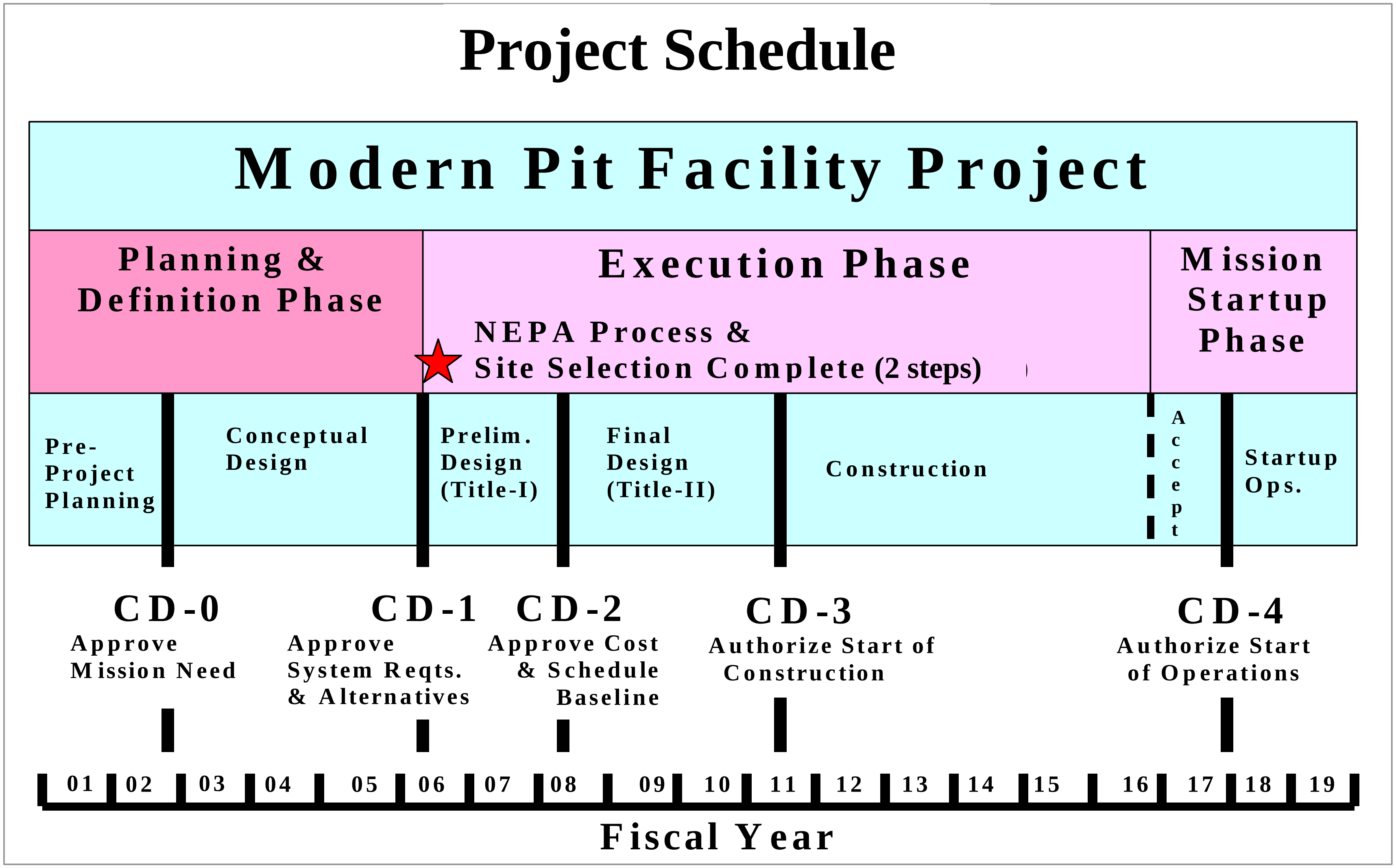
December 2000, in which Professor Jeanloz concluded that, "Plutonium exhibits good crystalline order even after decades of aging." Professor Jeanloz suggested this as evidence that phase stability was not a likely concern. Unfortunately, recent local-structure measurements by the weapons laboratories have demonstrated the immense complexity of local atomic arrangements in the crystalline plutonium lattice and increased delta-phase stability with aging cannot be assumed. Although measurements of naturally aged plutonium have shown macroscopic delta-phase stability over time, NNSA is examining the local structure picture carefully in the accelerated aging program to assure that the 45-60 year pit lifetime remains valid.

NNSA has made substantial progress in the past few years in achieving a fundamental understanding of some of the age-related changes in plutonium. The theoretical, modeling, and experimental components are now in place to make significant progress over the next few years to quantify the margins and uncertainties. NNSA is encouraged that measurements to date have not shown any significant degradation of pits over approximately 40 years. The changes observed to date have been quite small, giving both LANL and LLNL investigators reasonable confidence in the 45-year minimum lifetime estimate based on the data collected to date.

S.2.1.3 Capacity as a Driver

Most of the pits in the enduring stockpile were produced in the mid-to-late 1970s and 1980s, and no pits have been produced since 1989. In approximately 2020, some pits in the enduring stockpile will be approaching the 45-year pit lifetime. Given the fact that many types of pits in the enduring stockpile may reach their EOL at about the same time (see Section S.2.1.4), prudent risk management requires that NNSA initiate action now to ensure that appropriate pit production capacity is available when needed. As shown on Figure S.2.1.3–1, it will take approximately 17 years to design and construct a MPF before full-scale production can begin. Consequently, in order for a MPF to be in production by approximately 2020, planning for such a facility must begin now.

It should also be noted that the size and composition of the enduring stockpile are also uncertain. In classified analyses, the NNSA has considered possible futures in which the stockpile size could be reduced to 1,000 total weapons or in which it could be as large as required to meet Nuclear Posture Review (NPR) requirements. Although the precise future capacity requirements are not known with certainty, enough clarity has been obtained through these ongoing classified studies (which are part of the classified appendix to this MPF EIS) that NNSA can identify a range of pit production capacity requirements that form the basis of initial MPF alternative evaluations during the conceptual design phase. The classified studies examined capacity requirements that would result from a wide range of enduring stockpile sizes and compositions, pit lifetimes, emergency production needs (referred to as "contingency" requirements), facility full-production start dates, and production operating practices, e.g., single versus multiple shifts.



Source: NNSA 2002.

Figure S.2.1.3–1. Modern Pit Facility Project Schedule

Pit capacity requirements must also account for the need for additional pits, e.g., logistics spares and surveillance units. As a result of this requirement, the number of pits that must be available to support a specific weapon system will exceed the number of deployed strategic weapons and vary by pit type.

Contingency production requirements are also an important driver for the need for a MPF. Contingency production, which is the ability to produce a substantial quantity of pits on short notice, is distinct from the capacity needed to replace pits destroyed for surveillance or other reasons (such as for production quality assurance or other experiments). The capacity of a MPF needs to support both scheduled stockpile pit replacement at EOL and any "unexpected" short-term production. Such short-term "contingency" production may be required for reliability replacement (replacement of pits to address, for example, a design, production, or unexpected aging flaw identified in surveillance), or for stockpile augmentation (such as the production of new weapons, if required by national security needs).

In all cases, and in all combinations with other capacity drivers, the interim production capacity being established at LANL will be inadequate to maintain these projected stockpiles. The required production capacity is a function of pit lifetime, stockpile size, and start date of full-scale production. To account for these variables, this MPF EIS evaluates a pit production capacity between 125-450 ppy for full-scale production beginning in approximately 2020.

S.2.1.4 Agility as a Driver

A critical element of production readiness is the agility (the ability to change rapidly from the production of one pit type to another, or to simultaneously produce different pit types) of the production line. Pits in the current enduring stockpile were produced over a relatively short period of time and can therefore be expected to reach their respective EOLs at about the same time, as well. Thus, any strategy to replace the enduring stockpile pits before they reach their EOL must address both the production rate for a particular pit type (the capacity driver discussed in Section S.2.1.1), and the ability to produce all necessary pit types in a relatively short period of time. For this reason, agility is an essential requirement for a MPF.

Contingency production also requires agility. If contingency production is ever needed, the response time will likely be driven by either a reliability problem that requires prompt response, or another type of emergency that must be addressed quickly. Thus, changeover from production of one pit type to another will have to be demonstrated for both replacements of pits at EOL (a process that will allow for planning and scheduled activities in advance of the need date), as well as for startup of contingency production with little notice (and therefore little planning time).

S.2.2 Purposes to be Achieved by a Modern Pit Facility

If constructed and operated, a MPF would address a critical national security issue by providing sufficient capability to maintain, long-term, the nuclear deterrent that is a cornerstone of U.S. national security policy. A MPF would provide the necessary pit production capacity and agility that cannot be met by pit production capabilities at LANL.

As explained in Section S.1.4, this EIS and NEPA process will support a ROD by the Secretary of Energy on: (1) whether to proceed with a MPF; and (2) if so, where to locate a MPF. A siting decision would enable NNSA to better focus detailed design activities and to improve the efficiency and cost-effectiveness of pre-construction activities. If the Secretary decides to proceed with a MPF, a tiered, project-specific EIS would be prepared after the MPF EIS ROD. That tiered EIS, which would utilize detailed design information to evaluate site-specific location alternatives in the vicinity of the host site picked in the MPF EIS ROD, would ultimately support a ROD for construction and operation of a MPF.

S.2.3 National Security Policy Considerations

There are several principal national security policy overlays and related treaties that are potentially relevant to the proposal to construct and operate the MPF, such as: the NPR; the Nuclear Weapons Stockpile Memorandum and the corresponding Nuclear Weapons Stockpile Plan; the Nuclear Nonproliferation Treaty (NPT), and the Comprehensive Test Ban Treaty. Each of these is discussed below.

S.2.3.1 Nuclear Posture Review

In 2001, Congress required the DOD, in consultation with DOE, to conduct a comprehensive review of the nuclear posture of the United States for the next 5-10 years. The resulting classified report to Congress, entitled the *Nuclear Posture Review*, addresses the following elements:

- The role of nuclear forces in U.S. military strategy, planning, and programming
- The policy requirements and objectives for the United States to maintain a safe, reliable, and credible nuclear deterrence posture
- The relationship among the U.S. nuclear deterrence policy, targeting strategy, and arms control objectives
- The levels and composition of the nuclear delivery systems that will be required for implementing the U.S. national and military strategy, including any plans for replacing or modifying existing systems
- The nuclear weapons complex that will be required for implementing the U.S. national and military strategy, including any plans to modernize or modify the complex
- The active and inactive nuclear weapons stockpile that will be required for implementing the U.S. national and military strategy, including any plans for replacing or modifying warheads

With respect to the Proposed Action in this EIS, the NPR confirms that a MPF production facility will be required for large-scale replacement of existing plutonium components and any production of new designs. The NPR also recommends that the DOE/NNSA "accelerate preliminary design work on a modern pit manufacturing facility so that production capacity can be brought online when needed."

S.2.3.2 Nuclear Weapons Stockpile Memorandum and Nuclear Weapons Stockpile Plan

Although the NWSP and NWSM are classified documents, their effect in shaping the MPF EIS can be explained in an unclassified context. As explained in Section S.1.3, the NWSP specifies the types and quantities of nuclear weapons required, and sets limits on the size and nature of stockpile changes that can be made without additional approval by the President. The NWSM, which is jointly signed by the Secretaries of Defense and Energy, includes the NWSP and a long-range planning assessment. As such, the NWSM is the basis for NNSA stockpile support planning. The NWSP and NWSM are highly dependent upon national security objectives determined by the President. In this regard, the United States has committed to reduce the number of operationally deployed strategic nuclear weapons to 1,700-2,200 in 2012.

S.2.3.3 Nuclear Nonproliferation Treaty

The NPT was ratified by the U.S. Senate in 1969 and officially entered into force as a Treaty of the United States in 1970. Today, the United States continues to view the NPT as the bedrock of the global effort to prevent the spread of nuclear weapons and to reduce nuclear weapons stockpiles. Article VI of the NPT obligates the parties "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." The United States has taken this obligation seriously and has reduced its nuclear weapons stockpile. Some examples are the 1987 Treaty on Intermediate Range Nuclear Forces, which eliminated an entire class of nuclear weapon systems; and the 1991 Presidential Nuclear Initiative, which led to the withdrawal and destruction of thousands of U.S. nonstrategic nuclear weapons. U.S. and Russian cooperation throughout the 1990s has led to continued reductions in nuclear weapons and the withdrawal of hundreds of tons of fissile material from defense stockpiles. The 1991 Strategic Arms Reduction Treaty led to significant reductions in the number of deployed strategic nuclear warheads. In the future, the United States will require far fewer nuclear weapons. Accordingly, President Bush has decided that the United States will reduce its operationally deployed strategic nuclear weapons to a level between 1,700 and 2,200 over the next decade.

It must be noted that the NPT does not provide any time period for achieving the ultimate goal of nuclear disarmament nor does it preclude the maintenance of nuclear weapons until their disposition. For this MPF EIS, speculation on the terms and conditions of a "zero level" U.S. stockpile, as some have suggested during the scoping meetings, goes beyond the bounds of the reasonably foreseeable future consistent with the NPR. The Proposed Action in this EIS, which would enable NNSA to maintain the reliability of the enduring stockpile until the ultimate goals of the NPT are attained, is consistent with the NPT.

S.2.3.4 Comprehensive Test Ban Treaty

The Comprehensive Test Ban Treaty, which bans all nuclear explosions for civilian or military purposes, was signed by the United States on September 24, 1996, but has never been ratified by the U.S. Senate. Nonetheless, the United States has been observing a moratorium on nuclear testing since 1992, and the NPR strategy discussed in Section S.2.3.1 reflects this policy. The

Proposed Action in this EIS would be consistent with a continuing U.S. moratorium or a Comprehensive Test Ban Treaty.

S.3 ALTERNATIVES

S.3.1 Pit Production Operational Requirements

This EIS analyzes the impacts from the construction and operation of a new facility, referred to as a MPF, to produce plutonium pits for nuclear weapons. In addition to the construction of a totally new facility, an option to upgrade the existing TA-55 Facility at the LANL to increase its output is analyzed as well as the No Action Alternative. This section discusses the overall pit production process, and lists the facility requirements necessary to accommodate this process. The MPF is in a conceptual design stage.

S.3.1.1 Pit Production Process

The following discussion is a brief summary of the pit production process that would be accomplished in a MPF. The overall process is depicted in Figure S.3.1.1–1 which shows three main areas: Material Receipt, Unpacking, & Storage; Feed Preparation; and Manufacturing.

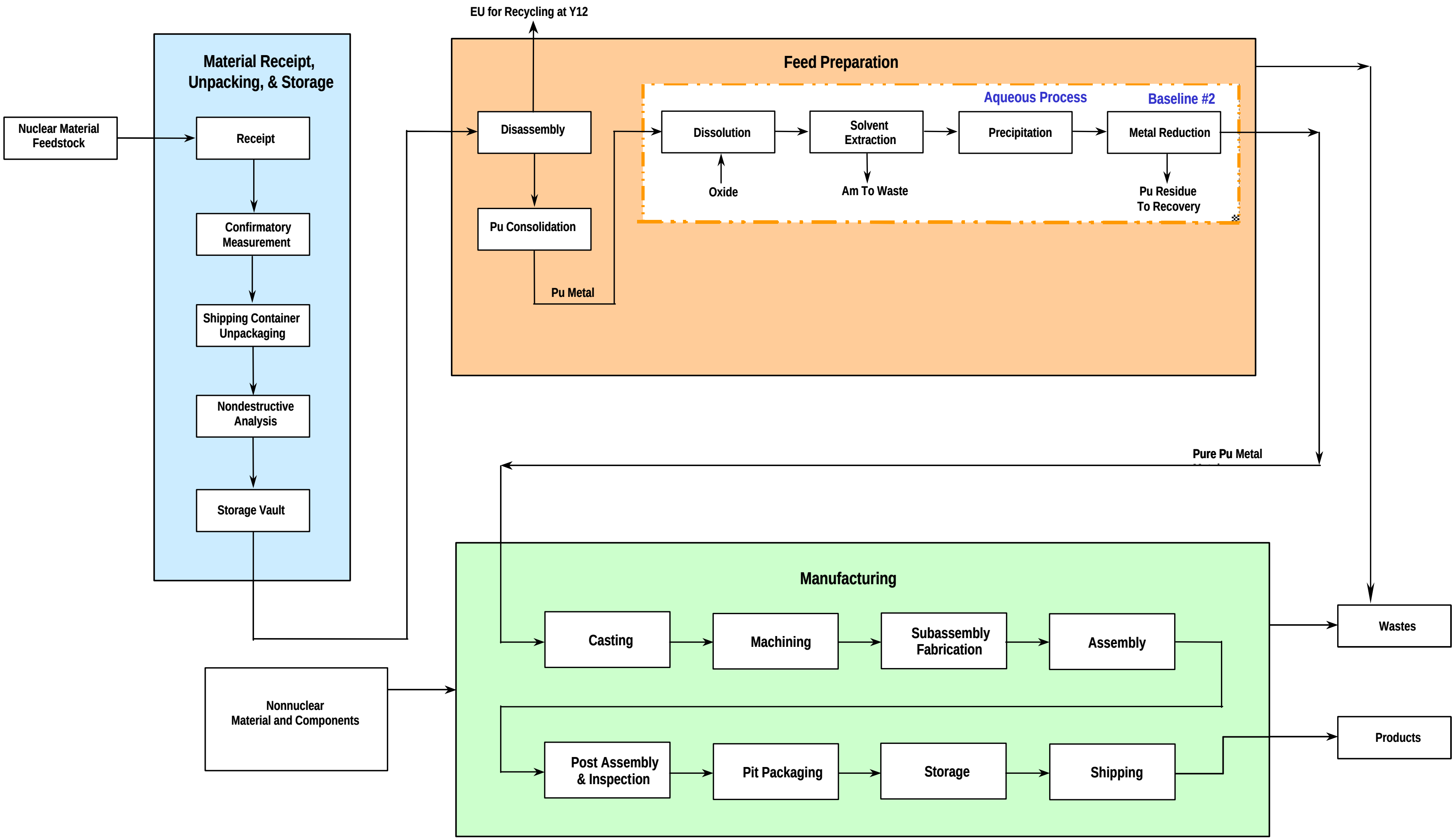
Material Receipt, Unpacking, & Storage

Plutonium feedstock material would be delivered from offsite sources in DOE/Department of Transportation (DOT) approved shipping containers, hauled by Safe Secure Trailers (SST) or Safeguards Transporters (SGT). The bulk of the feedstock material would be in the form of pits from old weapons to be recycled with small amounts of plutonium metals from LANL and SRS. Each shipment would be measured to confirm the plutonium content, entered into the facility's Material Control & Accountability (MC&A) database, and placed into temporary storage. Containment vessels with the feedstock material would then be accountability measured and transferred to the Receipt Storage Vault pending transfer to the Feed Preparation Area.

Feed Preparation

The containers would then be transferred through a secure transfer corridor to an adjacent Feed Preparation Area where plutonium metal is prepared for manufacturing. For pits to be recycled, mechanical disassembly involves cutting the pit in half and removing all non-plutonium components. Notable among these non-plutonium components is enriched uranium, which would be decontaminated and then shipped to the Y-12 National Security Complex for recycling. All of the other disassembled components would be decontaminated to the maximum extent possible and then disposed of as either low level waste (LLW) or TRU waste as appropriate.

There are two baseline processes being evaluated for the purification of the plutonium metal. One baseline relies more heavily on aqueous chemistry (aqueous process) and the other on pyrochemical reactions (pyrochemical process). The primary difference between the two baselines is that the aqueous process does not employ chloride containing aqueous solutions, which means conventional stainless steels can readily be used to contain all of its processes. On the other hand the pyrochemical process requires specialized materials to contain the corrosive chloride bearing solutions that it employs.



Am = Americium.
EU = Enriched Uranium.
Pu = Plutonium.
Source: Modified from NNSA 2002.

Figure S.3.1.1–1. Modern Pit Facility Flow Process

The primary process evaluated in this EIS is the aqueous process. This is a well-known process that has been successfully used at DOE sites for many years. It is comparatively simple and experiences few, but well controlled corrosion problems. However, it is not as space efficient and does not produce as pure a product metal as the pyrochemical process. This lower purity requires more complete processing and historically the aqueous process produces significantly more waste than the pyrochemical process. This provides a bounding analysis of the waste impact from a MPF.

The pyrochemical process is more complex than the aqueous process, employing seven versus four major processing steps. However, this can be done in less space with more processing flexibility. It also produces very pure metal and a lower volume of waste. The purity of metal allows the pyrochemical process to have the option of only partially processing metallic plutonium to obtain adequate production purity. Although it requires special materials of construction to contain the corrosive chloride solutions it appears to have the greatest potential for improvement based on results from ongoing technology development projects. The pyrochemical process has been used for many years at LANL.

The pyrochemical process is being investigated because it has the potential to be environmentally more benign, thus having less environmental impact than the aqueous process. The impacts from both of these processes will therefore be bounded in this EIS. As the design of the MPF develops and a final purification method is chosen, the site-specific tiered-EIS will evaluate the impact of the actual process to be used.

Manufacturing

The plutonium metal resulting from the purification process would be transferred to the manufacturing area where it would be melted and cast into required shapes in a foundry operation. These castings would be machined to proper dimensions, combined with other non-plutonium parts, and assembled into pits. New pits would be inspected and prepared for storage and eventual shipment to Pantex.

S.3.1.2 Modern Pit Facility Requirements

Aside from the question of when a MPF would need to become operational, the question of design size of a MPF is next in importance. Design size would be primarily affected by both the operational lifetime of pits and the size of the stockpile. Since there is uncertainty over both these issues (see Section S.2), the final design size of a MPF has not yet been determined. These uncertainties have been evaluated in classified studies. Three levels of production are evaluated to provide a reasonable range for analysis in this MPF EIS. These are 125, 250, and 450 pits per year in a single-shift operation. To accommodate these three production rates, this EIS analyzes three different plant sizes. Another consideration is the contingency or surge use of two-shift operations for emergencies.

Security

The majority of the facilities of a MPF would be located within a Perimeter Intrusion Detection and Assessment System (PIDAS). The PIDAS is a multiple sensor system within a 9-m (30-ft) wide zone enclosed by two fences that surround the entire Security Protection Area. In addition, there would be 6-m (20-ft) clear zones on either side of the PIDAS. There would be an Entry Control Facility (ECF) at the entrance to the Security Protection Area.

Process Buildings

A proposed concept being evaluated for a MPF divides the major plant components into three separate process buildings identified as Material Receipt, Unpacking, & Storage; Feed Preparation; and Manufacturing. The process buildings would be two-story reinforced concrete structures located above ground at grade.

The first story of each building would include plutonium processing areas, manufacturing support areas, waste handling, control rooms, and support facilities for operations personnel. The second story of each of the three process buildings would include the heating, ventilating, and air conditioning (HVAC) supply fans, exhaust fans and high-efficiency particulate air (HEPA) filters, breathing/plant/instrument air compressor rooms, electrical rooms, process support equipment rooms, and miscellaneous support space. Each of these processing buildings would have its own ECF, truck loading docks, operations support facility, and safe havens designed in accordance with applicable safety and security requirements. The three process buildings would be connected with secure transfer corridors.

Support Buildings Within the Perimeter Intrusion Detection and Assessment System

The major support structures located within the PIDAS would include the Analytical Support Building and the Production Support Building. The Analytical Support Building would contain the laboratory equipment and instrumentation required to provide analytical chemistry and metallurgical support for the MPF processes, including radiological analyses. The Production Support Building would provide the capability for performing nonradiological classified work related to the development, testing, staging, and troubleshooting of MPF processes and equipment during operations. A number of other smaller structures also supporting the MPF would include the standby generator buildings, fuel and liquid gas storage tanks, HVAC chiller buildings, cooling towers, and the HVAC exhaust stack.

Support Buildings Outside the Perimeter Intrusion Detection and Assessment System

The major structures located outside the PIDAS would include the Engineering Support Building, the Commodities Warehouse, and the Waste Staging/TRU Packaging Building. This Waste Staging/TRU Packaging Building would be used for characterizing and certifying the TRU waste prior to packing and short-term lag storage prior to shipment to the TRU waste disposal site. Parking areas and stormwater detention basins would also be located outside the PIDAS. In addition, a temporary Concrete Batch Plant and Construction Laydown Area would be required during construction.

A generic layout showing the major buildings and their relationship to each other is shown in Figure S.3.1.2–1. Table S.3.1.2–1 shows the dimensions involved for the three different plant capacities.

Table S.3.1.2–1. Dimensions for the Three Different MPF Capacities

	125 ppy	250 ppy	450 ppy
Processing Buildings Footprint (m^2)	28,600	32,800	44,900
Support Buildings Footprint (m^2)	26,000	26,200	29,900
Total Buildings Footprint (m^2)	54,600	59,000	74,800
Total Buildings Footprint (ha)	5.46	5.90	7.48
Area inside PIDAS (ha)	25.5	26.3	31.6
Area Developed During Construction (ha)	56.3	58.3	69.2
Post Construction Developed Area (ha)	44.5	46.5	55.8

Source: MPF Data 2003.

S.3.1.3 Differences Between a Modern Pit Facility and the Rocky Flats Plant

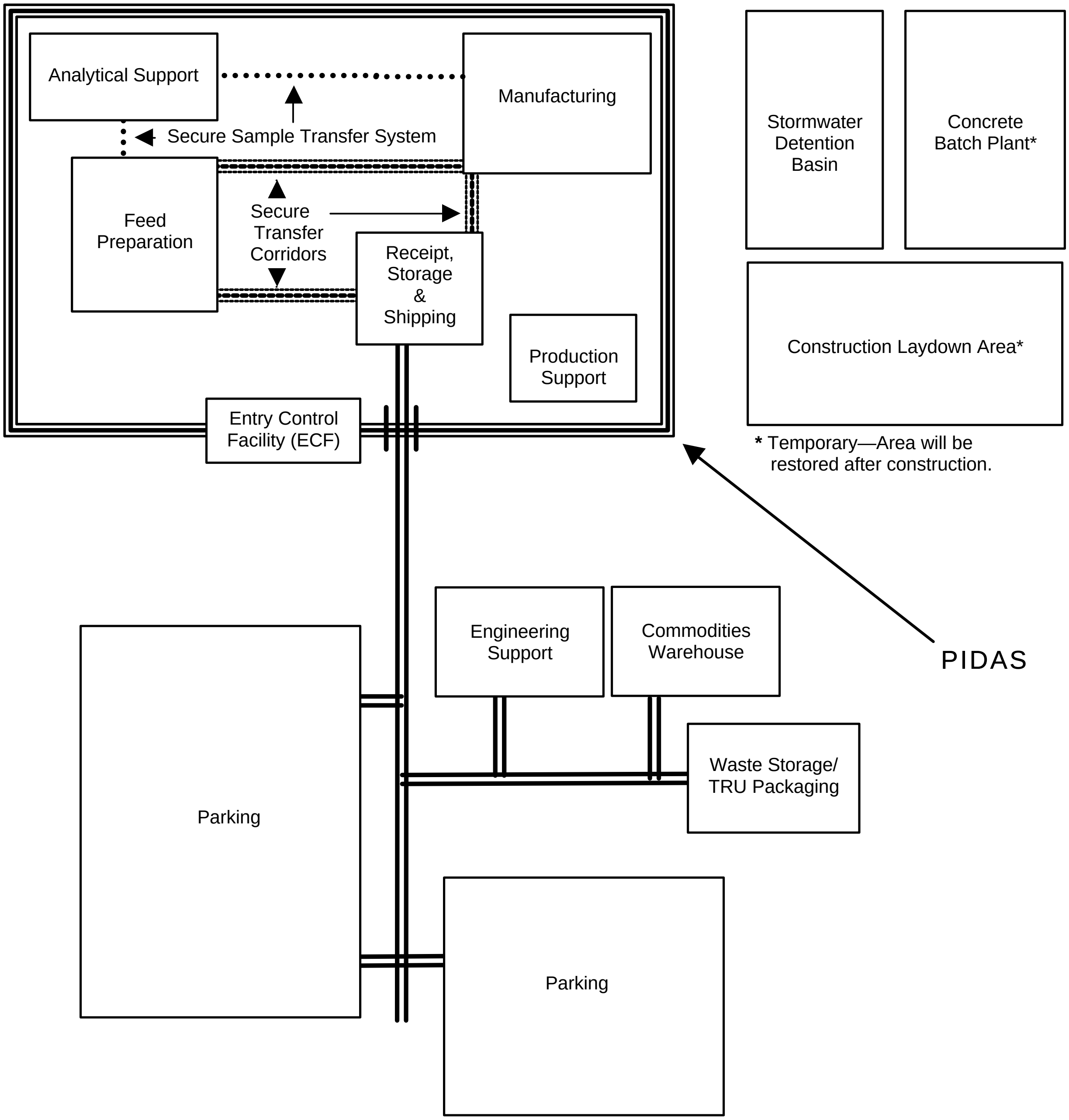
A MPF would be designed and operated to minimize risk to both workers and the general public during normal operations and in the event of an accident. Benefiting from decades of experience, the MPF would employ modern processes and manufacturing technologies and would utilize an oversight structure for safety, environmental protection, and management oversight that has been established since Rocky Flats ceased operations.

Building Design

Modern safety and security design standards of today require substantially different structures from the earlier pit manufacturing facilities at the Rocky Flats Plant, near Golden, Colorado. The buildings at the Rocky Flats Plant were constructed in the 1950s with metal roof sheeting covered by a built-up weather seal. In contrast, the exterior walls and roof of PF-4 (the current interim production plutonium machining facility at LANL) are constructed of reinforced concrete more than a foot thick. Internal walls at PF-4 are designed to provide multiple-hour fire barriers between wings. A MPF would be designed with similar improvements over practices at Rocky Flats.

Fire Control

Although DOE experienced accidents associated with the manufacture of plutonium pits, most of these accidents occurred in a relatively short time period (from 1966-1969) at the Rocky Flats Plant. The majority of these accidents involved plutonium metal and chips undergoing spontaneous ignition. Such events can occur when the environment they are in allows for the rapid oxidation of plutonium, often in association with a moist air environment. Efforts at Rocky Flats concentrated on the elimination of such fires. It is now recognized that potential for fire initiation cannot be totally eliminated. Although the frequency and severity of fires can be reduced through the management of combustible materials and facility design, such events are now anticipated and planned for in the structural and process design and operational procedures. Engineering monitoring systems would be activated if a fire occurs. These systems would activate controls and procedures to control, quickly suppress, and contain fires within the specific originating glovebox, minimizing the risk to workers and the general public.



Source: Modified from MPF Data 2003.

Figure S.3.1.2–1. Generic Layout of a Modern Pit Facility

Today, plutonium machining activities are conducted in gloveboxes supplied with an inert gas. Furthermore, gloveboxes are now equipped with exhaust filter systems. All working areas are separately vented with systems containing HEPA filters. These HEPA filters are fabricated of special nonflammable bonded material. Filter plenums are equipped with an automatic cooling system to reduce the temperature of the air reaching the final stages of HEPA filters. Unlike Rocky Flats, a MPF would have an automatic fire detection and suppression system designed to meet the latest National Fire Protection Association life safety codes and standards for manufacturing facilities. The design features would include multiple zones for both fire detection and suppression to assure that any fire which may occur would be isolated in small, separated areas of the facility, and thereby preclude the spread of fire to other separated areas or the entire building.

Waste Management and Material Control

A MPF would have a dedicated waste handling area capable of preparing waste for transport in accordance with established procedures and waste acceptance requirements. In addition, all waste streams to be generated by the MPF would have an established disposition path for each alternative being considered. Since the MPF EIS analyzes operations over a 50-year period, it is reasonable to expect that some disposition paths may change. A MPF would utilize a stringent Material Control and Accountability System to accurately account for all special nuclear material.

S.3.1.4 TA-55 Upgrade Facility Requirements

The TA-55 Upgrade Alternative (80 ppy) would involve expanding the current pit production capabilities of plutonium facilities in Building PF-4 up to approximately 80 pits per year without expanding the size of the building. To do this, a number of plutonium processing activities that are not related to pit production or stockpile certification would be relocated to other facilities or downsized and consolidated within PF-4. Material characterization and chemical analyses would be performed at another LANL facility.

The TA-55 Upgrade Alternative differs from a MPF in several important aspects that derive from upgrading existing facilities. First, a production level of only 80 ppy is the maximum deemed feasible and is used in this analysis. Next, the MPF design life of 50 years may not be achievable by a facility that will have already operated about 40 years before achieving these increased production levels. Since equipment for feed material preparation, recovery of metal from scrap, and waste processing already exist in this building, feed preparation will use the pyrochemical process to purify material in conjunction with aqueous processing of recoverable residues.

Additionally, all production functions—Receipt and Storage, Feed Preparation, Manufacturing, and Analytical Support—will be performed within a single PIDAS at TA-55 in buildings connected by secure transfer corridors. Feed preparation and manufacturing will be performed in PF-4 and analytical support functions will be performed at another LANL facility. PF-4 will be upgraded as appropriate to perform required material receipt and storage functions.

PF-4 Alterations

Additional space for pit manufacturing would be obtained by expanding into laboratory space currently used for processing operations that are unrelated to pit manufacturing. In this option, these activities would have to be relocated to another facility or downsized/consolidated (with a subsequent reduction of capacity) and the vacated space used for pit manufacturing support. The affected activities include analytical chemistry and materials characterization (AC and MC) operations. Approximately 511 m^2 (5,500 ft^2) of floorspace would be realized by moving the AC and MC operations out of PF-4.

Modifications to the facility would include major upgrades to the residue recovery/metal feed facilities in the 400 Area of PF-4. Many of the gloveboxes in this part of the facility would have to be replaced. Replacement of these older gloveboxes would be required to ensure that the recovery/feed process operations are adequate to supply plutonium metal to the manufacturing operations. There would also be significant glovebox decontamination/decommissioning/ disposal operations as new process development and certification operations are moved into other areas of PF-4. In addition, various manufacturing equipment will be added to or replaced in the fabrication areas of PF-4 to increase capacity and reliability.

To obtain the required space in PF-4 and to expand the pit manufacturing production to greater than 20 pits per year, consolidation of plutonium-238 operations and relocation of plutonium-239 oxide characterization operations within the facility would be necessary. Consolidation of plutonium-238 operations from approximately 790 m^2 (8,500 ft^2) to about 641 m^2 (6,900 ft^2) of laboratory space would reduce the capacity, but not eliminate the capability, for heat source fabrication. Additional space could be obtained by moving some plutonium-239 oxide characterization operations (214 m^2 [2,300 ft^2]) from one laboratory to the upgraded 400 Area and by acquiring space from some programs that would be completed in the 2015 to 2020 timeframe when space is needed for expanding pit production capacities.

Support Facilities

Modifications to existing facilities at TA-55 would be to accommodate additional workers employed in pit manufacturing. As the capacity of the pit fabrication operations is increased, the plant ingress/egress requirement for plutonium workers also increases. This results in the need for additional space for the increased access/egress as well as additional change rooms. New engineering support facilities containing a cold (nonradiological) laboratory, additional office space, and a warehouse for receipt and storage of nonradioactive materials and parts would have to be constructed. The cold laboratory is needed for cold process development, staging, training, and as space for uncleared workers. Office space at TA-55 is currently oversubscribed and increasing the pit fabrication capacity would require additional space.

The Radioactive Liquid Waste Treatment Facility (TA-50) and the Solid Waste Management Facility (TA-54) would be capable of processing the waste streams from PF-4 even with the enhanced fabrication mission of 80 ppy. A small glovebox decontamination/handling facility at TA-54 that is specifically designed to prepare decommissioned gloveboxes for shipment to the Waste Isolation Pilot Plant as TRU waste or burial as low-level waste would be required. This facility is required because the modifications in this alternative would entail the removal of approximately 140 gloveboxes over the course of about 10 years. The new decontamination/handling facility would perform decontamination, size-reduction, packaging, and/or other activities necessary to satisfy the waste acceptance or burial criteria.

The construction of these new facilities would result in an addition of approximately 1.0 ha (2.5 ac) to the permanent TA-55 footprint with 2.5 ha (6.2 ac) total area disturbed during construction. The actual removal of the gloveboxes from PF-4 and decontamination/ decommissioning are not included as part of the construction process, and the workers and waste resulting from these activities are not included in the construction data presented in Section 3.1.4.3 of this EIS. Because the removal of the approximately 140 gloveboxes would take place over a 10-year period, the requirements and wastes from the activity are included with the operational values.

S.3.2 Development of Reasonable Alternatives and Environmental Impact Statement Scope

S.3.2.1 Planning Assumptions and Basis for Analysis

This MPF EIS evaluates reasonable alternatives in order to decide: (1) whether to proceed with construction and operation of a MPF; and (2) if so, where to locate a MPF. Five alternatives are evaluated for a new MPF: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site, (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas. For the five MPF site alternatives, the EIS evaluates the environmental impacts associated with constructing and operating the MPF to produce sufficient quantities of plutonium pits to support the U.S. nuclear stockpile. In addition, the EIS evaluates the environmental impacts associated with expanding operations at TA-55 while upgrading the existing TA-55 facilities (TA-55 Upgrade Alternative). Some of the more specific assumptions and considerations that form the basis of the analyses and impact assessments that are the subject of this EIS are presented below.

- As required by the Council on Environmental Quality (CEQ) regulations, the MPF EIS evaluates a No Action Alternative. The No Action Alternative would utilize the capabilities currently being established at LANL for interim capacity to meet the Nation's long-term needs for pit manufacturing. Under the No Action Alternative, NNSA would not proceed with a MPF, which might limit the ability to maintain, long-term, the nuclear deterrent that is a cornerstone of U.S. national security policy. In previous NEPA documents (the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236 and the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238 [LANL SWEIS]), DOE evaluated the environmental impacts associated with producing up to 50-80 ppy at LANL; however, the ROD for the LANL SWEIS limited production to 20 ppy. Thus, under the MPF EIS No Action Alternative, NNSA could produce up to 20 ppy for the foreseeable future.
- In the LANL SWEIS, DOE committed to provide appropriate NEPA review to implement manufacturing capacity beyond 20 ppy. This MPF EIS provides NEPA coverage for nominal pit production up to approximately 80 ppy at LANL under the TA-55 Upgrade Alternative. Construction activities (primarily the addition of office space) associated with

approximately 140 gloveboxes over the course of about 10 years. The new decontamination/handling facility would perform decontamination, size-reduction, packaging, and/or other activities necessary to satisfy the waste acceptance or burial criteria.

The construction of these new facilities would result in an addition of approximately 1.0 ha (2.5 ac) to the permanent TA-55 footprint with 2.5 ha (6.2 ac) total area disturbed during construction. The actual removal of the gloveboxes from PF-4 and decontamination/ decommissioning are not included as part of the construction process, and the workers and waste resulting from these activities are not included in the construction data presented in Section 3.1.4.3 of this EIS. Because the removal of the approximately 140 gloveboxes would take place over a 10-year period, the requirements and wastes from the activity are included with the operational values.

S.3.2 Development of Reasonable Alternatives and Environmental Impact Statement Scope

S.3.2.1 Planning Assumptions and Basis for Analysis

This MPF EIS evaluates reasonable alternatives in order to decide: (1) whether to proceed with construction and operation of a MPF; and (2) if so, where to locate a MPF. Five alternatives are evaluated for a new MPF: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site, (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas. For the five MPF site alternatives, the EIS evaluates the environmental impacts associated with constructing and operating the MPF to produce sufficient quantities of plutonium pits to support the U.S. nuclear stockpile. In addition, the EIS evaluates the environmental impacts associated with expanding operations at TA-55 while upgrading the existing TA-55 facilities (TA-55 Upgrade Alternative). Some of the more specific assumptions and considerations that form the basis of the analyses and impact assessments that are the subject of this EIS are presented below.

- As required by the Council on Environmental Quality (CEQ) regulations, the MPF EIS evaluates a No Action Alternative. The No Action Alternative would utilize the capabilities currently being established at LANL for interim capacity to meet the Nation's long-term needs for pit manufacturing. Under the No Action Alternative, NNSA would not proceed with a MPF, which might limit the ability to maintain, long-term, the nuclear deterrent that is a cornerstone of U.S. national security policy. In previous NEPA documents (the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236 and the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238 [LANL SWEIS]), DOE evaluated the environmental impacts associated with producing up to 50-80 ppy at LANL; however, the ROD for the LANL SWEIS limited production to 20 ppy. Thus, under the MPF EIS No Action Alternative, NNSA could produce up to 20 ppy for the foreseeable future.
- In the LANL SWEIS, DOE committed to provide appropriate NEPA review to implement manufacturing capacity beyond 20 ppy. This MPF EIS provides NEPA coverage for nominal pit production up to approximately 80 ppy at LANL under the TA-55 Upgrade Alternative. Construction activities (primarily the addition of office space) associated with

the upgrade would begin in approximately 2008 and end in approximately 2012. However, production of 80 ppy would not be possible until replacement of all gloveboxes would be completed by approximately 2018.

- If the Secretary decides to build and operate the proposed MPF at one of the five site alternatives, construction would begin in approximately 2011, peak in 2014, and last about 6 years. Mission start-up and initial operations would occur between 2017 and 2019, with full-scale production beginning in 2020. Because a MPF would be designed for a service life of at least 50 years, the EIS assesses the environmental impacts associated with the operation of a MPF for a period of 50 years, at which time the structures would undergo decontamination and decommissioning (D&D).

- The MPF is in a conceptual design stage. As such, best available design information for the analysis is contained in this EIS (see the descriptions of a MPF in Sections S.3.1 and Appendix A). For the purpose of the environmental impact analysis, assumptions have been used such that construction requirements and operational characteristics of the MPF would maximize the environmental impacts. Thus, the potential impacts from the implementation of any MPF final designs are expected to be less severe than those analyzed in this EIS.

- The exact size and composition of the enduring stockpile is determined on an annual basis as explained in Sections S.1.1.3. In the classified appendix to a MPF EIS, the NNSA has considered a range of future stockpiles. Based on current long-range planning consistent with the NPR, NNSA must be capable of supporting a stockpile of approximately 1,700-2,200 strategic deployed weapons in 2012 and beyond. Classified studies have examined capacity requirements that would result from a wide range of enduring stockpile sizes and compositions, pit lifetimes, emergency production needs (referred to as "contingency" requirements), and facility full-production start dates. Although the precise future capacity requirements are not known with certainty, enough clarity has been obtained through these ongoing classified studies that the NNSA has identified a range of pit production capacity requirements (125-450 ppy) that form the basis of the capacity evaluations in this EIS. The EIS evaluates the impacts of a MPF designed to produce three capacities: 125 ppy, 250 ppy, and 450 ppy. A pit lifetime range of 45-60 years is assumed.

- For each of the capacities (125 ppy, 250 ppy, and 450 ppy), the EIS evaluates the environmental impacts associated with single-shift operations 5 days per week, as this represents the most likely long-term, normal operating scenario for the MPF. However, if national security requirements ever demand, the MPF could be operated in a two-shift mode to produce more pits than in the single-shift mode. Because the environmental impacts associated with single-shift production of 250 ppy would bound the impacts associated with two-shift production in a 125 ppy plant, no additional NEPA analysis would be necessary for this scenario. Likewise, because the environmental impacts associated with single-shift production of 450 ppy would bound the impacts associated with two-shift production in a 250 ppy plant, no additional analysis would be necessary for this scenario. For the 450 ppy capacity, the EIS assesses the environmental impacts of two-shift operations in a qualitative sensitivity analysis.

- This EIS does not support decisions to select a specific location at any DOE site alternative for a MPF. However, initial reference locations have been identified at each site, consistent with the environmental analysis in this EIS to evaluate the potential environmental impacts of a MPF. These reference locations were designated by the individual DOE site offices not to conflict or interfere with existing or planned future site operations. Other locations may be identified by the DOE office at the selected site, if the Secretary of Energy decides to proceed with a MPF. In general, undeveloped areas are used so that any potential environmental impacts would be greater than those projected for a specific location to be developed. These reference locations are defined for each site in Section S.3.3.2. The characterization of the affected environment addresses the entire candidate site and the affected region surrounding the site. Each region varies by resource, but generally extends to an 80-km (50-mi) radius from the center of each site.

- Both construction and operational impacts are considered for all resources at all sites. Construction impacts are generally short-term (e.g., would occur over the 6-year construction period), while operational impacts are expected to be long-term (e.g., would occur annually over the 50-year operating period).
- Generated wastes would be managed in accordance with applicable Federal, state, and local laws, regulations, and requirements, as well as DOE/NNSA’s waste management orders and pollution prevention and waste minimization policy.
- The EIS analyzes low-consequence/high-probability accidents and high-consequence/low probability accidents. A spectrum of both types of accidents is analyzed. For radiological accidents, impacts are evaluated for both the general population residing within an 80-km (50-mi) radius (including the maximally exposed individual) and for non-involved workers in collocated facilities. The accident analyses in this EIS are based on facility conditions that are expected to exist in 2020. The core set of accident scenarios is applicable to each location alternative with adjustments to certain parameter values (e.g., leak path factors and materials at risk) to reflect site-specific features. Added to the core set of accidents are other site-specific accidents, if any, caused by natural phenomena or accidents at collocated facilities, that have the potential for initiating accidents at a MPF. The impacts of accidents analyzed for each alternative reflect and bound the impacts of all reasonably foreseeable accidents that could occur if the alternative were implemented.
- The plutonium Research and Development (R&D) mission and pit surveillance functions would remain at LANL and Lawrence Livermore National Laboratory and would be unaffected by the Proposed Alternative.
- Proven technology is used as a baseline. No credit is taken for emerging technology improvements. The design goal of the MPF includes consideration of waste minimization and pollution prevention to minimize facility and equipment contamination, and to make future D&D as simple and inexpensive as possible. The EIS includes a general discussion of the environmental impacts from D&D, including a discussion of the D&D process, the types of actions associated with D&D, and the general types of impacts associated with D&D. Any discussion of specific D&D impacts are more appropriate for tiered NEPA documents because the extent of contamination, the degree of decontamination, and the environmental impacts associated with performing D&D, cannot be known without performing a detailed study of a MPF at the appropriate time.
- Liquid TRU and low level waste (LLW) streams will be solidified as part of the MPF process, (i.e., the MPF would not generate any liquid TRU or LLW that requires

disposition). The solidified waste forms would meet applicable waste acceptance criteria prior to leaving the MPF. Any TRU waste generated by the MPF would be treated and packaged in accordance with the WIPP Waste Acceptance Criteria and transported to WIPP or a similar type facility for disposition. The preferred alternative in the *WIPP Disposal Phase Final Supplemental Environmental Impact Statement* (SEIS) (DOE 1997b) currently includes a 35-year operating period starting in March 1999. To accommodate all project TRU waste from MPF and other NNSA operations, DOE must ensure that either the WIPP or another similar type facility would be available for long-term disposition of TRU waste. Section 6.5.1.5 gives additional detail relative to the WIPP. All other wastes would be managed in accordance with applicable site procedures and disposed of in accordance with decisions made in the *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* Records of Decision.

- The MPF would be capable of producing all existing pit types in the nuclear weapons stockpile, as well as any future new-design pits. The environmental impacts associated with manufacturing a particular type of pit, whether an existing design pit or future new-design pit, are considered to be similar.
- The operation of a MPF would require transporting existing pits from Pantex, where more than 12,000 are presently stored, to a MPF, and transporting new pits from a MPF to Pantex where they would be assembled into weapons. In addition, small quantities of plutonium metal would be transported from LANL and SRS to a MPF location. All transportation of pits and plutonium metal is assumed to occur via the NNSA transportation fleet of SSTs over Federal and state highways to the extent practicable. The quantities of pits and other materials that would be transported to/from the MPF are provided in Appendix D.
- A modern nuclear weapon consists of many components, most of which are nonnuclear. In general, any components for pits not produced at the MPF would be produced in existing facilities and shipped to a MPF for assembly into the pit. The environmental impacts associated with producing these components have been addressed in previous NEPA documents (see specifically the Nonnuclear Consolidation EA, DOE/EA- 0792, DOE 1993).
- Because the NNSA will need a facility to manufacture beryllium components required for the MPF, this programmatic EIS assesses the environmental impacts of such manufacturing for completeness (see Section 5.7.1). Site-specific issues concerning the manufacturing of beryllium components will be addressed in the future NEPA documentation, as required.
- The methodology used to assess the environmental impacts of constructing and operating a MPF is described in Appendix F.
- As explained in Section S.3.3.3, the MPF EIS evaluates an upgrade to the TA-55 Facility at LANL to increase pit production capacity. Although this Upgrade Alternative does not meet the minimum capacity requirement of 125 ppy, it is evaluated as a "hedge" in the event of significant further reductions in the nuclear weapons stockpile size, or if future technical studies demonstrate that pit lifetimes significantly exceed 45-60 years. The TA-55 Facility is the only existing pit production facility capable of being upgraded to provide such a hedge (see Sections S.3.4.3 and S.3.4.4). As such, this is the only

reasonable Upgrade Alternative assessed in this EIS. It is noted that this Upgrade Alternative would be timed to minimize disruptions of LANL's interim small-scale pit production activities required to meet current DOD requirements.

- The classified appendix with information relevant to this EIS has been prepared and will be considered by the decisionmaker during this NEPA process. To the extent allowable, the MPF EIS summarizes this information in an unclassified manner.

S.3.2.2 Development of the Environmental Impact Statement Site Alternatives

Following the approval of the Critical Decision on Mission Need (CD-0) by the Secretary of Energy on May 24, 2002, the NNSA developed a site screening process to develop the reasonable site alternatives that are evaluated in this MPF EIS. The purpose of the site screening process was two-fold: (1) to identify reasonable site alternatives for the MPF EIS; and (2) to identify unsuitable site alternatives and document why these alternatives were not reasonable for the MPF EIS.

A two-step screening process was employed: first, all potential sites were evaluated against "go/no go" criteria; and second, those sites satisfying the go/no go criteria were evaluated against desired, weighted criteria. The desired criteria and weights were developed by members of the MPF project office. Federal employees from the NNSA and other relevant DOE program offices then "scored" the potential sites using the desired criteria. Aggregate scores for the alternatives were then tallied, and the reasonable site alternatives were determined.

Existing, major DOE sites were considered to serve as the host location for a MPF. Non-DOE or new sites were not considered to avoid potential contamination issues at a new location that had not previously been associated with plutonium or plutonium-bearing waste operations. Many DOE sites did not satisfy the go/no-go criteria and were eliminated during the first step of the screening process. The seven sites that were evaluated through both steps of the screening process were: Idaho National Engineering and Environmental Laboratory, LANL, NTS, Pantex, SRS, the Carlsbad Site, and the Y-12 National Security Complex.

The site screening analysis considered the following criteria: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA presence at the site, and infrastructure. The first two criteria were deemed to be go/no go criteria; that is, a site either passed or failed on each of these two criteria. The sites that passed the go/no go criteria were then scored against all criteria. Based upon results from the site screening analysis, the following were determined to be reasonable alternatives for a MPF: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site; (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas. Appendix G contains a copy of the site screening study.

S.3.3 Reasonable Alternatives

S.3.3.1 No Action Alternative

Consistent with the 1996 SSM PEIS ROD (61 FR 68014) and the 1999 LANL SWEIS ROD (64 FR 50797), NNSA has been re-establishing an interim pit manufacturing capability at LANL. The establishment of the interim pit production capacity is expected to be completed in 2007. As required by the CEQ NEPA Regulations (40 CFR Parts 1500-1508) and the DOE NEPA Regulations (10 CFR Part 1021), the MPF EIS includes a No Action Alternative. The No Action Alternative would be to maintain the interim pit production capacity at LANL PF-4 in TA-55 and not build the MPF at any site. The No Action Alternative is encompassed within the Expanded Operations Alternative listed in the LANL SWEIS, which evaluated the impact of producing 50-80 ppy at PF-4, but selected a 20 ppy level in the respective Record of Decision. There would be no additional impact on the other four sites.

S.3.3.2 Modern Pit Facility Alternatives

This section presents the alternatives to build a new MPF at each of the five alternative sites. In addition, if a MPF is built at any of these sites, including LANL, the interim pit capability at TA-55/PF-4 would not be relied on to meet future stockpile needs. For each of the sites, a representative or reference location for MPF at that site has been chosen for analysis purposes only. When a decision is made as to whether to proceed with the MPF, and if so, at which site to locate a MPF, a site-specific EIS process will be completed. The site-specific process will analyze reasonable locations in the vicinity of the selected site.

Each reasonable location was chosen based on the following factors: the site is approximately 32 hectares (ha) (80 acres [ac]) in size, does not conflict with any on-going or planned activities, is not potentially contaminated, and is located near an existing Category I Security Area (if possible). If the selected site did not have the requisite 32 ha (80 ac) (the maximum desired area inside a PIDAS), but still had enough space to accommodate the entire facilities footprint, it was deemed adequate for analysis purposes in this EIS. The proposed reference locations provide a basis for impact studies on the site and surrounding areas, which will allow reasonable comparisons between the various sites. If a decision is made to go forward with one of the MPF alternatives, a site will be selected, and the actual MPF location will be determined in a site-specific tiered EIS.

Los Alamos Site

The Los Alamos Site MPF Alternative would involve constructing a MPF at LANL as described in Section S.3.1.2. For analysis purposes, it is assumed that a MPF would be located on an unused location in TA-55. This is shown in Figure S.3.3.2–1. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

Nevada Test Site

The NTS MPF Alternative would involve constructing a MPF at NTS as described in Section S.3.1.2. For analysis purposes, it is assumed that a MPF would be located on an unused location

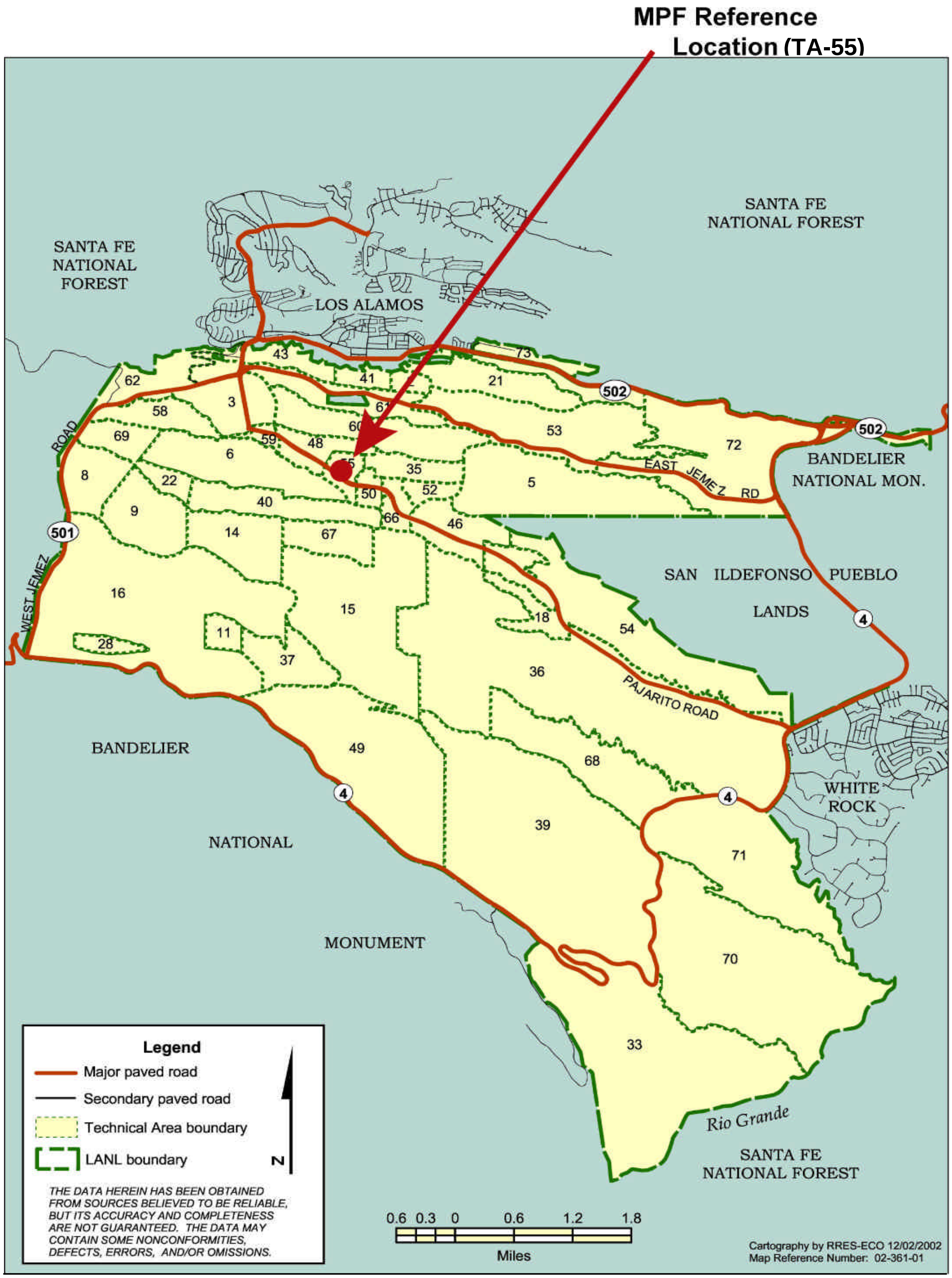


Figure S.3.3.2–1. Los Alamos Site

near the Device Assembly Facility. This is shown in Figure S.3.3.2–2. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

Pantex Site

The Pantex Site MPF Alternative would involve constructing a MPF at Pantex as described in Section S.3.1.2. For analysis purposes, it is assumed that a MPF would be located on an unused location in Area 11. This is shown in Figure S.3.3.2–3. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

Savannah River Site

The SRS MPF Alternative would involve constructing a MPF at SRS as described in Section S.3.1.2. For analysis purposes, it is assumed that a MPF would be located on an unused location southwest of the F Canyon area. This is shown in Figure S.3.3.2–4. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

Carlsbad Site

The Carlsbad Site MPF Alternative would involve constructing a new MPF at Carlsbad as described in Section S.3.1.2. For analysis purposes, it is assumed that a MPF would be located on an unused location. This is shown in Figure S.3.3.2–5. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

NNSA notes that legislation may be required to proceed with the construction and operation of a MPF at the Carlsbad Site either on land at the WIPP site or in the vicinity of the WIPP site.

The U.S. Environmental Protection Agency's (EPA's) current compliance certification of WIPP does not consider the potential impacts of a MPF on the long-term performance of the repository. If the Secretary of Energy were to decide to locate a MPF in the vicinity of WIPP, DOE would need to provide EPA with sufficient information for the Agency to determine whether the potential impacts of a MPF should be included in the performance assessment to ensure that they would not adversely impact the repository's long-term performance. EPA's consideration of a MPF's potential impacts could result in a modification rulemaking involving the compliance certification.

S.3.3.3 TA-55 Upgrade Alternative

The TA-55 Upgrade Alternative (80 ppy) would involve expanding the pit production capability of PF-4 without expanding the size of the facility as described in Section S.3.1.4 and the Summary of TA-55/PF-4 Upgrade Evaluation to Provide Long-term Pit Manufacturing Capacity contained in Appendix G. Two support facilities would also be constructed in TA-55 and one in TA-54. The interim pit production capability at LANL would be expanded to approximately 80 ppy through the upgrade process.

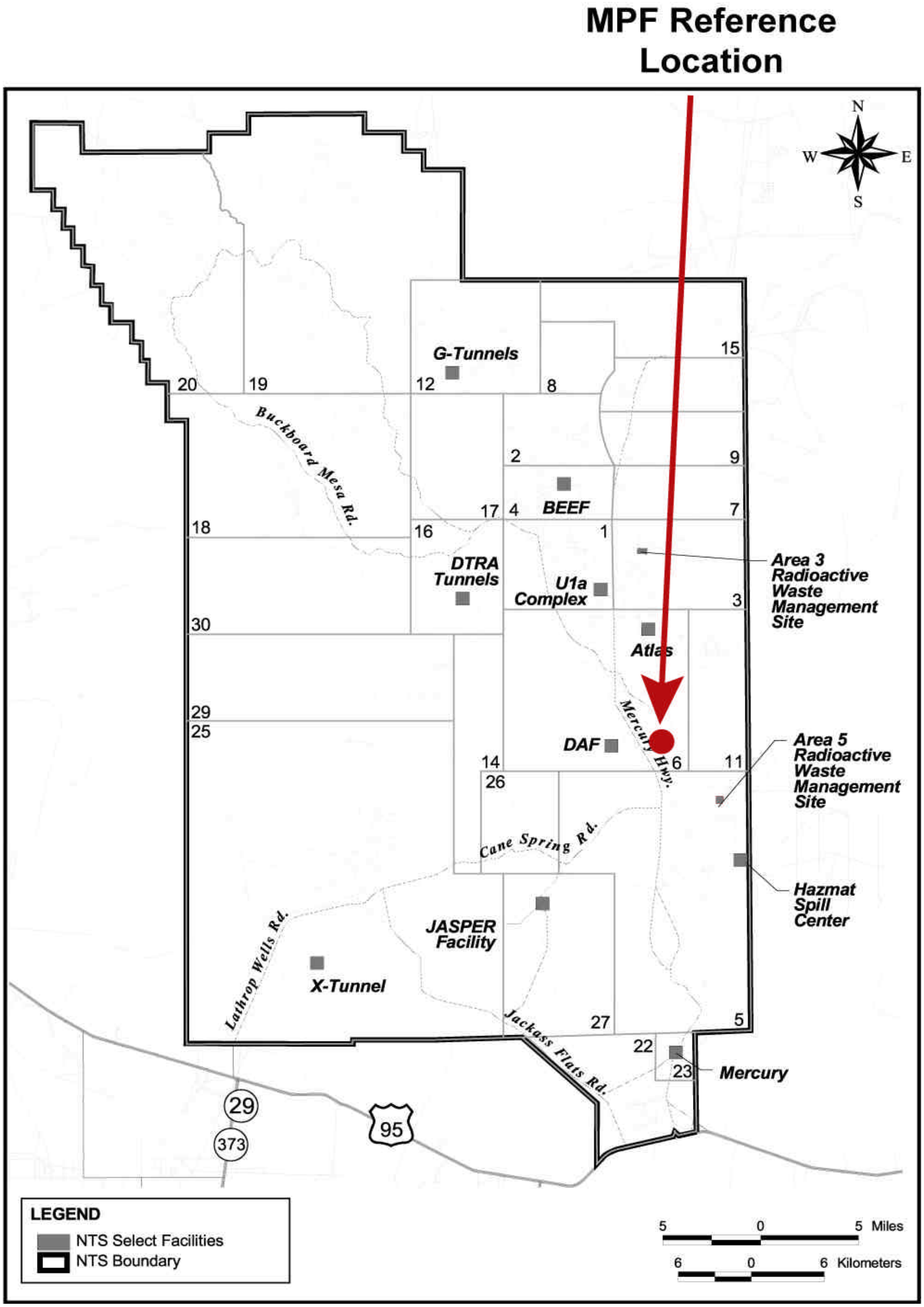


Figure S.3.3.2–2. Nevada Test Site

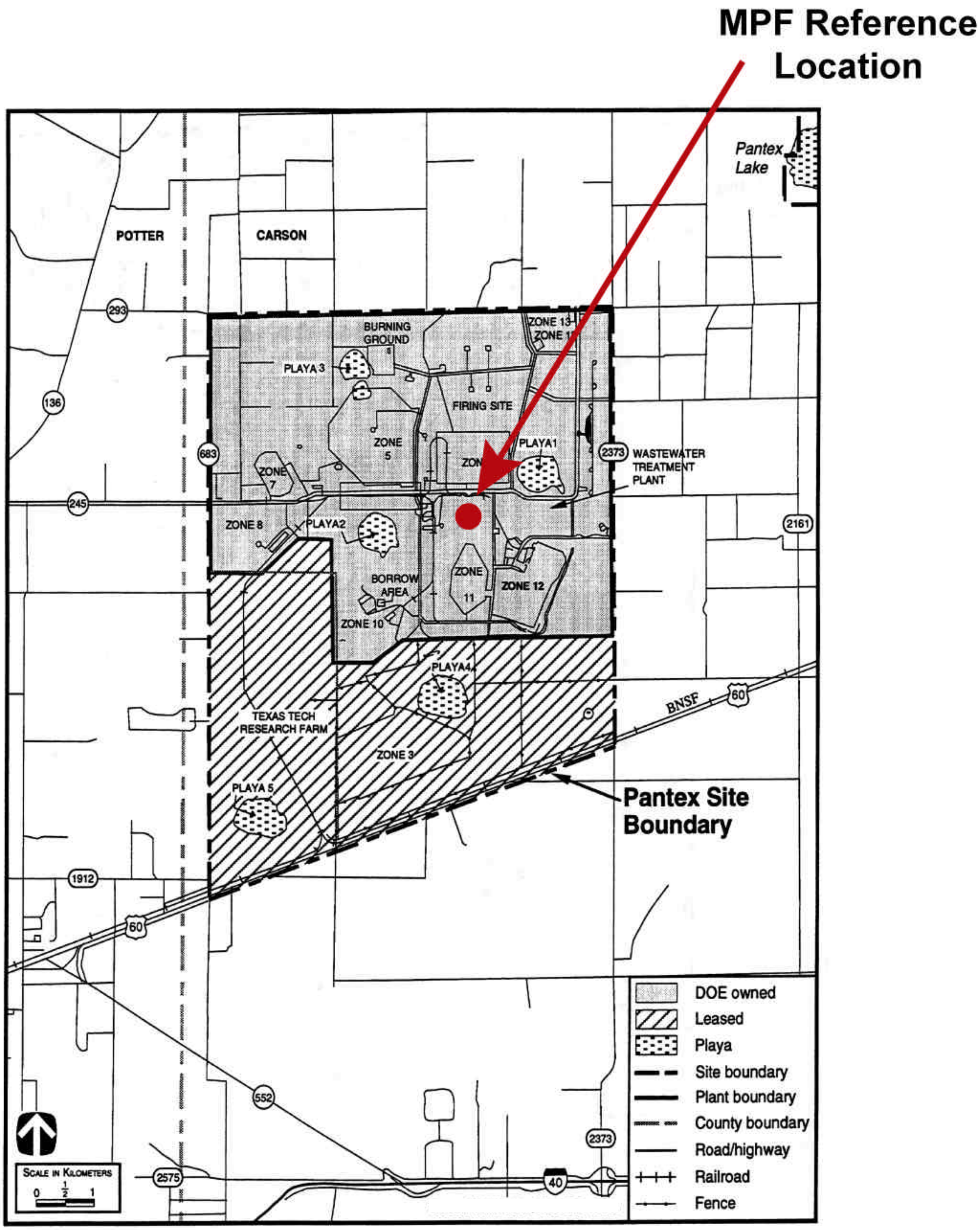


Figure S.3.3.2–3. Pantex Site

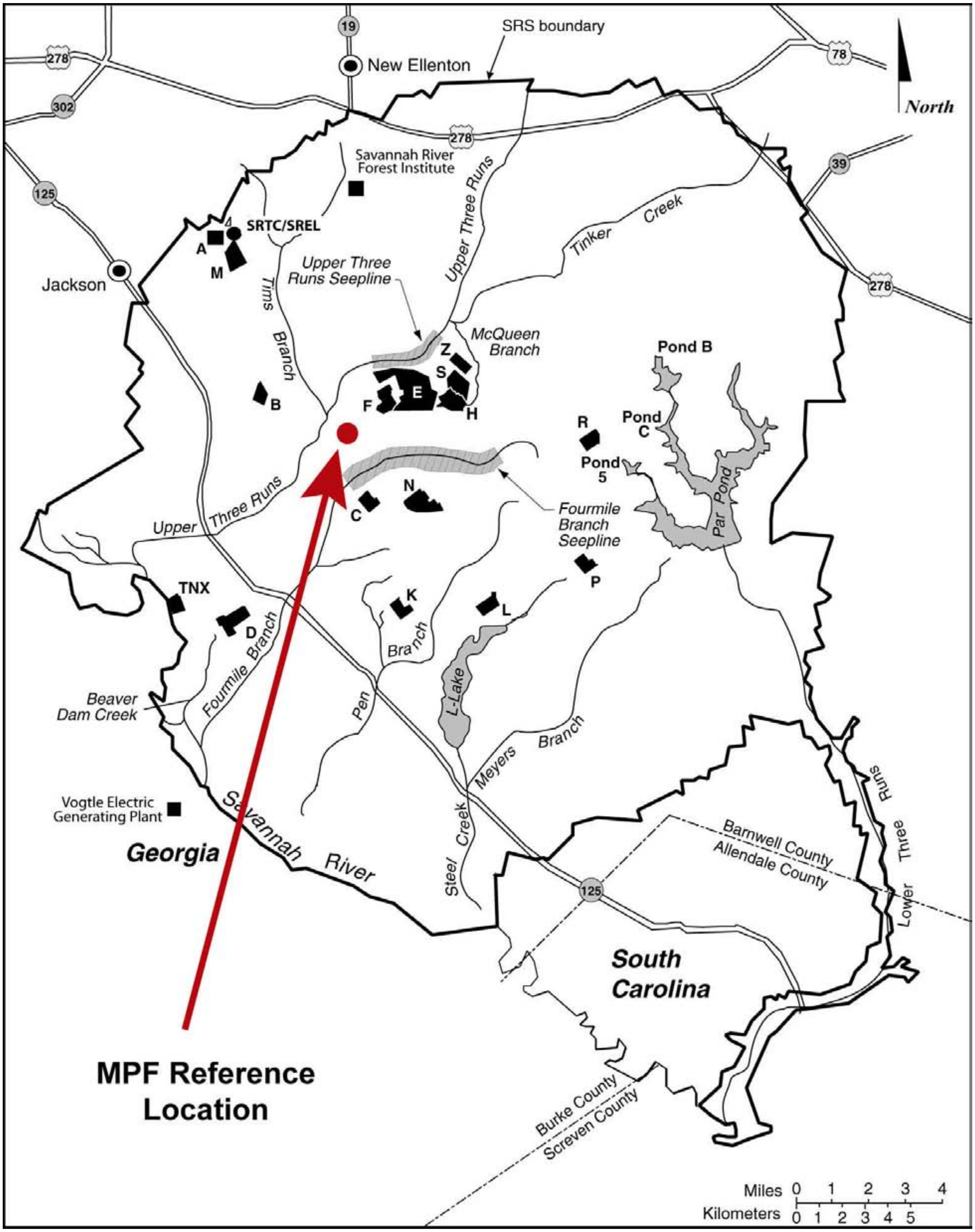


Figure S.3.3.2–4. Savannah River Site

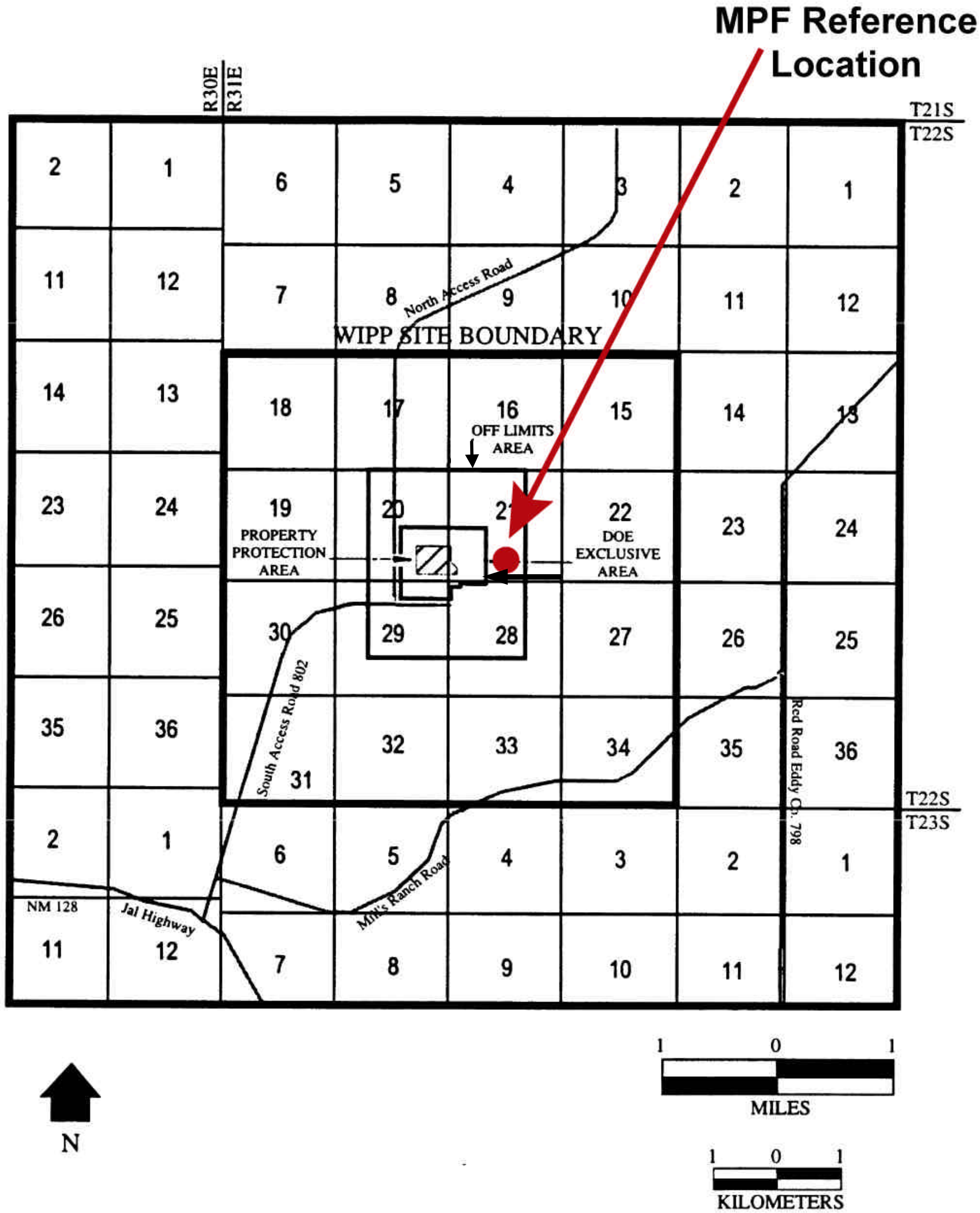


Figure S.3.3.2–5. Carlsbad Site

S.3.4 Alternatives Considered but Eliminated from Detailed Study

S.3.4.1 Purchase Pits

While there is no national policy that prohibits purchase of defense materials such as pits from foreign sources, NNSA has determined that the uncertainties associated with obtaining pits from foreign sources render this alternative unreasonable for an assured long-term supply.

S.3.4.2 Utilizing the Pit Disassembly and Conversion Facility at the Savannah River Site

NNSA is currently planning for the permanent disposition of weapons-grade plutonium no longer required for defense purposes. In September 2000, the United States and Russia signed a Plutonium Management and Disposition Agreement (PMDA) in which each country agreed to permanently dispose of 34 metric tons (37 tons) of plutonium. The obligations under this "government-to-government" agreement equate to a pledge by each country to meet the terms put forth in the agreement. Under current plans, surplus nuclear weapons pits would be disassembled and the resulting plutonium metal converted into oxide in a planned Pit Disassembly and Conversion Facility (PDCF). The resulting plutonium oxide would then be fabricated into mixed-oxide fuel at a second facility, the Mixed-Oxide Fuel Fabrication Facility, to be built at the SRS and then irradiated in existing commercial reactors. However, the PMDA includes several restrictions that would likely impact synergy between the plutonium disposition program and the MPF. For example, facilities constructed under the PMDA are designated "disposition facilities" and the use of these facilities to process plutonium other than "disposition plutonium" (such as pit manufacturing, or other defense purposes) is prohibited. Article VI Paragraph 5 of the PMDA states, "Disposition facilities may <u>only</u> receive and process disposition plutonium and blend stock." (See Appendix G for more details regarding the PMDA and other potential restrictions.)

NNSA has decided that the international constraints on the PDCF render the facility at SRS incompatible with the MPF National Security mission.

S.3.4.3 TA-55 Upgrade Alternatives

In August 2002, a multidisciplinary team comprised of national laboratory, NNSA production plant, and Federal Government personnel was chartered to: (1) determine the potential production rates that might be achieved at LANL with upgrades to PF-4; (2) estimate the implementation costs of these upgrade options; (3) address the advantages and disadvantages of upgrading PF-4 to higher production capacities; and (4) prepare information to support a determination on the "reasonableness" of the alternative of relying on an upgraded PF-4. The team was also tasked to prepare detailed environmental data for the MPF Draft EIS on any PF-4 upgrade alternative considered reasonable even though a 50-year life for a MPF may not be achievable for a TA-55 Upgrade.

The team evaluated three upgrade options for TA-55/PF-4 to increase production rate:

- TA-55 Upgrade Option 1 - No impact on current LANL missions in PF-4.
- TA-55 Upgrade Option 2 - Impact some current LANL nondefense-related missions in PF-4.
- TA-55 Upgrade Option 3 - Add floorspace (new wing) to PF-4 and impact some current LANL nondefense-related missions.

Based on the team's evaluation, NNSA determined that TA-55 Upgrade Option 1 would not result in an upgraded TA-55 production capacity that was greater than 50 ppy. Since production capacities in this range are already included in the bounding analyses for the No Action Alternative, no separate evaluation of TA-55 Upgrade Option 1 is necessary.

NNSA also determined that TA-55 Upgrade Option 3, which required construction of additional floor space on PF-4 and had hypothetical potential to achieve a maximum capacity of up to 150 ppy, was not a reasonable alternative. Option 3 approaches the cost and schedule of a small, newly-constructed MPF, but does not provide the agility or contingent capacity needed for the long-term.

TA-55 Upgrade Option 2, estimated to achieve a nominal manufacturing capacity approximately 80 ppy, was determined to be a reasonable alternative for evaluation in the MPF EIS. While the NNSA notes that Option 2 does not have the potential to reach the minimum production capacity (125 ppy) or agility required by a MPF, inclusion of this upgrade alternative provides a capacity greater than the No Action Alternative. This provides a "hedge" in the event of unforeseeable changes in stockpile size or pit lifetime result in a significantly smaller pit production capacity requirement. It is noted that this Upgrade Alternative would need to be timed to minimize disruptions to LANL's interim small-scale pit production activities required to meet current DOD requirements.

S.3.4.4 Upgrade Building 332 at Lawrence Livermore National Laboratory

Building 332 at the Lawrence Livermore National Laboratory (LLNL) is located in what is known as the "Superblock." Building 332 is a plutonium R&D facility containing a wide breadth of plutonium processing and fabrication technologies but offering minimal production-like capability. Building 332 does not have an existing pit-manufacturing mission and is small in comparison to the TA-55/PF-4 facility at LANL. In order to produce a meaningful quantity of pits, drastic modifications to Building 332 would be required. Additionally, because of the significant population encroachment at LLNL, an upgrade alternative at LLNL is undesirable. Accordingly, the alternative to upgrade Building 332 was eliminated from detailed study.

S.3.4.5 Chemistry and Metallurgy Research Building Replacement (CMRR)

NNSA is currently preparing an EIS for the CMRR. The purpose of the CMRR EIS is to evaluate alternatives for replacing the existing Chemistry and Metallurgy Research Building at LANL, where nuclear operations are scheduled to be shut down in approximately 2010. A new CMRR would provide analytical, chemical and material characterization support to existing missions at LANL that are expected to continue for the long term. Such support is needed independent of the MPF EIS proposal. While a CMRR could provide support to an eventual

MPF at LANL (if LANL were the selected site), such support is not in the baseline design of the CMRR, nor is it required. The environmental impacts of providing chemical and metallurgical support for a MPF at LANL would be essentially the same whether such support were to occur within the CMRR or the MPF; thus, the MPF EIS includes this analysis as a direct impact in this MPF EIS. Under the No Action Alternative and the TA-55 Upgrade Alternative, direct analytical chemistry and metallurgical support would be provided by the existing CMR or the proposed CMRR. As such, the CMRR EIS includes an analysis of environmental impacts associated with pit production up to approximately 80 ppy.

S.3.4.6 Savannah River Site Facilities

The F&H Canyon facilities, which are approximately 50-plus years old, were originally designed to recover plutonium and uranium from reactor fuel rods. As such, the portions of these facilities that might be applicable to pit production are primarily in the areas where processing operations took place. Because the only F-Area Canyon Facility that is set up to purify plutonium material from recycled pits is the New Special Recovery Facility, extensive upgrades and modifications would be required to generate an adequate capacity over the life of the MPF mission. A list of some of the major deficiencies associated with utilizing the canyons to support a MPF follows:

- Modifications to existing contaminated facilities are very costly due to radiological control issues. Labor cost increases of 300-500 percent vs. “clean” work are commonly estimated.

- Project risks are increased when using existing facilities due to the higher number of unknown conditions that may be encountered during the project, and the challenges of coordinating construction activities with any ongoing facility operations.

- There is a high potential for hidden cost and regulatory risks associated with the long-term commitment to a legacy facility.

- The service life of the renovated facility would likely not meet the 50-year MPF design requirement.

- The existing robust canyon structures cannot be modified significantly and would therefore result in inefficient equipment arrangement, material handling, and storage locations.

- Imbedded infrastructure such as shielding, ventilation systems, electrical cable/switchgear, and process piping/drains may not be suitable for a revised facility mission.

- Obstacles to adding distance and wall shielding in existing structures make achievement of the 500 millirem per year design goal, personnel exposure limit unlikely.

Based on these factors, NNSA determined that the F&H Canyon facilities are not reasonable alternatives for supporting a MPF mission. Likewise, NNSA considered whether use of the K-Area Materials Storage Facility would be beneficial to the MPF, but concluded that no such advantages existed.

S.3.4.7 Other Department of Energy/National Nuclear Security Administration Sites

Section S.3.2.2 describes the site screening process utilized to determine the reasonable site alternatives for the MPF EIS. As described in that section, all existing, major DOE sites were considered to serve as the host location for a MPF. A two-step screening process was employed: first, all potential sites were judged against "go/no go" criteria; and second, those sites satisfying the go/no go criteria were judged against desired, weighted criteria. Sites that did not satisfy the go/no go criteria, or which scored lowest against desired, weighted criteria were judged to be unreasonable site alternatives for a MPF.

S.3.4.8 Construct and Operate a Smaller Modern Pit Facility

As stated previously, the exact size and composition of the enduring stockpile is uncertain. Studies in the classified appendix have examined capacity requirements that would result from a wide range of enduring stockpile sizes and compositions, pit lifetimes, emergency production needs (referred to as "contingency" requirements), and facility full-production start dates. Although the precise future capacity requirements are not known with certainty, enough clarity has been obtained through these ongoing classified studies that the NNSA has identified a range of pit production capacity requirements (125-450 ppy) that form the basis of the capacity evaluations in this EIS. The EIS evaluates the impacts of a new MPF designed to produce three capacities: 125 ppy, 250 ppy, and 450 ppy. If there were significant further reductions in the nuclear weapons stockpile (beyond those already considered in the classified analyses), or if future technical studies demonstrate that pit lifetimes significantly exceed 45-60 years, then the need, capacity, and timing for a new MPF would need to be reassessed. With respect to these uncertainties, NNSA has chosen not to speculate beyond the assumptions described in this EIS. As such, this EIS does not propose to construct and operate a new MPF with a capacity smaller than 125 ppy. However, as described in Sections S.3.3.3, this EIS does evaluate a TA-55 Upgrade Alternative (80 ppy) as a "hedge" in the event of unforeseeable significant changes in stockpile size or pit lifetime.

S.4 PREFERRED ALTERNATIVE

The CEQ regulations require an agency to identify its preferred alternative to fulfill its statutory mission, if one or more exists in a draft EIS (40 CFR 1502.14 [e]). For this MPF Draft EIS, constructing and operating a new MPF is the preferred alternative based on considerations of environmental, economic, technical, and other factors. A preferred host site for the MPF has not yet been determined, but will be identified in the Final EIS, if the Secretary decides to proceed with a MPF.

S.5 COMPARISON OF ALTERNATIVES

S.5.1 Introduction

To aid the reader in understanding the differences among the various alternatives, this section presents a summary comparison of the potential environmental impacts associated with the alternatives in the MPF EIS. The comparisons concentrate on those resources with the greatest potential to be impacted.

S.3.4.7 Other Department of Energy/National Nuclear Security Administration Sites

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The information in this section is a summary of the environmental impacts based on information presented in Chapter 5 of the EIS. Table S.5.1–1 at the end of this document provides quantitative information that supports the text below.

S.5.2 Environmental Impacts

Land Use

All action alternatives would result in land disturbance. As shown in Table S.5.1–1, the amount of land disturbed for all alternatives would be less than 2 percent of the available land area. However, there would be no impacts to land use plans or policies.

Visual Resources

All action alternatives except SRS would result in no changes to current Class IV BLM Visual Resource Management ratings. Although SRS does not have a BLM Visual Resource Management rating, constructing and operating a MPF would be consistent with the currently developed areas of SRS.

Site Infrastructure

SRS has adequate electrical energy capacity and peak load capability for all three proposed MPF sizes. LANL has adequate electrical energy and peak load capability for the TA-55 Upgrade Alternative (80 ppy). LANL would require additional peak load capability, and Pantex Site would require additional energy capacity for the 450 ppy plant. Carlsbad Site would require additional peak load capability for all three sized plants and additional energy capacity for the 450 ppy plant. NTS would require additional energy capacity and peak load capability for all three sized plants.

Pantex Site, SRS, and the TA-55 Upgrade Alternative (80 ppy) at LANL have adequate process steam available to support all MPF size plants. The Carlsbad Site would require extension of a local gas pipeline and NTS would require the construction of a pipeline or a rail line to supply fuel for the process steam plant required for any of three production capacity options.

Air Quality

All action alternatives would result in air quality levels that would be in attainment with the NAAQS for all criteria pollutants. However, surge operations of the 450 ppy plant at LANL would exceed the 24-hour nitrogen dioxide standard by approximately 5 percent. If the 450 ppy plant is built at LANL, mitigation measures would be designed and implemented to bring these emissions into compliance. All sites are in attainment areas. A PSD analysis would be done in the site-specific tiered EIS.

Water Resources

The water requirements for the construction of all action alternatives would be within existing site water allotments. The existing site water allotment at NTS, Pantex Site, and SRS would be adequate to support the operation of all three plant sizes. Although the current water allotment at

LANL would support the TA-55 Upgrade Alternative (80 ppy) and 125 ppy options, LANL would need to expand its water allotment for the 250 ppy and 450 ppy plant by purchasing more water. Carlsbad Site would need to purchase more water to expand its water allotment for the operation of all three plant sizes. Sufficient capacity exists for both LANL and Carlsbad Site to purchase additional water to support MPF operations.

Biological Resources

For all action alternatives, some habitats unique to each area would be modified or lost and there could be a decrease in quality of the habitat adjacent to the proposed development. It is not expected that any wetlands would be impacted by any alternative. There are no designated critical habitats for any listed threatened or endangered species at any of the site alternatives, and thus no impacts are expected.

Cultural and Paleontological Resources

Any ground disturbance has the potential to impact cultural and paleontological resources at any of the alternative sites. At the programmatic level, there are no significant differences between the alternative sites with respect to potential impacts to cultural and paleontological resources. Prior to any ground-disturbing activity, NNSA would identify and evaluate any cultural and paleontological resources that could potentially be impacted by the construction of a MPF or upgrade to the TA-55 Facility. If necessary, NNSA would implement appropriate measures to avoid, reduce, or mitigate any impacts.

Socioeconomics

New jobs would be created for all action alternatives. For the MPF alternatives, the number of direct jobs created during the peak year of construction would range from approximately 770-1,100, depending upon the capacity constructed. The number of indirect jobs created would vary depending upon the site. Table S.5.1-1 displays an estimate of the total number of jobs (direct plus indirect) created during the peak year of construction for the various MPF site alternatives. The maximum population influx would not exceed 3 percent at any site.

During operations, the number of direct jobs created would range from approximately 990-1,800, depending upon the capacity of the MPF. As shown on Table S.5.1-1, the total number of jobs would range from 1,230-3,090, depending upon the capacity of the MPF. During operations, all sites except NTS and SRS would have an increase in population for all plant sizes. The population increases are shown on Table S.5.1-1. Due to the population increases, which would be less than 3 percent, there would be no impacts on community services, except at Carlsbad Site, where increases in some resources would be required to maintain comparable levels of community services.

The TA-55 Upgrade Alternative (80 ppy) would result in a maximum of 190 direct jobs during the peak year of construction and 660 direct jobs during operations. Table S.5.1-1 displays the total number of jobs (direct plus indirect) associated with the TA-55 Upgrade Alternative.

Radiological Impacts

During normal MPF operations, radiological impacts to workers and the public would occur. Impacts to workers would be independent of the MPF site. At all MPF sites, the average individual dose to a worker would be 290 mrem/yr for the 125 ppy facility, 390 mrem/yr for the 250 ppy facility, and 510 mrem/yr for the 450 ppy facility. These doses would be below regulatory limits and limits imposed by DOE Orders. Statistically, for the average worker, a 290 mrem/yr dose translates into a risk of one fatal cancer every 8,620 years of operation; a 390 mrem/yr dose translates into a risk of one fatal cancer every 6,410 years of operation; a 510 mrem/yr dose translates into a risk of one fatal cancer every 4,900 years of operation.

For the TA-55 Upgrade Alternative, the average individual dose to a worker would be a 380 mrem/yr. Statistically, this translates into a risk of one fatal cancer every 6,580 years of operation.

Doses to the public would be site dependent. Sites with the smallest 80-km (50-mi) population would have the smallest impact. For example, the collective population dose to the population surrounding NTS and Carlsbad Site would be smaller than LANL, Pantex Site, and SRS due to the relative remoteness of NTS and Carlsbad Site. However, the collective population dose at any of the five sites is small in any event. The maximum collective population dose would occur at SRS for the 450 ppy facility. This dose would be 1.3×10^{-6} person-rem/yr, which statistically would translate into one fatal cancer risk every 1.5 billion years of operation. The TA-55 Upgrade Alternative would also be bounded by this population dose. At all sites, the maximally exposed offsite individual would receive a dose less than 1 mrem per year.

Nonradiological Impacts

Statistically, nonradiological occupational impacts to workers during the construction and operation of a MPF would be expected to result in less than one fatality. The impacts to workers are estimated to be the same for all action alternatives except the TA-55 Upgrade Alternative (80 ppy) which would have the smallest potential impact due to the least amount of construction activity.

Accidents

Radiological. Potential impacts from accidents were estimated using computer modeling. In the event of any accidents, the projected annual risk of latent cancer fatality (LCF) at all MPF sites for the surrounding population would be less than one. For the bounding accident analyzed in the EIS (explosion in a feed casting furnace), the highest potential annual risk to the population within 80-km (50-mi) would be an increase in LCFs of 0.125 at LANL from either the MPF or TA-55 Upgrade Alternative. Statistically, this would equate to one additional LCF among the 80-km (50-mi) population surrounding LANL every 8 years of operation and this accident would be expected to occur once every 100 years. For this accident, the dose to the maximally exposed offsite individual would be 38 rem, which exceeds DOE exposure guidelines. The analyses in these cases for NEPA purposes are based on unmitigated releases of radioactive material to select a site for the MPF. Following the ROD and selection of a site, additional NEPA action would be taken that would identify specific mitigating features that would be incorporated in the

MPF design to ensure compliance with DOE exposure guidelines. At NTS and Carlsbad Site, this risk would be smallest due to the relative remoteness of these two sites.

Nonradiological. The impacts associated with the potential release of the most hazardous chemicals used at a MPF were modeled to determine whether any impacts could exceed site boundaries. Based upon those modeling results, it was determined that no chemical impacts would exceed site boundaries at SRS and NTS. At LANL, Pantex Site, and Carlsbad Site, an accidental chemical release had the potential to cause impacts beyond site boundaries. In such an event, emergency preparedness procedures would be employed to minimize potential impacts.

Transportation

During normal transportation of radiological materials (plutonium, enriched uranium, TRU waste and LLW), radiological impacts to transportation workers and the public would occur. Impacts to workers and the public would be dependent on the MPF site and the population along expected transportation routes. All pits would originate and terminate at Pantex and all enriched uranium components would be transported to the MPF site from the Y-12 National Security Complex at Oak Ridge, Tennessee, and back. Two locations (Pantex Site and Carlsbad Site) would transport LLW offsite.

For all alternatives, the environmental impacts and potential risks of transportation would be small, e.g., less than one latent cancer fatality per year. As shown in Table S.3.5–1, the average collective dose to transportation workers from incident free transportation would be a maximum of 10.2 person-rem/yr for the 450 ppy facility. Statistically, a 10.2 person-rem/yr dose translates into a risk of one fatal cancer every 245 years of operation. The average collective dose to the general public from incident free transportation would be a maximum of 12 person-rem/yr for the 450 ppy facility. Statistically, a 12 person-rem/yr dose translates into a risk of one fatal cancer every 167 years of operation.

In the event of a transportation accident, the maximum average collective dose to the general public from a transportation accident would be 0.29 person-rem/yr for the 450 ppy facility. Statistically, a 0.29 person-rem/yr dose translates into a risk of one fatal cancer every 6,897 years of operation.

Waste Management

The amount of waste generated by the MPF would be the same at all sites. These values and those from the TA-55 Upgrade Alternative (80 ppy) are shown in Table S.5.1–1. The TRU waste from all sites would be transported to the Waste Isolation Pilot Plant or other similar type facility for disposal (the impact of this is included in the transportation section). All LLW at LANL and at NTS would be handled in existing onsite burial LLW disposal facilities. The existing aboveground E-Area retrievable vault storage facilities at SRS are not adequate and planned onsite disposal facilities would require additional capacity to handle the quantities of LLW generated by the MPF for the 250 ppy and 450 ppy facilities. Pantex Site and Carlsbad Site do not have any onsite LLW disposal facilities and would ship their MPF LLW to NTS. Pantex Site would need to expand its temporary LLW storage facility, and Carlsbad Site would need to construct a temporary LLW storage facility.

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Table S.5.1–1. Summary of Environmental Impacts

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
LAND USE							
Percent of available site disturbed	No change[a]	~ 0.03 %	~ 0.6–0.7%	~ 0.02%	~ 0.9–1.1%	~ 0.07–0.09%	~ 1.4–1.7%
SITE INFRASTRUCTURE (Operations)							
80 ppy							
Electrical Supply	No change[a]	Adequate	—	—	—	—	—
Fuel for Process Supply	No change[a]	Steam Available	—	—	—	—	—
125 ppy							
Electrical Supply	—	—	Adequate	Additional energy capacity and peak load capability would be needed	Adequate	Adequate	Additional peak load capacity would be needed
Fuel for Process Supply	—	—	Steam Available	Pipeline/Rail line required	Steam Available	Steam Available	Extension of existing pipeline required
250 ppy							
Electrical Supply	—	—	Adequate	Additional energy capacity and peak load capability would be needed	Adequate	Adequate	Additional peak load capability would be needed
Fuel for Process Supply	—	—	Steam Available	Pipeline/Rail line required	Steam Available	Steam Available	Extension of existing pipeline required
450 ppy							
Electrical Supply	—	—	Additional peak load capability would be needed	Additional energy capacity and peak load capability would be needed	Additional energy capacity would be needed	Adequate	Additional energy capacity and peak load capability would be needed
Fuel for Process Supply	—	—	Steam Available	Pipeline/Rail line required	Steam Available	Steam Available	Extension of existing pipeline required

Table S.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
WATER RESOURCES							
Construction – All Capacity Sizes							
Adequate site water allotment	No change[a]	yes	yes	yes	yes	yes	yes
Operations							
80 ppy							
Adequate site water allotment	No change[a]	yes	—	—	—	—	—
125 ppy							
Adequate site water allotment	—	—	yes	yes	yes	yes	no
250 ppy							
Adequate site water allotment	—	—	no	yes	yes	yes	no
450 ppy							
Adequate site water allotment	—	—	no	yes	yes	yes	no
BIOLOGICAL RESOURCES							
Terrestrial – All Capacity Sizes							
	No impact	No impact	Approximately 56-69 ha of low value vegetation and potential habitat modified or lost; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha of primarily shrubland habitat cleared, modified, or lost; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha of shortgrass prairie and habitat cleared or modified; loss of shortgrass prairie plant community and wildlife habitat; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha of potential forested habitat modified or lost; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha cleared, modified or lost of grass and shrub plant communities and wildlife habitat; decrease in quality of habitat adjacent to proposed development

Table S.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
SOCIOECONOMICS[b]							
Construction – Jobs Created	No change[a]	—	—	—	—	—	—
80 ppy	—	Direct: 190 Indirect: 120	—	—	—	—	—
125 ppy	—	—	Direct: 770 Indirect: 480	Direct: 770 Indirect: 740	Direct: 770 Indirect: 660	Direct: 770 Indirect: 550	Direct: 770 Indirect: 280
250 ppy	—	—	Direct: 850 Indirect: 530	Direct: 850 Indirect: 820	Direct: 850 Indirect: 730	Direct: 850 Indirect: 610	Direct: 850 Indirect: 300
450 ppy	—	—	Direct: 1,100 Indirect: 690	Direct: 1,100 Indirect: 1,060	Direct: 1,100 Indirect: 940	Direct: 1,100 Indirect: 790	Direct: 1,100 Indirect: 390
Operations – Jobs Created	No change[a]	—	—	—	—	—	—
80 ppy	—	Direct: 660 Indirect: 220	—	—	—	—	—
125 ppy	—	—	Direct: 990 Indirect: 280	Direct: 990 Indirect: 620	Direct: 990 Indirect: 710	Direct: 990 Indirect: 950	Direct: 990 Indirect: 240
250 ppy	—	—	Direct: 1,360 Indirect: 390	Direct: 1,360 Indirect: 850	Direct: 1,360 Indirect: 980	Direct: 1,360 Indirect: 620	Direct: 1,360 Indirect: 330
450 ppy	—	—	Direct: 1,800 Indirect: 510	Direct: 1,800 Indirect: 1,130	Direct: 1,800 Indirect: 1,290	Direct: 1,800 Indirect: 820	Direct: 1,800 Indirect: 430
POPULATION AND HOUSING[c]							
Construction – Total Expected New Residents	No change[a]	—	—	—	—	—	—
80 ppy	—	150	—	—	—	—	—
125 ppy	—	—	1,600	No impact	1,400	140	1,700
250 ppy	—	—	1,900	No impact	1,600	350	1,900
450 ppy	—	—	2,500	No impact	2,300	1,000	2,600
Operations – Expected New Residents	No change[a]	—	—	—	—	—	—
80 ppy	—	335	—	—	—	—	—
125 ppy	—	—	—	No impact	1,400	No impact	1,900

Table S.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
250 ppy	—	—	2,100	No impact	2,400	No impact	2,800
450 ppy	—	—	3,200	No impact	3,500	No impact	3,900
COMMUNITY SERVICES							
All Capacity Sizes	No impact	No impact	No impact	No impact	No impact	No impact	Potential impact
HUMAN HEALTH AND SAFETY							
Annual Radiological Impacts to Individual MPF Workers							
Individual Workers – Average individual dose, mrem/yr							
80 ppy	No change[a]	380	—	—	—	—	—
125 ppy	—	—	290	290	290	290	290
250 ppy	—	—	390	390	390	390	390
450 ppy	—	—	510	510	510	510	510
Average worker cancer fatality risk	No change[a]	—	—	—	—	—	—
80 ppy	—	1.5×10^{-4}	—	—	—	—	—
125 ppy	—	—	1.2×10^{-4}	1.2×10^{-4}	1.2×10^{-4}	1.2×10^{-4}	1.2×10^{-4}
250 ppy	—	—	1.6×10^{-4}	1.6×10^{-4}	1.6×10^{-4}	1.6×10^{-4}	1.6×10^{-4}
450 ppy	—	—	2.0×10^{-4}	2.0×10^{-4}	2.0×10^{-4}	2.0×10^{-4}	2.0×10^{-4}
Annual Radiological Impacts to MPF Worker Population							
Collective dose, person-rem	No change[a]	—	—	—	—	—	—
80 ppy	—	154	—	—	—	—	—
125 ppy	—	—	160	160	160	160	160
250 ppy	—	—	310	310	310	310	310
450 ppy	—	—	560	560	560	560	560
Cancer fatality risk	No change[a]	—	—	—	—	—	—
80 ppy	—	0.062	—	—	—	—	—
125 ppy	—	—	0.064	0.064	0.064	0.064	0.064
250 ppy	—	—	0.12	0.12	0.12	0.12	0.12
450 ppy	—	—	0.22	0.22	0.22	0.22	0.22
Annual Radiological Impacts on Public							
Population within 80 km (50 mi)							
Collective dose, person-rem	No change[a]	—	—	—	—	—	—
80 ppy	—	2.5×10^{-8}	—	—	—	—	—

Table S.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
125 ppy	—	—	3.4×10^{-7}	2.7×10^{-8}	1.2×10^{-7}	4.2×10^{-7}	4.2×10^{-8}
250 ppy	—	—	5.5×10^{-7}	4.3×10^{-8}	2.0×10^{-7}	7.0×10^{-7}	6.8×10^{-8}
450 ppy	—	—	1.0×10^{-6}	7.7×10^{-8}	3.6×10^{-7}	1.3×10^{-6}	1.2×10^{-7}
LCFs	No change[a]	—	—	—	—	—	—
80 ppy	—	1.2×10^{-11}	—	—	—	—	—
125 ppy	—	—	1.7×10^{-10}	1.3×10^{-11}	6.2×10^{-11}	2.1×10^{-10}	2.1×10^{-11}
250 ppy	—	—	2.8×10^{-10}	2.1×10^{-11}	1.0×10^{-10}	3.5×10^{-10}	3.4×10^{-11}
450 ppy	—	—	5.0×10^{-10}	3.8×10^{-11}	1.8×10^{-10}	6.5×10^{-10}	6.2×10^{-11}
Offsite MEI – Dose (mrem)	No change[a]	—	—	—	—	—	—
80 ppy	—	3.0×10^{-9}	—	—	—	—	—
125 ppy	—	—	4.1×10^{-8}	1.6×10^{-9}	1.7×10^{-8}	2.6×10^{-9}	2.3×10^{-8}
250 ppy	—	—	6.6×10^{-8}	2.5×10^{-9}	2.8×10^{-8}	4.3×10^{-9}	3.6×10^{-8}
450 ppy	—	—	1.2×10^{-7}	3.8×10^{-9}	5.0×10^{-8}	8.0×10^{-9}	6.5×10^{-8}
Cancer fatality risk	No change[a]	—	—	—	—	—	—
80 ppy	—	1.5×10^{-15}	—	—	—	—	—
125 ppy	—	—	2.1×10^{-14}	8.0×10^{-16}	8.5×10^{-15}	1.3×10^{-15}	1.2×10^{-14}
250 ppy	—	—	3.3×10^{-14}	1.3×10^{-15}	1.4×10^{-14}	2.2×10^{-15}	1.8×10^{-14}
450 ppy	—	—	6.0×10^{-14}	2.3×10^{-15}	2.5×10^{-14}	4.0×10^{-15}	3.3×10^{-14}
Nonradiological Impacts							
Construction total fatalities for project duration	—	—	—	—	—	—	—
80 ppy	—	0.09	—	—	—	—	—
125 ppy	—	—	0.54	0.54	0.54	0.54	0.54
250 ppy	—	—	0.60	0.60	0.60	0.60	0.60
450 ppy	—	—	0.78	0.78	0.78	0.78	0.78
Operations total fatalities per year	No change[a]	—	—	—	—	—	—
80 ppy	—	0.025	—	—	—	—	—
125 ppy	—	—	0.04	0.04	0.04	0.04	0.04
250 ppy	—	—	0.05	0.05	0.05	0.05	0.05
450 ppy	—	—	0.07	0.07	0.07	0.07	0.07

Table S.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
ACCIDENTS (Maximum Annual Cancer Risk for Highest Risk Accident)							
Population	No change[d]	0.125	0.125	0.003	0.023	0.035	0.0081
MEI	No change[d]	3.8×10^{-4}	3.8×10^{-4}	7.4×10^{-6}	8.8×10^{-5}	9.6×10^{-6}	3.1×10^{-4}
TRANSPORTATION							
Operations – Annual Incident Free-collective dose (person-rem/LCFs)							
Transportation Workers	0.23/ 9.1×10^{-5}	—	—	—	—	—	—
80 ppy	—	0.54/ 2.2×10^{-4}	—	—	—	—	—
125 ppy	—	—	$0.76/3.0 \times 10^{-4}$	$2.2/9.0 \times 10^{-4}$	$4.2/1.7 \times 10^{-3}$	$3.1/1.2 \times 10^{-3}$	$3.7/1.5 \times 10^{-3}$
250 ppy	—	—	$1.1/4.5 \times 10^{-4}$	$3.1/1.2 \times 10^{-3}$	$6.6/2.6 \times 10^{-3}$	$4.1/1.6 \times 10^{-3}$	$6.0/2.4 \times 10^{-3}$
450 ppy	—	—	$1.8/7.3 \times 10^{-4}$	$4.9/2.0 \times 10^{-3}$	$10/4.0 \times 10^{-3}$	$6.4/2.5 \times 10^{-3}$	$9.2/3.7 \times 10^{-3}$
General Public	0.36/ 1.8×10^{-4}	—	—	—	—	—	—
80 ppy	—	0.88/ 4.4×10^{-4}	—	—	—	—	—
125 ppy	—	—	$1.2/6.2 \times 10^{-4}$	$3.6/1.8 \times 10^{-3}$	$3.4/1.7 \times 10^{-3}$	$5.8/2.9 \times 10^{-3}$	$2.6/1.3 \times 10^{-3}$
250 ppy	—	—	$1.8/8.8 \times 10^{-4}$	$4.9/2.5 \times 10^{-3}$	$5.1/2.7 \times 10^{-3}$	$7.6/3.8 \times 10^{-3}$	$4.3/2.2 \times 10^{-3}$
450 ppy	—	—	$2.9/1.4 \times 10^{-3}$	$7.8/3.9 \times 10^{-3}$	$8.0/4.0 \times 10^{-3}$	$12.0/5.9 \times 10^{-3}$	$6.8/3.4 \times 10^{-3}$
Operations – Radiological Accident Impact	4.6×10^{-5}/ 2.3×10^{-8}	—	—	—	—	—	—
80 ppy	—	1.3×10^{-4}/ 6.4×10^{-8}	—	—	—	—	—
125 ppy	—	—	1.7×10^{-4}/ 8.6×10^{-8}	9.2×10^{-4}/ 4.6×10^{-7}	1.1×10^{-3}/ 5.5×10^{-7}	0.011/ 5.4×10^{-6}	4.3×10^{-4}/ 2.2×10^{-7}
250 ppy	—	—	2.2×10^{-4}/ 1.1×10^{-7}	1.2×10^{-3}/ 5.8×10^{-7}	1.6×10^{-3}/ 8.1×10^{-7}	0.013/ 6.7×10^{-6}	6.9×10^{-4}/ 3.5×10^{-7}
450 ppy	—	—	3.3×10^{-4}/ 1.6×10^{-7}	1.8×10^{-3}/ 8.8×10^{-7}	2.5×10^{-3}/ 8.1×10^{-7}	0.021/ 1.0×10^{-5}	1.1×10^{-3}/ 5.3×10^{-7}

Table S.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
WASTE MANAGEMENT – *Annual Operations (m^3)*							
80 ppy							
TRU Waste–solid	—	445 [e]	—	—	—	—	—
LLW–solid	—	1,445 [e]	—	—	—	—	—
Mixed LLW–solid and liquid	—	53 [e]	—	—	—	—	—
Hazardous waste–solid and liquid	—	205 [e]	—	—	—	—	—
Adequate onsite LLW disposal facilities	—	Adequate	—	—	—	—	—
125 ppy							
TRU Waste–solid	—	—	590	590	590	590	590
LLW–solid	—	—	2,070	2,070	2,070	2,070	2,070
Mixed LLW–solid and liquid	—	—	1.7	1.7	1.7	1.7	1.7
Hazardous waste–solid and liquid	—	—	2.8	2.8	2.8	2.8	2.8
Adequate onsite LLW disposal facilities	—	—	Adequate	Adequate	No onsite disposal; additional onsite capacity would be needed until LLW transferred	Adequate	No onsite disposal capability for MPF LLW waste
250 ppy							
TRU Waste–solid	—	—	740	740	740	740	740
LLW–solid	—	—	3,300	3,300	3,300	3,300	3,300
Mixed LLW–solid and liquid	—	—	2.4	2.4	2.4	2.4	2.4
Hazardous waste–solid and liquid	—	—	3.4	3.4	3.4	3.4	3.4

Table S.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
Adequate onsite LLW disposal facilities	—	—	Adequate	Adequate	No onsite disposal; additional onsite capacity would be needed until LLW transferred	Additional capacity required for currently planned LLW facilities	No onsite disposal capability for MPF LLW waste
450 ppy							
TRU Waste–solid	—	—	1,130	1,130	1,130	1,130	1,130
LLW–solid	—	—	5,030	5,030	5,030	5,030	5,030
Mixed LLW–solid and liquid	—	—	4.2	4.2	4.2	4.2	4.2
Hazardous waste–solid and liquid	—	—	5.6	5.6	5.6	5.6	5.6
Adequate onsite LLW disposal facilities	—	—	Adequate	Adequate	No onsite disposal; additional onsite capacity would be needed until LLW transferred	Additional capacity required for currently planned LLW facilities	No onsite disposal capability for MPF LLW waste

[a] No change from current operations
[b] Differences in the number of indirect jobs created at each site are based upon unique Bureau of Economic Analysis multipliers for each site region.
[c] Total population impacts were determined by multiplying the number of workers required from outside the ROI by the average household size for the United States. The number of in-migrating workers was determined based on the current ROI laborforce composition and unemployment rates.
[d] No Action accidents addressed by existing documentation.
[e] Operational waste values from the upgrade include the removal of 140 gloveboxes over a 10-year period and additional waste from the pyrochemical process.
Offsite MEI = Maximally Exposed Offsite Individual.
LCF = Latent Cancer Fatality.

DOE/EIS-236-S2

U.S. Department of Energy

Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

Volume I

Chapters 1 – 11

May 2003

U.S. Department of Energy
National Nuclear Security Administration

COVER SHEET

***Responsible Agency*:** United States Department of Energy (DOE) National Nuclear Security Administration (NNSA)

***Title*:** Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

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Abstract: DOE's NNSA is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including production readiness required to maintain that stockpile. Since 1989, DOE has been without the capability to produce certified plutonium pits, which are an essential component of nuclear weapons. NNSA, the Department of Defense, and Congress have highlighted the lack of long-term pit production capability as a national security issue requiring timely resolution. While a small interim capacity is currently being established at the Los Alamos National Laboratory (LANL), classified analyses indicate that long-term support of the nuclear stockpile, which is a cornerstone of U.S. national security policy, will require a long-term pit production capability.

Pursuant to *National Environmental Policy Act* of 1969, as amended (42 USC 4321 et seq.), and DOE Regulations Implementing *National Environmental Policy Act* (10 CFR Part 1021), NNSA has prepared a Supplement to the Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility (hereafter, referred to as the MPF EIS) to support a Record of Decision (ROD) by the Secretary of Energy on: (1) whether to proceed with a Modern Pit Facility (MPF); and (2) if so, where to locate a MPF. This MPF EIS evaluates the environmental impacts associated with constructing a new MPF at the following sites: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site; (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas. The MPF EIS also evaluates an upgrade to the plutonium pit manufacturing capabilities currently being established at Technical Area 55 (TA-55) at LANL, and the No Action Alternative of relying on the small interim capacity at LANL. The MPF EIS evaluates a range of pit production capabilities consistent with national security requirements. Additional NEPA analysis will be required for

the specific siting of such a facility should the decision be made that a MPF is required. For this MPF Draft EIS, constructing and operating a MPF is the preferred alternative. A preferred site for a MPF has not yet been determined, but will be identified in the Final EIS.

Public Comments: In preparing this MPF Draft EIS, NNSA considered comments received during the public scoping period from September 20, 2002, through November 22, 2002. In addition, six public hearings were held to assist NNSA in defining the scope of the analysis. The first of these public hearings was held on October 8, 2002, in Amarillo, Texas. Hearings were also held in Carlsbad, New Mexico, on October 10, 2002, in Washington, DC, on October 15, 2002, in Las Vegas, Nevada, on October 17, 2002, in Los Alamos, New Mexico, on October 24, 2002, and in North Augusta, South Carolina, on October 29, 2002. Comments made at these hearings, as well as each comment received by fax, e-mail, and mail during the scoping period, were considered in the preparation of the MPF Draft EIS. A summary of the comments is included in this draft.

The comment period for this MPF Draft EIS will be from June 6, 2003 to August 5, 2003. Public meetings will also be held during this 60-day comment period. The dates, times, and locations of these meetings will be announced in the *Federal Register* and in local newspapers. All comments received during the comment period will be considered by NNSA in the Final EIS.

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ACRONYMS AND ABBREVIATIONS

AC and MC	Analytical Chemistry and Materials Characterization
ACHP	Advisory Council on Historic Preservation
ALARA	as low as reasonably achievable
ALOHA	Aerial Location of Hazardous Atmospheres
AQCR	Air Quality Control Region
ARF	airborne release fraction
Bison-m	Biota Information System of New Mexico
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BNM	Bandelier National Monument
CAA	*Clean Air Act*
CAIRS	Computerized Accident/Incident Reporting System
CD-0	critical decision on mission need
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CIF	Consolidated Incineration Facility
CMR	Chemistry and Metallurgy Research
CMRR	Chemistry and Metallurgy Research Building Replacement Project
CRT	Cargo Restraint Transporter
CWA	*Clean Water Act*
D&D	Decontamination and Decommissioning
DAF	Device Assembly Facility
DCGs	Derived Concentration Guidelines
DHHS	Department of Health and Human Services
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
DR	damage ratio
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
ECF	Entry Control Facility
EIS	Environmental Impact Statement
EOL	End-of-Life
EPA	U.S. Environmental Protection Agency

ER	Environmental Restoration
ESL	Effects Screening Level
EU	Enriched Uranium
FM	Farm-to-Market Road
FONSI	Finding of No Significant Impact
FPPA	*Farmland Protection Policy Act*
HAN	hydroxylamine nitrate
HANDSS-55	"handling and segregation system for 55-gallon drums"
HEPA	high efficiency particulate air
HEWTF	High Explosives Wastewater Treatment Facility
HI	Hazard Index
HQ	Hazard Quotient
HSC	Hazardous Materials Spill Center
HVAC	heating, ventilating, and air conditioning
HWDU	Hazardous waste disposal units
HWTPF	Hazardous Waste Treatment and Processing Facility
HYDEC	hydride/dehydride casting
I	Interstate Highway
ICD-9-CM	International Classification of Disease, 9th Revision, Clinical Modification
ICRP	International Commission on Radiological Protection
INEEL	Idaho National Engineering and Environmental Laboratory
IOM	Institution of Medicine
ISCST	Industrial Source Complex Short Term
ISD	Independent School District
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
LAC	Los Alamos County
LANL	Los Alamos National Laboratory
LANL SWEIS	*Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory*
LANSCE	Los Alamos Neutron Science Center
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOS	Level of Service
LPF	leak path factor
MACCS2	MELCOR Accident Consequence Code System Version 2
MAR	material at risk
MC&A	Material Control & Accountability

MCL	Maximum Contamination Level
MEI	Maximally Exposed Individual
MEK	methyl ethyl ketone
MOX	Mixed Oxide
MPF	Modern Pit Facility
MPF EIS	Modern Pit Facility Environmental Impact Statement
MSGP	Multi-Sector General Permit
MWDU	Mixed Waste Disposal Unit
NAAQS	National Ambient Air Quality Standards
NCRP	National Council on Radiation Protection Measurements
NEPA	*National Environmental Policy Act*
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NHPA	*National Historic Preservation Act*
NMAQCR	New Mexico Air Quality Control Regulations
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPR	Nuclear Posture Review
NPT	Nuclear Nonproliferation Treaty
NRCS	Natural Resources Conservation Service
NRHP	National Registry of Historic Places
NTS	Nevada Test Site
NWSM	Nuclear Weapons Stockpile Memorandum
NWSP	Nuclear Weapons Stockpile Plan
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PAAA	*Price-Anderson Amendments Act*
Pantex	Pantex Plant
PCB	polychlorinated biphenyls
pCi/L	picocuries per liter
PF-4	Plutonium Facility, Building 4
PIDAS	Perimeter Intrusion Detection and Assessment System
ppbv	parts per billion by volume
ppy	pits per year
PQL	Practical Quantitation Limit

PSD	Prevention of Significant Deterioration
Pu	Plutonium
PMDA	Plutonium Management and Disposition Agreement
PUREX	Plutonium-Uranium Extraction Process
R&D	Research and Development
RANT	Radioassay and Nondestructive Testing
RCRA	*Resource Conservation and Recovery Act*
RIMSII	Regional Input-Output Modeling System
RF	respirable fraction
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	Region of Influence
RRF	respirable release fraction
RWMS	Radioactive Waste Management Sites
S.C.	South Carolina State Highway
SCDHEC	South Carolina Department of Health and Environmental Control
SEIS	Supplemental Environmental Impact Statement
SFNF	Santa Fe National Forest
SGT	Safeguards Transporters
SHEO	sentinel health event for occupation
SHPO	State Historic Preservation Officer
SMR	standardized mortality rate
SRS	Savannah River Site
SS&C	sand, slag and crucible
SSM	Stockpile Stewardship and Management
SSM PEIS	*Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
SST	Safe Secure Trailers
SVOC	Semi-volatile organic compound
SWEIS	Site-Wide Environmental Impact Statement
SWSC	Sanitary Wastewater Systems Consolidation
TA	Technical Area
TA-55	Technical Area 55
TBP	tributylphosphate
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resource Conservation Commission
TPDES	Texas Pollutant Discharge Elimination System
TRAGIS	Transportation Routing Analysis Geographic Information System

TRU	transuranic
TRUPACT-II	Transuranic Package Transporter
TSCA	*Toxic Substance Control Act*
TSP	total suspended particulates
USACE	United States Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VPP	Voluntary Protection Program
WCRRF	Waste Compaction, Reduction, and Repackaging Facility
WIPP	Waste Isolation Pilot Plant
WSRC	Westinghouse Savannah River Company
WWTF	Wastewater Treatment Facility

CHEMICALS AND UNITS OF MEASURE

BTEX	benzene, toluene, ethylbenzene, and xylenes
Bq	Becquerel
C	Celsius
Ci	curie
cm	centimeters
CFC	chlorofluorocarbons
CO	carbon monoxide
dB	decibel
dBA	decibel A-weighted
DCE	1, 2-dichloroethylene
DNA	deoxyribonucleic acid
F	Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
ft^3/s	cubic feet per second
g	grams
gal	gallons
ha	hectares
hr	hour
in	inches
kg	kilograms
km	kilometers
km^2	square kilometers
kV	kilovolts
kVA	kilovolt-ampere
kW	kilowatts
kWh	kilowatt hours
L	liters
lb	pounds
m	meters
m^2	square meters
m^3	cubic meters
m/s	meters per second
mg	milligram (one-thousandth of a gram)
mg/L	milligrams per liter

MGD	million gallons per day
MGY	million gallons per year
mi	miles
mi^2	square miles
mph	miles per hour
mrem	millirem (one-thousandth of a rem)
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatt hour
NO_2	nitrogen dioxide
NOX	nitrogen oxides
O_3	ozone
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
rem	roentgen equivalent man
s	seconds
SO_2	sulfur dioxide
T	short ton
t	metric tons
TCA	1, 1, 1-trichloroethane
TCE	trichloroethylene
yd^3	cubic yards
yr	year
µCi	microcurie (one-millionth of a curie)
µCi/g	microcuries per gram
µg	microgram (one-millionth of a gram)
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
$µg/m^3$	micrograms per cubic meter

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
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	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-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}

1.0 INTRODUCTION

Chapter 1 begins with an overview of the National Nuclear Security Administration's Modern Pit Facility (MPF) proposal. This chapter includes background information on the MPF mission, the scope of this MPF Environmental Impact Statement (EIS), and the alternatives analyzed in this EIS. This chapter also discusses other National Environmental Policy Act documents related to the MPF proposal, and the scoping process used to obtain public input on the issues that are addressed in this EIS. The chapter concludes with an outline of the organization of the document.

1.1 OVERVIEW

The U.S. Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including production readiness required to maintain that stockpile. Since 1989, DOE has been without the capability to produce stockpile certified plutonium pits, which are an essential component of nuclear weapons. NNSA, the Department of Defense (DOD), and Congress have highlighted the lack of long-term pit production capability as a national security issue requiring timely resolution. While a small interim capacity is currently being established at the Los Alamos National Laboratory (LANL), classified analyses indicate projected capacity requirements (number of pits to be produced over a period of time), and agility (ability to rapidly change from production of one pit type to another, ability to simultaneously produce multiple pit types, or the flexibility to produce pits of a new design in a timely manner) necessary for long-term support of the stockpile will require a long-term pit production capability. In particular, identification of a systemic problem associated with an existing pit type, class of pits, or aging phenomenon cannot be adequately responded to today, nor could it be with the small capability being established at LANL (see Chapter 2 of this Environmental Impact Statement [EIS] for a more detailed discussion regarding the purpose and need for a Modern Pit Facility [MPF]).

Prudent risk management requires that NNSA initiate action now to assure readiness to support the stockpile and that appropriate pit production capacity is available when needed. Pursuant to the *National Environmental Policy Act* of 1969 (NEPA), as amended (42 USC 4321 *et seq.*), and the DOE Regulations Implementing NEPA (10 CFR Part 1021), NNSA is preparing this Supplement to the Programmatic EIS (PEIS) on Stockpile Stewardship and Management (SSM) for a Modern Pit Facility (MPF) in order to decide: (1) whether to proceed with the MPF; and (2) if so, where to locate the MPF. Hereafter, this document will be referred to as the Modern Pit Facility Environmental Impact Statement (MPF EIS).

1.1.1 Relevant History

Plutonium pits for the nuclear weapons stockpile were manufactured at the DOE Rocky Flats Plant in Golden, Colorado, from 1952-1989. In December 1989, due to environmental and safety concerns, production at Rocky Flats was shut down by the DOE and no stockpile-certified pits have since been produced by this country. Today, the United States is the only nuclear weapons power without the capability to manufacture plutonium pits suitable for use in the nuclear weapons stockpile.[1] During the mid-1990s, DOE conducted a comprehensive analysis of the capability and capacity needs for the entire Nuclear Weapons Complex and evaluated alternatives for maintaining the Nation's nuclear stockpile in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS) (DOE/EIS-0236) (DOE 1996c). Issued in September 1996, the SSM PEIS assessed future stockpile requirements and looked extensively at pit manufacturing capability and capacity needs. The SSM PEIS evaluated reasonable alternatives for re-establishing interim pit production capability on a small scale. A large pit production capacity—in line with the capacity planned for other manufacturing functions—was not evaluated in the SSM PEIS "because of the small current demand for the fabrication of replacement pits, and the significant, but currently undefined, time period before additional capacity may be needed." In the SSM PEIS Record of Decision (ROD) (61 FR 68014) on December 26, 1996, the Secretary of Energy decided to re-establish an interim pit fabrication capability, with a small capacity, at LANL. That decision limited pit fabrication to a facility "sized to meet programmatic requirements over the next ten or more years." In the ROD, DOE committed to "performing development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity."

Subsequent to the SSM PEIS ROD, a number of citizen groups filed suit challenging the adequacy of the SSM PEIS. In August 1998, the SSM PEIS litigation was resolved. As a result of that litigation, DOE agreed to entry of a court order that required, "prior to taking any action that would commit DOE resources to detailed engineering design, testing, procurement, or installment of pit production capability for a capacity in excess of the level that has been analyzed in the SSM PEIS (50 pits per year [ppy] under routine conditions, 80 ppy under multiple-shift operations), DOE shall prepare and circulate a Supplemental PEIS, in accordance with DOE NEPA Regulation 10 Code of Federal Regulations (CFR) 1021.314, analyzing the reasonably foreseeable environmental impacts of and alternatives to operating such an enhanced capacity, and shall issue a ROD based thereon." This MPF EIS is being prepared in part to satisfy that obligation.

Following the SSM PEIS, in January 1999, DOE prepared the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (LANL SWEIS) (DOE/EIS-0238) (DOE 1999a), which evaluated site-specific alternatives for implementing pit production at LANL. Consistent with the SSM PEIS ROD, the LANL SWEIS evaluated alternatives that would implement pit production with a capacity up to 50 ppy under single-shift operations and 80 ppy using multiple shifts. In the ROD for the LANL SWEIS (64 FR 50797) issued on September 20, 1999, DOE decided to initiate actions that would allow for the production of up to 20 ppy at LANL, and deferred any decision to expand pit manufacturing beyond that level. Consistent with the 1996 SSM PEIS ROD and the 1999 LANL SWEIS ROD, NNSA has been establishing a small pit manufacturing capability at LANL. The establishment of the interim pit production capacity is expected to be completed in 2007.

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[1] NNSA has demonstrated the capability to manufacture development pits at the LANL TA-55 Plutonium Facility.

1.1.2 Function of the Pit in Nuclear Weapons

Nuclear weapons function by initiating and sustaining nuclear chain reactions in highly compressed material which can undergo both fission and fusion reactions. Modern nuclear weapons have a primary, which is used as the initial source of energy, and a secondary, which provides additional explosive energy release. The primary contains a central core, the "pit." Nuclear weapons cannot operate without a fully functioning pit.

1.1.3 Nuclear Weapons Stockpile

The size and composition of the U.S. nuclear weapons stockpile are determined annually by the President. The Secretaries of Defense and Energy jointly sign the Nuclear Weapons Stockpile Memorandum (NWSM), which includes the Nuclear Weapons Stockpile Plan (NWSP) as well as a long-range planning assessment. As such, the NWSM is the basis for all DOE stockpile support planning. DOD prepares the NWSP based on military requirements and coordinates the development of the plan with NNSA concerning its ability to support this plan. The NWSP, which is classified, covers the current year and a 5-year planning period. It specifies the types and quantities of weapons required, and sets limits on the size and nature of stockpile changes that can be made without additional approval of the President. The NWSM directly specifies the number and types of weapons required to support the stockpile.

Chapter 2 discusses the relevant factors, such as treaties and the Nuclear Posture Review (NPR), that shape national security policies related to the MPF Proposed Action.

1.2 PROPOSED ACTION, ENVIRONMENTAL IMPACT STATEMENT SCOPE, AND ALTERNATIVES

NNSA proposes to site, construct, and operate a MPF for the purpose of producing plutonium pits to support long-term national security needs. A range of pit production capacities consistent with national security requirements is analyzed in this EIS (see Chapters 2 and 3 for a discussion of pit production capacity and the range of capacities that is utilized in this EIS). This MPF EIS analyzes the reasonably foreseeable environmental impacts of, and alternatives to, operating at the various capacities. Consistent with this approach, the MPF EIS also evaluates the No Action Alternative of maintaining the plutonium pit capabilities at LANL that are currently planned to be in place by 2007, and an upgrade of the Technical Area (TA)-55, Plutonium Facility, Building 4 (PF-4), at LANL.

For the proposed MPF, this EIS analyzes all reasonable site locations. As described in detail in Appendix G, NNSA utilized a site screening process to determine a reasonable range of site alternatives for the MPF EIS. In this site screening process, all existing major DOE sites were initially considered to serve as potential host locations for a MPF. The site screening analysis considered the following criteria: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA presence at the site, and infrastructure. The first two criteria were deemed to be "exclusionary" criteria; that is, a site either passed or failed on each of these two criteria. The sites that passed the exclusionary criteria were then scored against all criteria. Based upon results from the site screening analysis, the following were determined to be reasonable alternatives for a MPF: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site (NTS); (3) Carlsbad Site, New Mexico; (4) Savannah River Site (SRS), South Carolina; and (5) Pantex Site, Texas.

1.3 *NATIONAL ENVIRONMENTAL POLICY ACT* STRATEGY

Deciding whether to proceed with a MPF, and if so, where to locate the MPF, is a major Federal action that could significantly affect the quality of the human environment; therefore, an EIS is required. NNSA envisions this MPF EIS as a "programmatic document" that would support these two decisions. In addition, the MPF EIS analyzes a No Action Alternative and an Upgrade Alternative to the existing PF-4 at TA-55 at LANL. If the Secretary of Energy decides to proceed with a MPF, a second, tiered, project-specific EIS would be prepared after the MPF EIS ROD. That tiered EIS would utilize more detailed design information to evaluate reasonable site-specific alternatives in the vicinity of the host site picked in the MPF EIS ROD. In the event that the tiered EIS considers alternative site locations beyond existing DOE site boundaries, such locations would be required to be consistent with the original host site selection criteria. That EIS would ultimately support a ROD for the construction and operation for a MPF of a specific capacity and design at a specific location.

1.4 OTHER RELEVANT *NATIONAL ENVIRONMENTAL POLICY ACT* REVIEWS

1.4.1 Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management, DOE/EIS-0236 (SSM PEIS)

The SSM PEIS evaluated alternatives for maintaining the safety and reliability of the Nation's nuclear stockpile in the post-Cold War world (DOE 1996c). In the December 26, 1996, SSM PEIS ROD (61 FR 68014), the Secretary of Energy decided, among other decisions, to establish an interim, small pit fabrication capability at LANL "sized to meet programmatic requirements over the next ten or more years." In the ROD, DOE committed to "performing development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity." Consistent with the SSM PEIS ROD, a MPF would provide a larger plutonium pit capacity to meet long-term national security needs.

1.4.2 Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, DOE/EIS-0238 (LANL SWEIS)

The LANL SWEIS evaluated alternatives for the continued operation of LANL (DOE 1999a). Four alternatives were evaluated: (1) No Action, (2) Expanded Operations, (3) Reduced Operations, and (4) a Greener Alternative. The LANL SWEIS evaluated site-specific alternatives for implementing pit production at LANL consistent with the SSM PEIS ROD. A LANL SWEIS ROD was issued on September 20, 1999, to select the Expanded Operations Alternative (64 FR 50797) with a modification in the level of pit production. This alternative included the continuation of all activities presently undertaken at LANL, at the highest level of activity, and an increased pit production capability. In this ROD, DOE decided to implement actions that would allow for the production of up to 20 ppy at LANL, and deferred any decision to expand pit manufacturing beyond that level. The LANL SWEIS provides the framework for the No Action Alternative in the MPF EIS. That is, if the Secretary of Energy decides to not proceed with a MPF or upgrade the LANL plutonium pit capabilities, then NNSA would rely upon the planned capacity at LANL to meet long-term national security needs (i.e., the No Action Alternative).

1.4.3 Final Programmatic Environmental Impact Statement for the Storage and Disposition of Weapons-Usable Fissile Materials, DOE/EIS-0229 (S&D PEIS)

The S&D PEIS analyzed the potential environmental consequences of alternatives for the long-term storage (up to 50 years) and disposition of plutonium from U.S. nuclear weapon dismantlements (DOE 1996e). Three storage alternatives were evaluated: (1) Upgrade at Multiple Sites, (2) Consolidation of Plutonium, and (3) Collocation of Plutonium and Enriched Uranium. Six candidate sites were considered: Hanford Site, NTS, Idaho National Engineering Laboratory, Pantex, Oak Ridge Reservation, and the SRS. On January 14, 1997, DOE issued a ROD (62 FR 3014) to upgrade the plutonium storage capabilities of Pantex, Hanford, and SRS and to continue to store plutonium at these facilities. Weapons-usable plutonium at Rocky Flats would be transported to Pantex and SRS. On August 13, 1998, DOE issued an amended ROD (63 FR 43386) to expand improvements to SRS storage facilities to allow for accelerated movement of plutonium from Rocky Flats. DOE further decided in the ROD that the Y-12 National Security Complex (Y-12) on the Oak Ridge Reservation would continue to store nonsurplus enriched uranium (for the long-term) and surplus enriched uranium (on an interim basis) in upgraded facilities pending final disposition. Based on these decisions, plutonium pits to be used in a MPF would be stored at Pantex and enriched uranium for a MPF would be stored at Y-12.

1.4.4 Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, DOE/EIS-0243 (NTS SWEIS)

The NTS SWEIS evaluated alternatives for the continued operation of NTS (DOE 1996b). Four alternatives were evaluated: (1) No Action Alternative, (2) Discontinuation of Operations, (3) Expanded Use, and (4) Alternate Use of Withdrawn Lands. On December 13, 1996, DOE published a ROD (61 FR 65551) selecting the Expanded Use Alternative. In July 2002, DOE issued a *Supplement Analysis for the Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE/EIS-0243-SA-01) (DOE 2002i). This supplement analysis determined that there were no significant changes from actions foreseen in 1996. Furthermore, there were no new major proposals and projects. Accordingly, it was determined that no supplemental EIS for the 1996 NTS EIS is required. For purposes of the MPF EIS, the analyses and decisions in the NTS SWEIS ROD and Supplement Analysis represent the No Action Alternative at NTS. That is, if the Secretary of Energy decides not to proceed with a MPF, or decides not to locate a MPF at NTS, then NNSA would conduct business at NTS within the framework of the NTS SWEIS ROD and Supplement Analysis.

1.4.5 Final Environmental Impact Statement for the Continued Operation of Pantex and Associated Storage of Nuclear Weapons Components, DOE/EIS-0225 (Pantex SWEIS)

The Pantex SWEIS evaluated alternatives for the continued operation of Pantex (DOE 1996d). The SWEIS examined environmental impacts resulting from a reasonable range of activity levels by assessing the operations on 2,000, 1,000, and 500 weapons per year. The EIS also addressed environmental impacts resulting from the relocation of interim pit storage to other DOE sites. On January 27, 1997, DOE issued a ROD (62 FR 3880) selecting the implementation of upgrades to enable continued operations, and continued interim pit storage, at Pantex, to enable increasing the storage level from 12,000 to 20,000 pits.

In April 2002, DOE completed a *Supplement Analysis for the Final EIS for the Continued Operation of Pantex and Associated Storage of Nuclear Weapon Components* (DOE/EIS-0225/SA-03) (DOE 2002e). This analysis looked at the SWEIS completed in 1996 and concluded that there is no need to supplement the Pantex SWEIS.

With respect to the MPF EIS, the decision to store up to 20,000 pits in upgraded storage facilities at Pantex is applicable to all alternatives analyzed in the MPF EIS; that is, regardless of any decisions in the MPF EIS, Pantex will continue to store plutonium pits for the Nation's nuclear weapon stockpile. Additionally, if the Secretary of Energy decides to not proceed with a MPF, or decides to not locate a MPF at Pantex, then NNSA would conduct business at Pantex within the framework of the Pantex SWEIS ROD and Supplement Analysis.

1.4.6 Final Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase, DOE/EIS-0026-S-2 (WIPP SEIS)

In 1980, the original *Final Environmental Impact Statement for the Waste Isolation Pilot Plant* (DOE/EIS-0200) was issued. Supplemental EISs (SEISs) was issued in 1990 and again in 1997. In addition, several Supplement Analyses (SAs) have been issued. In July 2002, DOE issued the WIPP EIS-SA (DOE/EIS-0026-S-2) (DOE 1997b). This EIS-SA, supported by the earlier analyses, examined the alternatives associated with the treatment, storage, transportation and disposal of transuranic (TRU) waste at WIPP, located near Carlsbad, New Mexico. On September 6, 2002, DOE issued a revised ROD (67 FR 56989) to allow for shipments from various locations to WIPP. For purposes of the MPF EIS, the analyses and decisions in the WIPP SEIS and ROD represent the No Action Alternative at WIPP. That is, if the Secretary of Energy decides to not proceed with a MPF, or decides to not locate a MPF at WIPP, then DOE would conduct business at WIPP within the framework of the RODs for WIPP EISs and SEISs.

1.4.7 Nonnuclear Consolidation Environmental Assessment, DOE/EA-0792

In June 1993, DOE issued the *Nonnuclear Consolidation Environmental Assessment* (Nonnuclear Consolidation EA) (DOE 1993). This EA analyzed the proposed consolidation of the facilities within the Nation's Nuclear Weapons Complex that manufactured the nonnuclear components used in the Nation's nuclear weapons arsenal. Based on the findings of this EA, on September 14, 1993, DOE issued a Finding of No Significant Impact (FONSI) which resulted in defense activities being withdrawn from the Mound Plant in Miamisburg, Ohio, the Pinellas Plant in Pinellas, Florida, and the nonnuclear activities at the Rocky Flats Plant in Golden, Colorado (58 FR 36658). These activities were relocated and consolidated at the Kansas City Plant in Kansas City, Missouri and Sandia National Laboratories, New Mexico. This action also transferred the tritium handling activities performed at the Mound Plant to Savannah River Site. With respect to the MPF EIS, the decision based on this Nonnuclear Consolidation EA would apply equally to all MPF alternatives. That is, nonnuclear components for pits would be produced in existing facilities and shipped to the pit production facility for assembly into pits.

1.4.8 Supplement Analysis, Changes Needed to the Surplus Plutonium Disposition Program

On April 19, 2002, DOE issued an amended ROD (67 FR 19432) for both the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE/EIS-0283) (DOE 1999h) and the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229) (DOE 1996e). This ROD cancelled the immobilization component of the U.S. surplus plutonium disposition program for surplus weapons-usable plutonium described in these two EISs and selected the alternative of immediate implementation of consolidated long-term storage at SRS of surplus non-pit plutonium now stored separately at Rocky Flats. The ROD also explained that DOE's current disposition strategy involves a mixed oxide-only approach, under which DOE would dispose of up to 34 metric tons (37 short tons) of surplus plutonium by converting it to mixed oxide fuel and irradiating it in nuclear power reactors. The Supplement Analysis concluded that changes to the Mixed Oxide Fuel Fabrication Facility (MOX Facility) in the F-Area at SRS to allow for the amended ROD would result in no additional impacts, and that no new or different bounding accident scenarios had been identified. Accordingly, it was determined that the original analysis was sufficient and that a Supplement EIS was not required. Relative to the MPF EIS, the NNSA considered use of the plutonium disposition facilities at SRS, but eliminated this option from detailed study (see Chapter 3, Section 3.4.2).

1.4.9 Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, DOE/EIS-0350D (CMRR EIS)

DOE/NNSA is currently preparing an EIS for the Chemistry and Metallurgy Research Building Replacement Project (CMRR) at LANL (DOE 2003). The purpose of the CMRR EIS is to evaluate the potential environmental impacts associated with alternatives for replacing the existing Chemistry and Metallurgy Research Building (CMR) at LANL, which is scheduled to be shut down in approximately 2010. The preferred alternative is to construct a new CMRR Facility at TA-55, consisting of two or three buildings. On July 23, 2002, DOE/NNSA published a Notice of Intent (NOI) to prepare the CMRR EIS in the *Federal Register* (67 FR 48160). Public Scoping Meetings were held in August 2002. DOE/NNSA issued a Draft CMRR EIS in May 2003. The Final CMRR EIS is expected to be issued in late 2003 or early 2004. Under the No Action Alternative and the TA-55 Upgrade Alternative, direct analytical, chemistry and metallurgical support would be provided by the existing CMR or the proposed CMRR (see Chapter 3, Section 3.4.5).

1.5 PUBLIC SCOPING PROCESS

Scoping is a process in which the public and stakeholders provide comments directly to the Federal Agency on the scope of the EIS. This process begins with the publication of a NOI in the *Federal Register*. On September 23, 2002, DOE published an NOI to prepare the MPF EIS (67 FR 59577) and invited public comment on the MPF EIS proposal. Subsequent to this notice, DOE held public scoping meetings in Amarillo, Texas; Carlsbad, New Mexico; Las Vegas, Nevada; Los Alamos, New Mexico; North Augusta, South Carolina; and Washington, DC. In addition, the public was encouraged to provide comments via mail, e-mail, fax, and the Internet.

A neutral facilitator conducted the meetings to direct and clarify discussions and comments. Court reporters were also present to provide a verbatim transcript of the proceedings and record any formal comments. All scoping meeting comments, along with those received by mail or Internet during the public scoping comment period were considered by DOE in preparing this EIS. A summary of the comments received during the public scoping process, as well as DOE's consideration of these comments, is provided in Appendix E of this EIS.

1.5.1 Summary of Major Comments Received

Nearly 1,600 comments were received from individuals, interested groups, and Federal, state, and local officials during the public scoping period, including approximately 480 oral comments made during the public meetings. The remainder of the comments (1,106) was submitted at the public meetings in written form, or submitted via U.S. mail, e-mail, or fax, over the entire scoping period. Some commentors who spoke at the public meetings also prepared written statements that were later submitted during or after the meetings. In this instance, each comment provided by an individual commentor in both oral and written form was counted as a single comment.

Many of the oral and written comments questioned the need for the MPF. In particular, commentors questioned why the facility was needed since the NOI stated that no problems that would require pit replacements had been found to date. Commentors also quoted several previous DOE documents and DOE and other government officials who stated that both the nuclear and nonnuclear parts of pits in the stockpile were stable and reliable into the foreseeable future.

Other commentors cited a number of studies done by both DOE and independent researchers that demonstrated the stability of plutonium, a main component of a pit, over time; thus commentors felt that until conclusive evidence on pit aging is established, a MPF is not necessary.

Several commentors dismissed the need for the Proposed Action by stating that the PF-4, the current interim production plutonium facility at LANL, analyzed in the 1996 *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996c) for production of up to 80 ppy, already met the needs of pit refurbishment for the nuclear stockpile. Many commentors also noted that the NOI statement that "…DOE has been without the capability to produce plutonium pits…" is alarmist and false, considering the PF-4 capability.

Many commentors raised the issue of international treaties and decisions, particularly the Nuclear Nonproliferation Treaty, the Strategic Offensive Nuclear Reduction Treaty (Moscow Treaty), the Comprehensive Test Ban Treaty, and International Court of Justice Decision, July 1996 opinion, questioning whether a MPF would be consistent with international law. Commentors specifically stated that since the United States had agreed, under the Moscow Treaty, to reduce its number of operationally deployed strategic nuclear weapons to approximately 1,700-2,200, the PF-4 was more than sufficient to meet pit refurbishment needs; thus a MPF would not be necessary. Furthermore, commentors wanted clarity on why "agility," defined in the NOI as the ability to change and expand pit production types and plutonium pit designs simultaneously, was necessary at all considering the United States had committed, under the Moscow Treaty, to reduce its number of weapons.

Other issues raised regarding need included questions on why the several thousand pits in reserve at Pantex could not be used to replace any potentially deteriorating pits in the active nuclear stockpile. Others questioned why a MPF was necessary at all since DOE had created the Stockpile Stewardship Program to monitor the nuclear stockpile. They went on to question that if a MPF were built, why would it be necessary to have both the Stockpile Stewardship Program and a MPF.

A significant number of commentors also expressed concern about the costs associated with building a MPF. Commentors wanted to see the full costs associated with each phase of a MPF: design, construction, operation, transportation of materials, waste handling and final disposition of waste, security, decommissioning, destruction and return of land to its original condition.

Several commentors expressed concern about environmental, safety, and health risks associated with a MPF, particularly the transportation of pit materials and waste across the Nation's highways. DOE representatives were urged to thoroughly evaluate the potential consequences of the Proposed Action on local wildlife, water resources, air quality, the potential for accidents and their consequences, and the health and safety of residents near a prospective site and along transportation routes. Commentors suggested that the EIS quantify all radionuclide and chemical emissions associated with the MPF Alternative. Many were concerned that a MPF would not avoid the waste and contamination problems of the old pit facility at the Rocky Flats Plant, which ceased operations in 1989.

Many commentors also expressed concern about the safety and security of a MPF from terrorist actions both from on the ground and from the sky and wanted to know what measures DOE would implement to prevent such actions.

Many commentors expressed support for the No Action Alternative. More than 70 of the comments received were part of a write-in postcard campaign objecting to nuclear weapons. Other commentors expressed favor or opposition to the MPF Alternative, reasons for which included security, cost, and workforce advantage. A number of commentors expressed support for a MPF. Major issues identified through the scoping period are addressed in this EIS by analyses in the following areas:

- Land resources, including land use and visual resources
- Site infrastructure
- Air quality and acoustics
- Water resources, including surface water and groundwater
- Geology and soils
- Biotic resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species

- Cultural and paleontological resources, including prehistoric resources, historic resources, and Native American resources
- Socioeconomics, including employment and local economy, population, housing, community or local government public finances, and local transportation
- Radiological and hazardous chemical impacts during normal operations and accidents
- Waste management
- Transportation of nuclear materials

In addition to analyses in these areas, the EIS also addresses unavoidable impacts and irreversible and/or irretrievable commitment of resources, and impacts of long-term production. A complete listing of the comments received, as well as how each specific comment was considered in the analysis of this document, is also included in Appendix E.

1.6 ORGANIZATION OF THIS ENVIRONMENTAL IMPACT STATEMENT

This EIS consists of two volumes. Volume I contains the main analyses, while Volume II contains technical appendixes that support the analyses in Volume I, along with additional project information. An Executive Summary is available as a separate publication. Volume I contains 11 chapters, which include the following information:

Chapter 1—Introduction: MPF EIS background and the environmental analysis process.

Chapter 2—Purpose and Need: Reasons why DOE needs to take action and purposes to be achieved.

Chapter 3—Proposed Action and Alternatives: The way DOE proposes to meet the specified need and achieve the objectives. This chapter also includes a summary comparison of the potential environmental impacts of the EIS alternatives and identifies any preferred alternative.

Chapter 4—Affected Environment: Aspects of the environment that might be affected by the EIS alternatives.

Chapter 5—Environmental Impacts: Analyses of the potential impacts on the environment. Impacts are compared to the projected environmental conditions that would be expected if no action were taken.

Chapter 6—Regulatory Requirements: Environmental, safety, and health regulations that would apply for the EIS alternatives, and agencies consulted for their expertise.

Chapters 7-11: An index; list of references; a list of preparers; a list of agencies, organizations, and persons to whom copies of this EIS were sent; and a glossary.

Volume II contains eight appendices of technical information in support of the environmental analyses presented in Volume I. These appendices contain the following information: details of the pit production process and requirements; human health; accidents; transportation; summary of scoping comments; methodology; project studies and notices; and contractor disclosure.

2.0 PURPOSE AND NEED

Chapter 2 discusses the reasons why the National Nuclear Security Administration is proposing to construct and operate a Modern Pit Facility (MPF), as well as the goals to be achieved with MPF. This chapter also discusses relevant national security policies and their relationship to MPF.

2.1 INTRODUCTION AND NEED FOR A MODERN PIT FACILITY

As explained in Section 1.1, the U.S. Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including production readiness required to maintain that stockpile. Plutonium pits are an essential component of nuclear weapons. Historically, plutonium pits for the nuclear weapons stockpile were manufactured at the DOE's Rocky Flats Plant in Colorado. At peak production, the Rocky Flats Plant produced a thousand or more pits per year (ppy). In 1989, due to environmental and safety concerns, pit production was shut down by the DOE at the Rocky Flats Plant, leaving the Nation without the capability to produce plutonium pits for the nuclear weapons stockpile. Today, the United States is the only nuclear weapons power without the capability to manufacture plutonium pits suitable for use in the nuclear weapons stockpile.[1]

Since approximately 1996, the NNSA has been establishing a small interim pit manufacturing capability at the Los Alamos National Laboratory (LANL). While this interim pit production capacity is expected to be completed in 2007, classified analyses indicate projected capacity requirements (number of pits to be produced over a period of time), and agility (ability to rapidly change from production of one pit type to another, ability to simultaneously produce multiple pit types, or the flexibility to produce pits of a new design in a timely manner) necessary for long-term support of the stockpile will require a long-term pit production capability. In particular, identification of a systemic problem associated with an existing pit type, class of pits, or aging phenomenon cannot be adequately responded to today, nor could it be with the small capability currently being established at LANL. Sections 2.1.1 and 2.1.2 discuss pit aging and assessment of the pit lifetime. Sections 2.1.3 and 2.1.4 provide a discussion of capacity and agility requirements that would be addressed by the proposed Modern Pit Facility (MPF).

2.1.1 Pit Aging as a Driver

Modern nuclear weapons have a primary which contains a central core, the "pit" (typically composed of plutonium-239). Many complex physical and chemical interactions occur during the split second that the primary operates.

However, as materials age, particularly those in nuclear weapons, they tend to change. Age-related changes that can affect a nuclear weapon's pit include changes in plutonium properties as

[1] The NNSA has demonstrated the capability to manufacture development pits at the LANL TA-55 Plutonium Facility.

impurities build up inside the material due to radioactive decay, and corrosion along interfaces, joints, and welds. The reliability of the U.S. nuclear weapons stockpile requires that pits will operate as designed.

Although the U.S. nuclear weapons stockpile is presently safe and reliable, these nuclear weapons are aging. The average age of the stockpile is currently about 19 years, and many weapons have exceeded their original design life. In the past, individual weapons in the stockpile were replaced by new-design or upgraded weapons before they approached the end of their design life. However, because the United States has not produced any new nuclear weapons since 1989, some weapons are remaining in the stockpile much longer than previously. This may create issues about the performance capability of stockpile weapons because of uncertainties in the effects of pit aging past the design life. Planning and design of a MPF is a prudent risk management approach to assure readiness to support the stockpile.

2.1.2 Assessment of the Pit Lifetime

The size and scope of a MPF is partly dependant on the age at which existing pits in the U.S. Stockpile must be replaced in order to ensure that each system can continue to meet the specified military characteristics. To date, only minor age-induced changes have been observed and there is no direct evidence that these affect pit performance, reliability, and safety. The response of each system to potential changes is specific to each particular design. The current estimate of the minimum age for replacement of pits is between 45 and 60 years. This is based on observations of pit and plutonium aging taken from pits up to 42 years old and conservative extrapolation of this data combined with system-specific design sensitivity analysis. Additional data and analysis coupled with further design sensitivity studies are needed to refine our estimates of minimum lifetimes for each system. It is possible these studies may show that certain systems exhibit lifetimes shorter than the stated 45 years or longer than 60. In the most conservative case that lifetimes are found to be less than 45 years of age, mitigation methods currently exist to extend these lifetimes to a 45-year minimum. The minimum lifetime assessment will be updated at the end of FY03 and again at the end of FY06 when more data and analyses are available. The age for replacement may vary from weapons system to weapons system depending on details of design and application.

The approach used to address the aging of pits starts with an identification of the key plutonium properties required to ensure safe and reliable weapon function. Knowledgeable design physicists and engineers—who use the information in computer simulations as part of the certification process—select the key properties. Next, materials scientists and chemists identify the aging mechanisms that could potentially alter these properties over time and develop models to help predict the changes. Finally, by combining data acquired through testing and evaluation, the material models for aging, and simulations of the system performance, an estimate of the pit life can be made. In addition, the program is also aimed at quantifying the margins and uncertainties associated with our understanding of aging in order to increase our confidence in the lifetime assessment.

Many of the important properties that affect performance have been measured on pits of varying age and/or on samples extracted from these pits. NNSA has had a surveillance program for several decades that includes destructive and nondestructive examinations. Over the past five years, this has been supplemented by examination of a large number of older pits of age up to 42 years. Over 1000 pits have been non-destructively examined, about 300 have been destructively examined and about 50 older pits have been subjected to special aging assessments. Each pit component has been assessed with the most focus placed on the plutonium.

The life limiting mechanisms of plutonium aging are understood to result from self-irradiation. Plutonium radioactively decays slowly to form uranium and helium, and in the process of this decomposition, can cause local disruption to the material structure. All but 10 percent of the damage is healed almost immediately and almost all of the remaining 10 percent forms stable defect structures called dislocations very soon thereafter. Of primary concern is the accumulation of helium within the material; how the helium build-up changes with time, and how it affects the plutonium properties—in particular the plutonium density. It is apparent from the evaluations conducted on samples from stockpile pits and follow-on modeling of the damage mechanisms that plutonium is aging very slowly. Pit designers are performing design sensitivity assessments to determine the extent to which performance may change with these properties. Nonetheless, at some age, the properties will change sufficiently so that replacement will be prudent.

While the pit aging assessment has so far been based on examination of old pits, the assessments to be completed at the end of FY06 include an evaluation of accelerated aging alloys. These alloys have been fabricated by substituting about 7.5 percent of the plutonium-239 with plutonium-238. This substitution accelerates the self-irradiation process because the decomposition of plutonium-238 into uranium and helium is faster than that of plutonium-239. If these alloys can be validated as sufficiently similar to plutonium alloys used in actual pits, then data from these alloys will be used in the updated lifetime assessment along with the data and analyses from old pits. In addition, new destructive and non-destructive examination tools have been developed and deployed in the NNSA surveillance program to better assure performance, safety, and reliability. The data from these examinations will also be used for the updated lifetime estimates.

During the public scoping period, some commentors questioned whether plutonium pits degrade over time. Many cited an article written by Raymond Jeanloz that appeared in *Physics Today* in December 2000, in which Professor Jeanloz concluded that, “Plutonium exhibits good crystalline order even after decades of aging.” Professor Jeanloz suggested this as evidence that phase stability was not a likely concern. Unfortunately, recent local-structure measurements by the weapons laboratories have demonstrated the immense complexity of local atomic arrangements in the crystalline plutonium lattice and increased delta-phase stability with aging cannot be assumed. Although measurements of naturally aged plutonium have shown macroscopic delta-phase stability over time, NNSA is examining the local structure picture carefully in the accelerated aging program to assure that the 45-60 year pit lifetime remains valid.

NNSA has made substantial progress in the past few years in achieving a fundamental understanding of age-related changes in plutonium. Further theoretical assessments, modeling, and experiments will allow for a more precise evaluation of the minimum age for pits from each system, and will allow for an assessment of the margins and uncertainties of this minimum age. NNSA is encouraged that measurements to date have not shown any significant degradation of pits. The changes observed have been quite small and the modeling has provided further confidence that the plutonium is aging at a slow pace—giving both LANL and Lawrence

Livermore National Laboratory (LLNL) investigators reasonable confidence in the minimum lifetime estimate of 45-60 years. However, further system-specific assessment is required. This range may be modified, including a finding that some systems have a lifetime shorter than 45 years and others a lifetime greater than 60 years, based on careful study of subtle changes in plutonium properties. In this event, mitigation methods are available to extend lifetimes in these systems to a 45-year minimum. Further experiments, modeling, and design sensitivity calculations on all weapon systems are required to gain greater confidence and reduce uncertainties in our estimates. A report entitled *Plutonium Aging: Implications for Pit Lifetimes*, prepared by LANL and LLNL, is included in Appendix G.

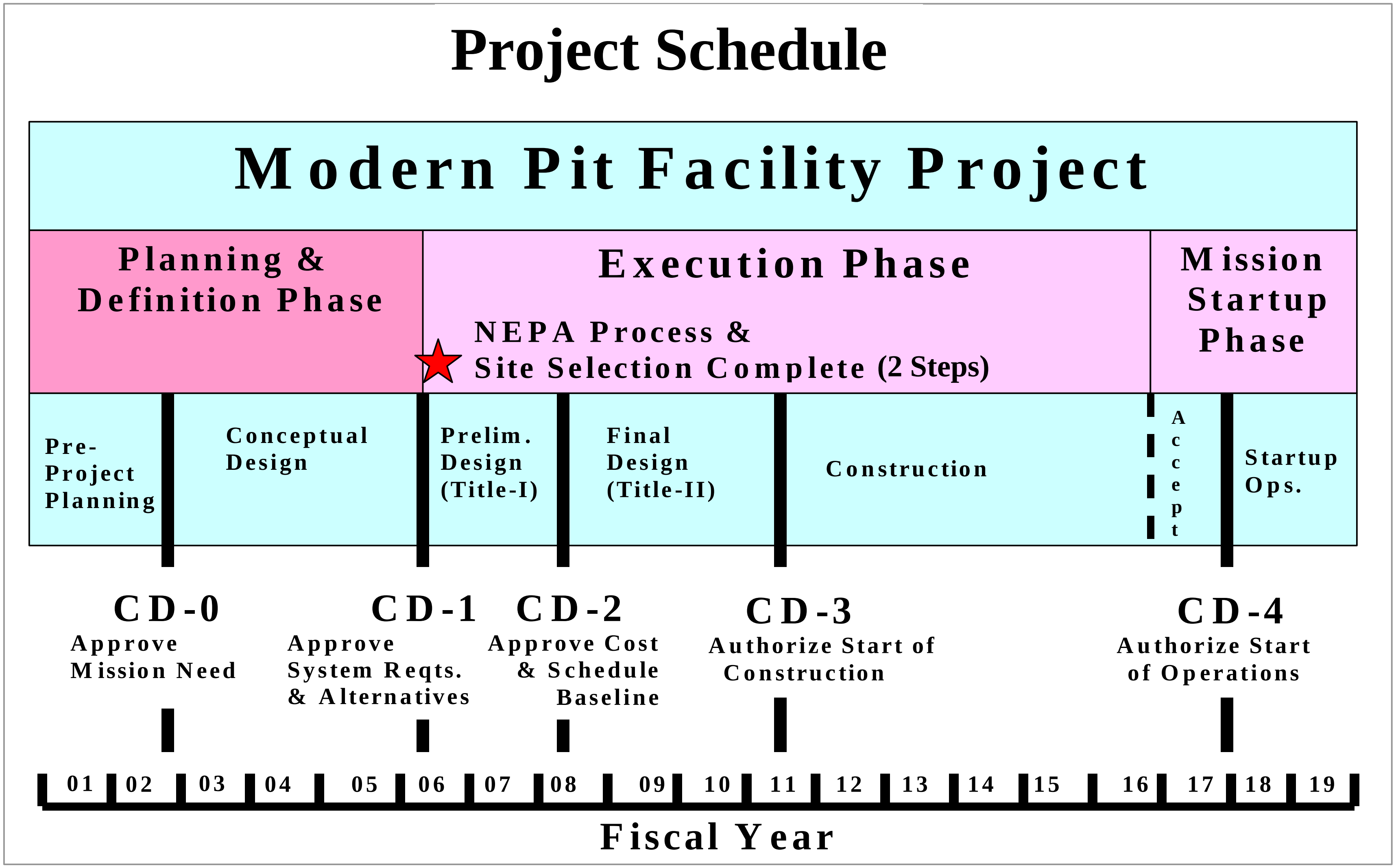
2.1.3 Capacity as a Driver

Most of the pits in the enduring stockpile were produced in the mid-to-late 1970s and 1980s, and no pits have been produced since 1989. In approximately 2020, some pits in the enduring stockpile will be approaching the 45-year pit lifetime. Given the fact that many types of pits in the enduring stockpile may reach their end-of-life (EOL) at about the same time (see Section 2.1.4 below), prudent risk management requires that NNSA initiate action now to ensure that appropriate pit production capacity is available when needed. As shown on Figure 2.1.3–1, it will take approximately 17 years to design and construct a MPF before full-scale production can begin. Consequently, in order for a MPF to be in production by approximately 2020, planning for such a facility must begin now.

It should also be noted that the size and composition of the enduring stockpile are also uncertain. In classified analyses, the NNSA has considered possible futures in which the stockpile size could be reduced to 1,000 total weapons or in which it could be as large as required to meet Nuclear Posture Review (NPR) requirements. Although the precise future capacity requirements are not known with certainty, enough clarity has been obtained through these ongoing classified studies (which are part of the classified appendix to this MPF EIS) that NNSA can identify a range of pit production capacity requirements that form the basis of initial MPF alternative evaluations during the conceptual design phase. The classified studies examined capacity requirements that would result from a wide range of enduring stockpile sizes and compositions, pit lifetimes, emergency production needs (referred to as “contingency” requirements), facility full-production start dates, and production operating practices, e.g., single versus multiple shifts.

Pit capacity requirements must also account for the need for additional pits, e.g., logistics spares and surveillance units. As a result of this requirement, the number of pits that must be available to support a specific weapon system will exceed the number of deployed strategic weapons and will vary by pit type.

Contingency production requirements are also an important driver for the need for a MPF. Contingency production, which is the ability to produce a substantial quantity of pits on short notice, is distinct from the capacity needed to replace pits destroyed for surveillance or other reasons (such as for production quality assurance or other experiments). The capacity of a MPF needs to support both scheduled stockpile pit replacement at EOL and any “unexpected” short-



Source: NNSA 2002.

Figure 2.1.3–1. Modern Pit Facility Project Schedule

term production. Such short-term "contingency" production may be required for reliability replacement (replacement of pits to address, for example, a design, production, or aging flaw identified in surveillance), or for unexpected stockpile augmentation (such as the production of new weapons, if required by national security needs).

In all cases, and in all combinations with other capacity drivers, the interim production capacity being established at LANL will be inadequate to maintain these projected stockpiles. The required production capacity is a function of pit lifetime, stockpile size, and start date of full-scale production. To account for these variables, this MPF EIS evaluates a pit production capacity between 125-450 ppy for full-scale production beginning in approximately 2020.

2.1.4 Agility as a Driver

A critical element of production readiness is the agility (the ability to change rapidly from the production of one pit type to another, or to simultaneously produce different pit types) of the production line. Pits in the current enduring stockpile were produced over a relatively short period of time and can therefore be expected to reach their respective EOLs at about the same time, as well. Thus, any strategy to replace the enduring stockpile pits before they reach their EOL must address both the production rate for a particular pit type (the capacity driver discussed in Section 2.1.1), and the ability to produce all necessary pit types in a relatively short period of time. For this reason, agility is an essential requirement for a MPF.

Contingency production also requires agility. If contingency production is ever needed, the response time will likely be driven by either a reliability problem that requires prompt response, or another type of emergency that must be addressed quickly. Thus, changeover from production of one pit type to another will have to be demonstrated for both replacements of pits at EOL (a process that will allow for planning and scheduled activities in advance of the need date), as well as for startup of contingency production with little notice (and therefore little planning time).

2.2 PURPOSES TO BE ACHIEVED BY A MODERN PIT FACILITY

If constructed and operated, a MPF would address a critical national security issue by providing sufficient capability to maintain, long-term, the nuclear deterrent that is a cornerstone of U.S. national security policy. A MPF would provide the necessary pit production capacity and agility that cannot be met by pit production capabilities at LANL.

As explained in Section 1.4, this EIS and *National Environmental Policy Act* (NEPA) process will support a Record of Decision (ROD) by the Secretary of Energy on: (1) whether to proceed with a MPF; and (2) if so, where to locate the MPF. A siting decision would enable NNSA to better focus detailed design activities and to improve the efficiency and cost-effectiveness of pre-construction activities. If the Secretary decides to proceed with a MPF, a tiered, project-specific EIS would be prepared after the MPF EIS ROD. That tiered EIS, which would utilize detailed design information to evaluate site-specific location alternatives in the vicinity of the host site picked in the MPF EIS ROD, would ultimately support a ROD for construction and operation of a MPF.

2.3 NATIONAL SECURITY POLICY CONSIDERATIONS

There are several principal national security policy overlays and related treaties that are potentially relevant to the proposal to construct and operate a MPF, such as: the NPR; the Nuclear Weapons Stockpile Memorandum (NWSM) and the corresponding Nuclear Weapons Stockpile Plan (NWSP); the Nuclear Nonproliferation Treaty (NPT), and the Comprehensive Test Ban Treaty. Each of these is discussed below.

2.3.1 Nuclear Posture Review

In 2001, Congress required the Department of Defense, in consultation with DOE, to conduct a comprehensive review of the nuclear posture of the United States for the next 5-10 years. The resulting classified report to Congress, entitled the *Nuclear Posture Review*, addresses the following elements:

- The role of nuclear forces in United States military strategy, planning, and programming
- The policy requirements and objectives for the United States to maintain a safe, reliable, and credible nuclear deterrence posture
- The relationship among the U.S. nuclear deterrence policy, targeting strategy, and arms control objectives
- The levels and composition of the nuclear delivery systems that will be required for implementing the U.S. national and military strategy, including any plans for replacing or modifying existing systems
- The nuclear weapons complex that will be required for implementing the U.S. national and military strategy, including any plans to modernize or modify the complex
- The active and inactive nuclear weapons stockpile that will be required for implementing the U.S. national and military strategy, including any plans for replacing or modifying warheads

With respect to the Proposed Action in this EIS, the NPR confirms that a MPF production facility will be required for large-scale replacement of existing plutonium components and any production of new designs. The NPR also recommends that the DOE/NNSA "accelerate preliminary design work on a modern pit manufacturing facility so that production capacity can be brought online when needed."

2.3.2 Nuclear Weapons Stockpile Memorandum and Nuclear Weapons Stockpile Plan

Although the NWSP and NWSM are classified documents, their effect in shaping the MPF EIS can be explained in an unclassified context. As explained in Chapter 1 (see Section 1.1.3), the NWSP specifies the types and quantities of nuclear weapons required, and sets limits on the size and nature of stockpile changes that can be made without additional approval by the President. The NWSM, which is jointly signed by the Secretaries of Defense and Energy, includes the

NWSP and a long-range planning assessment. As such, the NWSM is the basis for NNSA stockpile support planning. The NWSP and NWSM are highly dependent upon national security objectives determined by the President. In this regard, the United States has committed to reduce the number of operationally deployed strategic nuclear weapons to 1,700-2,200 in 2012.

2.3.3 Nuclear Nonproliferation Treaty

The NPT was ratified by the U.S. Senate in 1969 and officially entered into force as a Treaty of the United States in 1970. Today, the United States continues to view the NPT as the bedrock of the global effort to prevent the spread of nuclear weapons and to reduce nuclear weapons stockpiles. Article VI of the NPT obligates the parties "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." The United States has taken this obligation seriously and has reduced its nuclear weapons stockpile. Some examples are the 1987 Treaty on Intermediate Range Nuclear Forces, which eliminated an entire class of nuclear weapon systems; and the 1991 Presidential Nuclear Initiative, which led to the withdrawal and destruction of thousands of U.S. nonstrategic nuclear weapons. U.S. and Russian cooperation throughout the 1990s has led to continued reductions in nuclear weapons and the withdrawal of hundreds of tons of fissile material from defense stockpiles. The 1991 Strategic Arms Reduction Treaty led to significant reductions in the number of deployed strategic nuclear warheads. In the future, the United States will require far fewer nuclear weapons. Accordingly, President Bush has decided that the United States will reduce its operationally deployed strategic nuclear weapons to a level between 1,700 and 2,200 over the next decade.

It must be noted that the NPT does not provide any time period for achieving the ultimate goal of nuclear disarmament nor does it preclude the maintenance of nuclear weapons until their disposition. For this MPF EIS, speculation on the terms and conditions of a "zero level" U.S. stockpile, as some have suggested during the scoping meetings, goes beyond the bounds of the reasonably foreseeable future consistent with the NPR. The Proposed Action in this EIS, which would enable NNSA to maintain the reliability of the enduring stockpile until the ultimate goals of the NPT are attained, is consistent with the NPT.

2.3.4 Comprehensive Test Ban Treaty

The Comprehensive Test Ban Treaty, which bans all nuclear explosions for civilian or military purposes, was signed by the United States on September 24, 1996, but has never been ratified by the U.S. Senate. Nonetheless, the United States has been observing a moratorium on nuclear testing since 1992, and the NPR strategy discussed in Section 2.3.1 reflects this policy. The Proposed Action in this EIS would be consistent with a continuing U.S. moratorium or a Comprehensive Test Ban Treaty.

3.0 ALTERNATIVES

Chapter 3 begins with a description of the pit production operations and requirements of the proposed Modern Pit Facility. It includes a description of the reasonable alternatives and the planning assumptions and basis for the environmental impact statement analyses. The alternatives considered and subsequently eliminated from detailed evaluation also are discussed. The chapter concludes with a summary comparison of the environmental impacts associated with each of the alternatives and identifies the U.S. Department of Energy's Preferred Alternative.

3.1 PIT PRODUCTION OPERATIONS AND REQUIREMENTS

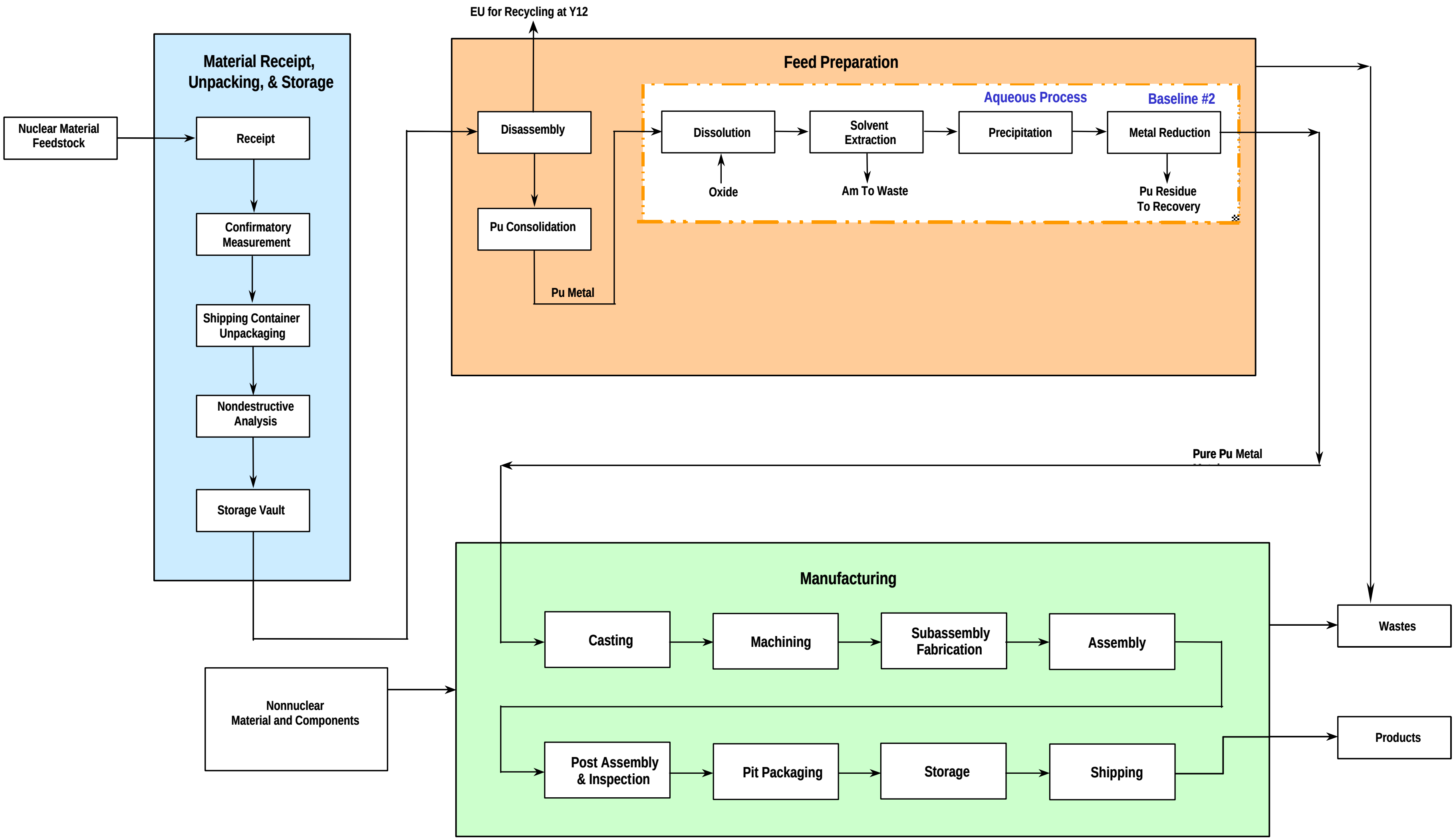
This Environmental Impact Statement (EIS) analyzes the impacts from the construction and operation of a new facility, referred to as a Modern Pit Facility (MPF), to produce plutonium pits for nuclear weapons. In addition to the construction of a totally new facility, an option to upgrade the existing Technical Area (TA)-55 Plutonium Facility, Building 4 (PF-4) at the Los Alamos National Laboratory (LANL) to increase its output is analyzed as well as the No Action Alternative. This section discusses the overall pit production process, and lists the facility requirements necessary to accommodate this process. The MPF is in a conceptual design stage.

3.1.1 Pit Production Process

The following discussion is a brief summary of the pit production process that would be accomplished in a MPF. A more detailed discussion is contained in Appendix A. The overall process is depicted in Figure 3.1.1–1 which shows three main areas: Material Receipt, Unpacking, & Storage; Feed Preparation; and Manufacturing.

3.1.1.1 Material Receipt, Unpacking, and Storage

Plutonium feedstock material would be delivered from offsite sources in the U.S. Department of Energy (DOE)/Department of Transportation (DOT) approved shipping containers. The shipping containers would be held in Cargo Restraint Transporters (CRT) and hauled by Safe Secure Trailers (SST) or Safeguards Transporters (SGT). The bulk of the feedstock material would be in the form of pits from old weapons to be recycled with small amounts of plutonium metals from LANL and SRS. The CRTs would be unloaded from the truck and the shipping packages unpacked from the CRT. Each shipment would be measured to confirm the plutonium content, entered into the facility's Material Control & Accountability (MC&A) database, and placed into temporary storage. The shipping packages would be later removed from storage and opened to remove the inner containment vessel. Containment vessels with the feedstock material would then be accountability measured and transferred to the Receipt Storage Vault pending transfer to the Feed Preparation Area.



Am = Americium.
EU = Enriched Uranium.
Pu = Plutonium.
Source: Modified from NNSA 2002.

Figure 3.1.1–1. Modern Pit Facility Flow Process

3.1.1.2 Feed Preparation

The containers would then be transferred through a secure transfer corridor to an adjacent Feed Preparation Area where plutonium metal is prepared for manufacturing. For pits to be recycled, mechanical disassembly involves cutting the pit in half and removing all non-plutonium components. Notable among these non-plutonium components is enriched uranium which would be decontaminated and then shipped to the Y-12 National Security Complex for recycling. All of the other disassembled components would be decontaminated to the maximum extent possible and then disposed of as either low level waste (LLW) or transuranic (TRU) waste as appropriate.

There are two baseline processes being evaluated for the purification of the plutonium metal. One baseline relies more heavily on aqueous chemistry (aqueous process) and the other on pyrochemical reactions (pyrochemical process). The primary difference between the two baselines is that the aqueous process does not employ chloride containing aqueous solutions, which means conventional stainless steels can readily be used to contain all of its processes. On the other hand the pyrochemical process requires specialized materials to contain the corrosive chloride bearing solutions that it employs.

The primary process evaluated in this EIS is the aqueous process. This is a well-known process, which has been successfully used at DOE sites for many years. It is comparatively simple and experiences few, but well controlled corrosion problems. However, it is not as space efficient and does not produce as pure a product metal as the pyrochemical process. This lower purity requires more complete processing and historically the aqueous process produces significantly more waste than the pyrochemical process. This provides a bounding analysis of the waste impact from a MPF.

The pyrochemical process is more complex than the aqueous process, employing seven versus four major processing steps. However, this can be done in less space with more processing flexibility. It also produces very pure metal and a lower volume of waste. The purity of metal allows the pyrochemical process to have the option of only partially processing metallic plutonium to obtain adequate production purity. Although it requires special materials of construction to contain the corrosive chloride solutions it appears to have the greatest potential for improvement based on results from ongoing technology development projects. The pyrochemical process has been used for many years at LANL.

The pyrochemical process is being investigated because it has the potential to be environmentally more benign, thus having less environmental impact than the aqueous process. The impacts from both of these processes will therefore be bounded in this EIS. As the design of a MPF develops and a final purification method is chosen, the site-specific tiered EIS will evaluate the impact of the actual process to be used.

3.1.1.3 Manufacturing

The plutonium metal resulting from the purification process would be transferred to the manufacturing area where it would be melted and cast into required shapes in a foundry operation. These castings would be machined to proper dimensions, combined with other non-plutonium parts, and assembled into pits. New pits would be inspected and prepared for storage and eventual shipment to Pantex. The majority of the waste from this process would be plutonium shavings that would be recycled within a MPF. Other wastes generated from the manufacturing process are included in Table 3.1.2.5–3.

3.1.2 Modern Pit Facility Requirements

Aside from the question of when a MPF would need to become operational, the question of actual design size of a MPF is next in importance. Design size would be primarily affected by both the operational lifetime of pits and the size of the stockpile. Since there is some level of uncertainty over both these issues (see Chapter 2), the final design size of a MPF has not yet been determined. These uncertainties have been evaluated in classified studies. Three levels of production are evaluated to provide a reasonable range for analysis in this MPF EIS. These are 125, 250, and 450 pits per year (ppy) in a single-shift operation. To accommodate these three production rates, this EIS analyzes three different plant sizes. Another consideration is the contingency or surge use of two-shift operations for emergencies.

3.1.2.1 Security

The majority of MPF would be located within a Perimeter Intrusion Detection and Assessment System (PIDAS). The PIDAS would be a multiple-sensor system within a 9-m (30-ft) wide zone enclosed by two fences that surround the entire Security Protection Area. In addition, there would be 6-m (20-ft) clear zones on either side of the PIDAS. There would be an Entry Control Facility (ECF) at the entrance to the Security Protection Area.

3.1.2.2 Process Buildings

A proposed concept being evaluated for a MPF divides the major plant components into three separate process buildings identified as Material Receipt, Unpacking & Storage; Feed Preparation; and Manufacturing as described in Section 3.1.1. The process buildings would be two-story reinforced concrete structures located aboveground at grade. The exterior walls and roofs would be designed to resist all credible man-made and natural phenomena hazards and comply with security requirements. The exterior walls of the first level would consist of double-reinforced concrete wall construction with loose aggregate backfill between the walls to satisfy security requirements.

The first story of each building would include plutonium processing areas, manufacturing support areas, waste handling, control rooms, and support facilities for operations personnel. The second story of each of the three process buildings would include the heating, ventilating, and air conditioning (HVAC) supply fans, exhaust fans and high-efficiency particulate air (HEPA) filters, breathing/plant/instrument air compressor rooms, electrical rooms, process support equipment rooms, and miscellaneous support space. Interior walls are typically reinforced concrete to provide personnel shielding and durability in the 50-year facility design life. Each of these processing buildings would have its own ECF, truck loading docks, operations support facility, and safe havens designed in accordance with applicable safety and security requirements. The three processing buildings would be connected with secure transfer corridors.

3.1.2.3 Support Buildings Within the Perimeter Intrusion Detection and Assessment System

The major support structures located within the PIDAS would include the Analytical Support Building and the Production Support Building. The Analytical Support Building would contain the laboratory equipment and instrumentation required to provide analytical chemistry and metallurgical support for the MPF processes, including radiological analyses. The Production Support Building would provide the capability for performing nonradiological classified work related to the development, testing, staging and troubleshooting of MPF processes and equipment during operations. A number of other smaller structures also supporting a MPF would include the standby generator buildings, fuel and liquid gas storage tanks, HVAC chiller building, cooling towers, and the HVAC exhaust stack.

3.1.2.4 Support Buildings Outside the Perimeter Intrusion Detection and Assessment System

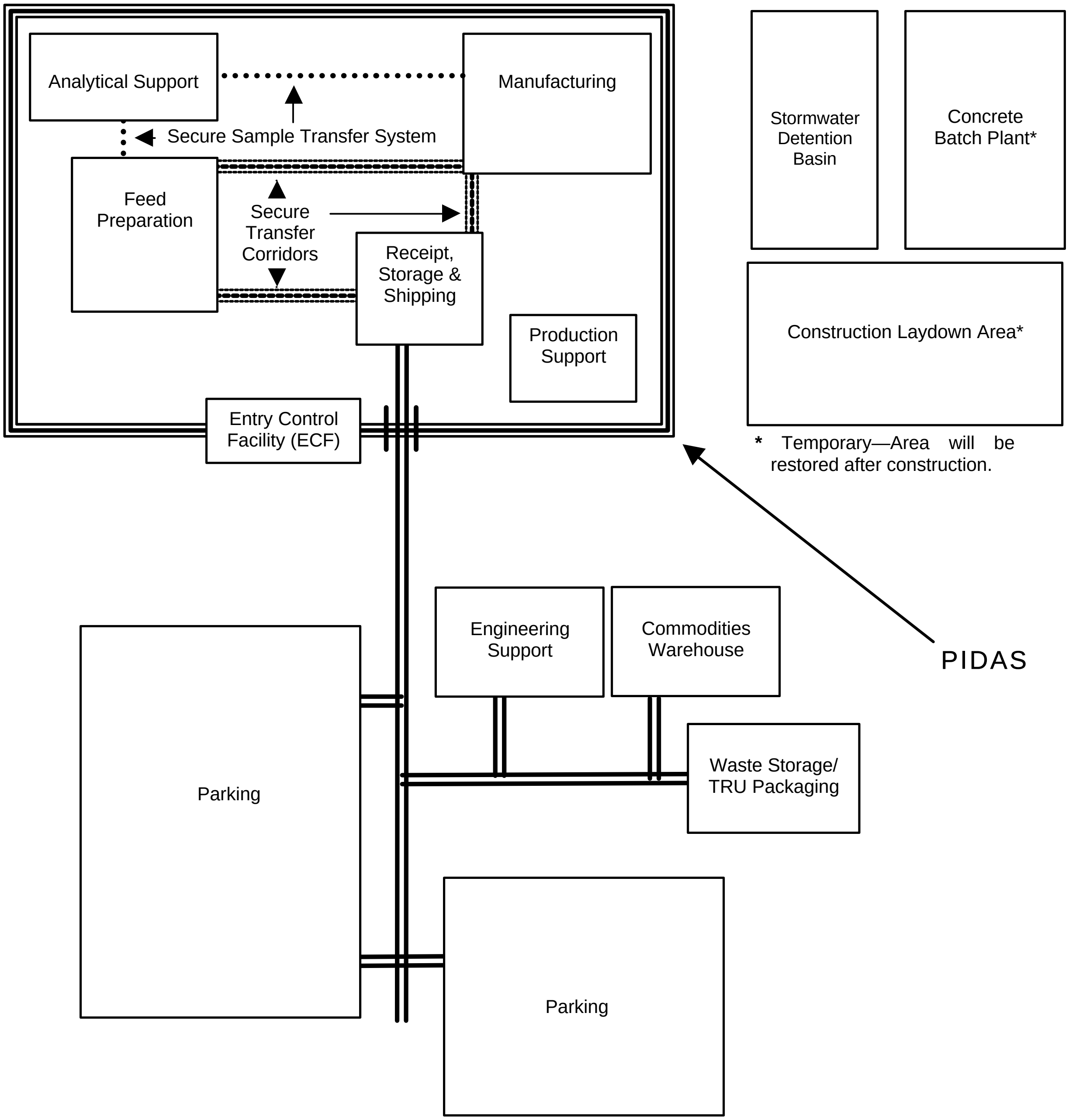
The major structures located outside the PIDAS would include the Engineering Support Building, the Commodities Warehouse, and the Waste Staging/TRU Packaging Building. This Waste Staging/TRU Packaging Building would be used for characterizing and certifying the TRU waste prior to packaging and short-term lag storage prior to shipment to the TRU waste disposal site. Parking areas and stormwater detention basins would also be located outside the PIDAS. In addition, a temporary Concrete Batch Plant and Construction Laydown Area would be required during construction. A generic layout showing the major buildings and their relationship to each other is shown in Figure 3.1.2.4–1. Table 3.1.2.4–1 shows the dimensions involved for the three different plant capacities.

The overall plant layout in the generic representation is a greenfield campus type layout, and would be adapted to each site as necessary. The actual footprint of all of the buildings, as shown in the table, is considerably less than the “developed” area from the generic layout. Thus, the actual developed site layout could be much less than that shown in Table 3.1.2.4–1, and could fit any site with enough space for buildings footprint and adequate security standoff distances.

Table 3.1.2.4–1. Dimensions for the Three Different MPF Capacities

	125 ppy	250 ppy	450 ppy
Processing Facilities Footprint (m^2)	28,600	32,800	44,900
Support Facilities Footprint (m^2)	26,000	26,200	29,900
Total Facilities Footprint (m^2)	54,600	59,000	74,800
Total Facilities Footprint (ha)	5.46	5.90	7.48
Area inside PIDAS (ha)	25.5	26.3	31.6
Area Developed During Construction (ha)	56.3	58.3	69.2
Post Construction Developed Area (ha)	44.5	46.5	55.8

Source: MPF Data 2003.



Source: Modified form MPF Data 2003.

Figure 3.1.2.4–1. Generic Layout of a Modern Pit Facility

3.1.2.5 Modern Pit Facility Construction and Operational Materials and Wastes

Tables 3.1.2.5–1 through 3.1.2.5–3 contain the construction and operational material requirements for all three plant sizes of a MPF along with the associated waste values.

Table 3.1.2.5–1. Modern Pit Facility Construction Requirements

Requirement	Total Consumption		
	125 ppy	**250 ppy**	**450 ppy**
Material/Resources			
Electrical Energy (MWh)	6,000	6,750	8,000
Peak Electricity (MWe)	3.0	3.5	4.0
Concrete (m^3)			
Total	214,000	241,000	349,000
Peak Yearly	74,000	84,000	122,000
Aggregate (m^3)			
Total	200,000	222,000	310,000
Peak Yearly	55,000	63,000	92,000
Steel (metric tons)			
Total	36,400	40,200	56,000
Peak Yearly	9,800	11,200	16,300
Liquid Fuels (Mega Liters)			
Total	16.7	10.1	13.0
Peak Yearly	2.6	2.9	3.7
Gases (m^3)			
Total	13,600	15,000	19,500
Peak Yearly	3,960	4,250	5,660
Water (Mega Liters)			
Total	71.9	79.5	110.0
Peak Yearly	21.2	23.8	33.7
Employment			
Total (Worker Years)	2,650	2,950	3,800
Peak (Workers)	770	850	1,100
Construction Period (yrs)	6	6	6

Mega Liters: 1 Mega Liter = 1 million liters.
Source: MPF Data 2003.

Table 3.1.2.5–2. Modern Pit Facility Operations Annual Requirements

Resources	Plant Size		
	125 ppy	250 ppy	450 ppy
Electrical Consumption[a] (MWh)	79,800	113,750	175,600
Peak Electrical (MWe)	20.5	23.5	36.5
Diesel Fuel[b] (L)	259,650	357,150	583,500
Nitrogen[c] (m^3)	223,900	245,050	303,250
Argon[c] (m^3)	4,200	7,300	11,800
Domestic Water[d] (L)	44,875,000	61,680,400	81,619,750
Cooling Tower Make-up (L)	232,514,800	267,758,300	422,737,800
Steam[e] (Kgs)	43,717,300	50,063,300	77,562,900
Employment			
Total workers	988	1,358	1,797
Radiation workers	546	799	1,101

[a] Electrical: Based on 24 hrs/day, 365 days/yr.
[b] Diesel Fuel: Based on diesel generator testing 1 hr/week
[c] Nitrogen and Argon: Annual consumption is based on 1 percent make-up.
[d] Domestic Water: Calculations for the annual consumption were based on 189 L/day/person, 240 days/year.
[e] Steam would require an energy source for generation. If coal were used, it would require 3,710 metric tons/yr (125 ppy), 4,245 metric tons/yr (250 ppy), 6,275 metric tons/yr (450 ppy). If natural gas were used, it would require 4,358,100 m^3/yr (125 ppy), 4,990,750 m^3/yr (250 ppy), 7,732,150 m^3/yr (450 ppy).
Source: MPF Data 2003.

Table 3.1.2.5–3. Modern Pit Facility Waste Volumes

Annual Operating Waste Type (m^3)	Plant Size		
	125 ppy	250 ppy	450 ppy
TRU Solid (including Mixed TRU)	590	740	1,130
TRU Liquid[a]	0	0	0
Mixed TRU Solid (included in TRU solid above)	200	275	420
Mixed TRU Liquid[a]	0	0	0
LLW Solid	2,070	3,300	5,030
LLW Liquid[a]	0	0	0
Mixed LLW Solid	1.5	2.0	3.5
Mixed LLW Liquid	0.2	0.4	0.7
Hazardous Solid	2.5	3.0	5.0
Hazardous Liquid	0.3	0.4	0.6
Nonhazardous Solid	5,500	5,800	6,900
Nonhazardous Liquid	45,000	61,900	81,800
Construction Waste Type (m^3)	**125 ppy**	**250 ppy**	**450 ppy**
Hazardous Liquid	4.9	5.1	5.9
Nonhazardous Solid	7,110	7,870	11,200
Nonhazardous Liquid	37,500	41,300	54,100

[a] Liquid waste in this category would be solidified at the MPF prior to disposition.
Source: MPF Data 2003.

3.1.3 Differences Between a Modern Pit Facility and the Rocky Flats Plant

A MPF would be designed and operated to minimize risk to both workers and the general public during normal operations and in the event of an accident. Benefiting from decades of experience, a MPF would employ modern processes and manufacturing technologies and would utilize an oversight structure for safety, environmental protection, and management oversight that has been established since the closure of Rocky Flats.

3.1.3.1 Building Design

Modern safety and security design standards of today require substantially different structures from the earlier pit manufacturing facilities at the Rocky Flats Plant, near Golden, Colorado. The buildings at the Rocky Flats Plant were constructed in the 1950s with metal roof sheeting covered by a built-up weather seal. In contrast, the exterior walls and roof of PF-4 (the current interim production plutonium machining facility at LANL) are constructed of reinforced concrete more than a foot thick. Internal walls at PF-4 are designed to provide multiple-hour fire barriers between wings. A MPF would be designed with similar improvements over practices at Rocky Flats.

3.1.3.2 Fire Control

Although DOE experienced accidents associated with the manufacture of plutonium pits, most of these accidents occurred in a relatively short time period (from 1966-1969) at the Rocky Flats Plant. The majority of these accidents involved plutonium metal and chips undergoing spontaneous ignition. Such events can occur when the environment they are in allows for the rapid oxidation of plutonium, often in association with a moist air environment. Efforts at Rocky Flats concentrated on the elimination of such fires. It is now recognized that potential for fire initiation cannot be totally eliminated. Although the frequency and severity of fires can be reduced through the management of combustible materials and facility design, such events are now anticipated and planned for in the structural and process design and operational procedures. Engineering monitoring systems would be activated if a fire occurs. These systems would activate controls and procedures to control, quickly suppress, and contain fires within the specific originating glovebox, minimizing the risk to workers and the general public.

Today, plutonium machining activities are conducted in gloveboxes supplied with an inert gas. Furthermore, gloveboxes are now equipped with exhaust filter systems. All working areas are separately vented with systems containing HEPA filters. These HEPA filters are fabricated of special non-flammable bonded material. Filter plenums are equipped with an automatic cooling system to reduce the temperature of the air reaching the final stages of HEPA filters. Unlike Rocky Flats, a MPF would have an automatic fire detection and suppression system designed to meet the latest National Fire Protection Association life safety codes and standards for manufacturing facilities. The design features would include multiple zones for both fire detection and suppression to assure that any fire which may occur would be isolated in small, separated areas of the facility, and thereby preclude the spread of fire to other separated areas or the entire building.

3.1.3.3 Waste Management and Material Control

A MPF will have a dedicated waste handling area capable of preparing waste for transport in accordance with established procedures and waste acceptance requirements. In addition, all waste streams to be generated by a MPF have an established disposition path for each alternative being considered. Since the MPF EIS analyzes operations over a 50-year period, it is reasonable to expect that some disposition paths may change. A MPF would utilize a stringent MC&A System to accurately account for all special nuclear material.

3.1.4 TA-55 Upgrade Facility Requirements

The TA-55 Upgrade Alternative (80 ppy) would involve expanding the current pit production capabilities of plutonium facilities in Building PF-4 up to approximately 80 ppy without expanding the size of the building. To do this, a number of plutonium processing activities that are not related to pit production or stockpile certification would be relocated to other facilities or downsized and consolidated within PF-4. Material characterization and chemical analyses would be performed at another LANL facility.

The TA-55 Upgrade Alternative differs from a MPF in several important aspects that derive from upgrading existing facilities. First, a production level of only 80 ppy is the maximum deemed feasible and is used in this analysis. Next, the MPF design life of 50 years may not be achievable by a facility that will have already operated about 40 years before achieving these increased production levels. Since equipment for feed material preparation, recovery of metal from scrap, and waste processing already exist in this building, feed preparation will use the pyrochemical process to purify material in conjunction with aqueous processing of recoverable residues.

Additionally, all production functions—Receipt and Storage, Feed Preparation, Manufacturing, and Analytical Support—will be performed within a single PIDAS at TA-55 in buildings connected by secure transfer corridors. Feed preparation and manufacturing will be performed in PF-4 and analytical support functions will be performed at another LANL facility. PF-4 will be upgraded as appropriate to perform required material receipt and storage functions.

3.1.4.1 PF-4 Alterations

Additional space for pit manufacturing would be obtained by expanding into laboratory space currently used for processing operations that are unrelated to pit manufacturing. In this option, these activities would have to be relocated to another facility or downsized/consolidated (with a subsequent reduction of capacity) and the vacated space used for pit manufacturing support. The affected activities include analytical chemistry and materials characterization (AC and MC) operations. Approximately 511 m^2 (5,500 ft^2) of floorspace would be realized by moving the AC and MC operations out of PF-4.

Modifications to the facility would include major upgrades to the residue recovery/metal feed facilities in the 400 Area of PF-4. Many of the gloveboxes in this part of the facility would have to be replaced. Replacement of these older gloveboxes would be required to ensure that the recovery/feed process operations are adequate to supply plutonium metal to the manufacturing operations. There would also be significant glovebox decontamination/decommissioning/

disposal operations as new process development and certification operations are moved into other areas of PF-4. In addition, various manufacturing equipment will be added to or replaced in the fabrication areas of PF-4 to increase capacity and reliability.

To obtain the required space in PF-4 and to expand the pit manufacturing production to greater than 20 ppy, consolidation of plutonium-238 operations and relocation of plutonium-239 oxide characterization operations within the facility would be necessary. Consolidation of plutonium-238 operations from approximately 790 m^2 (8,500 ft^2) to about 641 m^2 (6,900 ft^2) of laboratory space would reduce the capacity, but not eliminate the capability, for heat source fabrication. Additional space could be obtained by moving some plutonium-239 oxide characterization operations (214 m^2 [2,300 ft^2]) from one laboratory to the upgraded 400 Area and by acquiring space from some programs that would be completed in the 2015 to 2020 timeframe when space is needed for expanding pit production capacities.

3.1.4.2 Support Facilities

Modifications to existing facilities at TA-55 would be to accommodate additional workers employed in pit manufacturing. As the capacity of the pit fabrication operations is increased, the plant ingress/egress requirement for plutonium workers also increases. This results in the need for additional space for the increased access/egress as well as additional change rooms. New engineering support facilities containing a cold (nonradiological) laboratory, additional office space, and a warehouse for receipt and storage of nonradioactive materials and parts would have to be constructed. The cold laboratory is needed for cold process development, staging, training, and as space for uncleared workers. Office space at TA-55 is currently oversubscribed and increasing the pit fabrication capacity would require additional space.

The Radioactive Liquid Waste Treatment Facility (TA-50) and the Solid Waste Management Facility (TA-54) would be capable of processing the waste streams from PF-4 even with the enhanced fabrication mission of 80 ppy. A small glovebox decontamination/handling facility at TA-54 that is specifically designed to prepare decommissioned gloveboxes for shipment to WIPP as TRU waste or burial as low-level waste would be required. This facility is required because the modifications in this alternative would entail the removal of approximately 140 gloveboxes over the course of about 10 years. The new decontamination/handling facility would perform decontamination, size-reduction, packaging, and/or other activities necessary to satisfy the waste acceptance or burial criteria.

The construction of these new facilities would result in an addition of approximately 1.0 ha (2.5 ac) to the permanent TA-55 footprint with 2.5 ha (6.2 ac) total area disturbed during construction. The actual removal of the gloveboxes from PF-4 and decontamination/decommissioning are not included as part of the construction process, and the workers and waste resulting from these activities are not included in the construction data presented in Section 3.1.4.3. Because the removal of the approximately 140 gloveboxes would take place over a 10-year period, the requirements and wastes from the activity are included with the operational values.

3.1.4.3 TA-55 Upgrade Construction and Operational Materials and Wastes

Tables 3.1.4.3-1 through 3.1.4.3-3 contain the construction and operational material requirements and waste volumes for the TA-55 Upgrade Alternative (80 ppy).

Table 3.1.4.3–1. TA-55 Upgrade Construction Requirements

Requirement	TA-55 Upgrade (80 ppy)
Material/Resources	
Electrical Energy (MWh)	1.5
Peak Electricity (MWe)	
Concrete (m^3)	
Total	25,000
Peak Yearly	
Aggregate (m3)	
Total	In Concrete
Peak Yearly	
Steel (metric tons) including Rebar	
Total	3,500
Peak Yearly	
Liquid Fuels (Mega Liters)	
Total	0
Peak Yearly	
Material/Resources	
Gases (m^3)	
Total	3,000
Peak Yearly	
Water (Mega Liters)	
Total	0.021
Peak Yearly	
Employment	
Total (Worker Years)	430
Peak (Workers)	190
Radiation Workers	0
Construction Period (yrs)	4

Source: MPF Data 2003.

Table 3.1.4.3–2. TA-55 Upgrade Operations Annual Requirements

Requirement	TA-55 Upgrade (80 ppy)
Material/Resources	
Electrical Energy (MWh)	5,480
Peak Electricity (MWe)	10.0
Nitrogen (m^3)	
Argon (m^3)	
Diesel Fuel (Liters)	0
Domestic Water (Mega Liters)	30.2
Makeup Water (Mega Liters)	
Steam (metric tons)	
Natural Gas (m^3) for Steam	
Employment	
Total Workers	680
Radiation Workers	458

Source MPF Data 2003.

Table 3.1.4.3–3. TA-55 Upgrade Waste Volumes

Waste (m^3)	Annual Operating	Construction
TRU Waste		
Solid (includes Mixed TRU Solid)	440[a]	0
Liquid	5	0
Mixed TRU Waste		
Solid (included in TRU Solid)	2	0
Liquid	0	0
LLW		
Solid	1,430	0
Liquid	15	0
Mixed LLW		
Solid	53	0
Liquid	0	0
Hazardous		
Solid	203	0
Liquid	2	3
Nonhazardous		
Solid	552	7,500
Liquid	12,300	6,000

[a] Includes 56 m^3/yr over a 10-year period to replace gloveboxes in PF-4.
Source: MPF Data 2003.

3.2 DEVELOPMENT OF REASONABLE ALTERNATIVES AND ENVIRONMENTAL IMPACT STATEMENT SCOPE

3.2.1 Planning Assumptions and Basis for Analysis

This MPF EIS evaluates reasonable alternatives in order to decide: (1) whether to proceed with construction and operation of a MPF; and (2) if so, where to locate a MPF. Five alternatives are evaluated for a MPF: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site (NTS), Nevada; (3) the Carlsbad Site, New Mexico; (4) Savannah River Site (SRS), South Carolina; and (5) Pantex Site, Texas. For the five MPF site alternatives, the EIS evaluates the environmental impacts associated with constructing and operating a MPF to produce sufficient quantities of plutonium pits to support the U.S. nuclear stockpile. In addition, the EIS evaluates the environmental impacts associated with expanding operations at TA-55 while upgrading the existing TA-55 facilities (TA-55 Upgrade Alternative). Some of the more specific assumptions and considerations that form the basis of the analyses and impact assessments that are the subject of this EIS are presented below.

C As required by the Council on Environmental Quality (CEQ) regulations, the MPF EIS evaluates a No Action Alternative. The No Action Alternative would utilize the capabilities currently being established at LANL for interim capacity to meet the Nation's long-term needs for pit manufacturing. Under the No Action Alternative, National Nuclear Security Administration (NNSA) would not proceed with a MPF, which might limit the ability to maintain, long-term, the nuclear deterrent that is a cornerstone of U.S. national security policy. In previous *National Environmental Policy Act* (NEPA) documents (the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236 [SSM PEIS] and the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238 [LANL SWEIS]), DOE evaluated the environmental impacts associated with producing up to 50-80 ppy at LANL; however, the ROD for the LANL SWEIS limited production to 20 ppy. Thus, under the MPF EIS No Action Alternative, NNSA could produce up to 20 ppy for the foreseeable future.

C In the LANL SWEIS, DOE committed to provide appropriate NEPA review to implement manufacturing capacity beyond 20 ppy. This MPF EIS provides NEPA coverage for nominal pit production up to approximately 80 ppy at LANL TA-55 under the TA-55 Upgrade Alternative. Construction activities (primarily the addition of office space) associated with the upgrade would begin in approximately 2008 and end in approximately 2012. However, production of 80 ppy would not be possible until replacement of all gloveboxes would be completed by approximately 2018.

C If the Secretary decides to build and operate the proposed MPF, construction at one of the five site alternatives, would begin in approximately 2011, peak in 2014 and last about 6 years. Mission startup and initial operations would occur between 2017 and 2019, with full-scale production beginning in 2020. Because a MPF would be designed for a service life of at least 50 years, the EIS assesses the environmental impacts associated with the operation of a MPF for a period of 50 years, at which time the structures would undergo decontamination and decommissioning (D&D).

- The MPF is in a conceptual design stage. As such, best available design information for the analysis is contained in this EIS (see the descriptions of a MPF in Section 3.1 and Appendix A). For the purpose of the environmental impact analysis, assumptions have been used such that construction requirements and operational characteristics of a MPF would maximize the environmental impacts. Thus, the potential impacts from the implementation of any MPF final designs are expected to be less severe than those analyzed in this EIS.

- The exact size and composition of the enduring stockpile is determined on an annual basis as explained in Section 1.1.3. In the classified appendix to the MPF EIS, the NNSA has considered a range of future stockpiles. Based on current long-range planning consistent with the Nuclear Posture Review (NPR), NNSA must be capable of supporting a stockpile of approximately 1,700-2,200 strategic deployed weapons in 2012 and beyond. Classified studies have examined capacity requirements that would result from a wide range of enduring stockpile sizes and compositions, pit lifetimes, emergency production needs (referred to as "contingency" requirements), and facility full production start dates. Although the precise future capacity requirements are not known with certainty, enough clarity has been obtained through these ongoing classified studies that NNSA has identified a range of pit production capacity requirements (125-450 ppy) that form the basis of the capacity evaluations in this EIS. The EIS evaluates the impacts of a MPF designed to produce three capacities: 125 ppy, 250 ppy, and 450 ppy. A pit lifetime range of 45-60 years is assumed.

- For each of the capacities (125 ppy, 250 ppy, and 450 ppy), the EIS evaluates the environmental impacts associated with single-shift operations 5 days per week, as this represents the most likely long-term, normal operating scenario for a MPF. However, if national security requirements ever demand, a MPF could be operated in a two-shift mode to produce more pits than in the single-shift mode. Because the environmental impacts associated with single-shift production of 250 ppy would bound the impacts associated with two-shift production in a 125 ppy plant, no additional NEPA analysis would be necessary for this scenario. Likewise, because the environmental impacts associated with single-shift production of 450 ppy would bound the impacts associated with two-shift production in a 250 ppy plant, no additional analysis would be necessary for this scenario. For the 450 ppy capacity, the EIS assesses the environmental impacts of two-shift operations in a qualitative sensitivity analysis.

- This EIS does not support decisions to select a specific location at any DOE site alternative for a MPF. However, initial reference locations have been identified at each site, consistent with the environmental analysis in this EIS to evaluate the potential environmental impacts of a MPF. These reference locations were designated by the individual DOE site offices not to conflict or interfere with existing or planned future site operations. In general, undeveloped areas are used so that any potential environmental impacts would be greater than those projected for a specific location to be developed. These reference locations are defined for each site in Section 3.3.2. The characterization of the affected environment addresses the entire candidate site and the affected region surrounding the site. Each region varies by resource, but generally extends to an 80-km (50-mi) radius from the center of each site.

- Both construction and operational impacts are considered for all resources at all sites. Construction impacts are generally short-term (e.g., would occur over the 6-year construction period), while operational impacts are expected to be long-term (e.g., would occur annually over the 50-year operating period).

- Generated wastes would be managed in accordance with applicable Federal, state, and local laws, regulations, and requirements, as well as DOE/NNSA's waste management orders and pollution prevention and waste minimization policy.

- The EIS analyzes low-consequence/high-probability accidents and high-consequence/low-probability accidents. A spectrum of both types of accidents is analyzed. For radiological accidents, impacts are evaluated for both the general population residing within an 80-km (50-mi) radius (including the maximally exposed individual) and for non-involved workers in collocated facilities. The accident analyses in this EIS are based on facility conditions that are expected to exist in 2020. The core set of accident scenarios is applicable to each location alternative with adjustments to certain parameter values (e.g., leak path factors and materials at risk) to reflect site-specific features. Added to the core set of accidents are other site-specific accidents, if any, caused by natural phenomena or accidents at collocated facilities, that have the potential for initiating accidents at a MPF. The impacts of accidents analyzed for each alternative reflect and bound the impacts of all reasonably foreseeable accidents that could occur if the alternative were implemented. The plutonium Research and Development (R&D) mission and pit surveillance functions would remain at LANL and Lawrence Livermore National Laboratory (LLNL) and would be unaffected by the proposed alternatives.

- Proven technology is used as a baseline. No credit is taken for emerging technology improvements. The design goal of a MPF includes consideration of waste minimization and pollution prevention to minimize facility and equipment contamination, and to make future D&D as simple and inexpensive as possible. The EIS includes a general discussion of the environmental impacts from D&D, including a discussion of the D&D process, the types of actions associated with D&D, and the general types of impacts associated with D&D. Any discussion of specific D&D impacts are more appropriate for tiered NEPA documents, because the extent of contamination, the degree of decontamination, and the environmental impacts associated with performing D&D, cannot be known without performing a detailed study of a MPF at the appropriate time.

- Liquid TRU and LLW streams would be solidified as part of a MPF process (i.e., a MPF would not generate any liquid TRU or LLW) that requires disposition. The solidified waste forms would meet applicable waste acceptance criteria prior to leaving a MPF. Any TRU waste generated by a MPF would be treated and packaged in accordance with the WIPP Waste Acceptance Criteria and transported to WIPP or a similar type facility for disposition. The preferred alternative in the *WIPP Disposal Phase Final Supplemental Environmental Impact Statement* (SEIS) (DOE 1997b) currently includes a 35-year operating period starting in March 1999. To accommodate all projected TRU waste from MPF and other NNSA operations, DOE must ensure that either the WIPP or another similar type facility would be available for long-term disposition of TRU waste.

Section 6.5.1.5 gives additional detail relative to the WIPP. All other wastes would be managed in accordance with applicable site procedures and disposed of in accordance with decisions made in the *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* Records of Decision.

- A MPF would be capable of producing all existing pit types in the nuclear weapons stockpile, as well as any future new design pits. The environmental impacts associated with manufacturing a particular type of pit, whether an existing design pit or future new-design pit, are considered to be similar.

- The operation of a MPF would require transporting existing pits from Pantex, where more than 12,000 are presently stored, to a MPF, and transporting new pits from a MPF to Pantex where they would be assembled into weapons. In addition, small quantities of plutonium metal would be transported from LANL and SRS to a MPF location. All transportation of pits and plutonium metal is assumed to occur via the NNSA transportation fleet of SSTs over Federal and state highways to the extent practicable. The quantities of pits and other materials that would be transported to/from a MPF are provided in Appendix D.

- A modern nuclear weapon consists of many components, most of which are nonnuclear. In general, any components for pits not produced at a MPF would be produced in existing facilities and shipped to a MPF for assembly into the pit. The environmental impacts associated with producing these components have been addressed in previous NEPA documents (see specifically the *Nonnuclear Consolidation Environmental Assessment,* DOE/EA- 0792, DOE 1993).

- Because the NNSA will need a facility to manufacture beryllium components required for the MPF, this programmatic EIS assesses the environmental impacts of such manufacturing for completeness (see Section 5.7.1). Site-specific issues concerning the manufacturing of beryllium components will be addressed in future NEPA documentation, as required.

- The methodology used to assess the environmental impacts of constructing and operating a MPF is described in Appendix F.

- As explained in Section 3.3.3, the MPF EIS evaluates an upgrade to PF-4 at the TA-55 facility at LANL to increase pit production capacity. Although this TA-55 Upgrade Alternative does not meet the minimum capacity requirement of 125 ppy, it is evaluated as a “hedge” in the event of significant further reductions in the nuclear weapons stockpile size, or if future technical studies demonstrate that pit lifetimes significantly exceed 45-60 years. TA-55 is the only existing pit production facility capable of being upgraded to provide such a hedge (see Sections 3.4.3 and 3.4.4). As such, this is the only reasonable Upgrade Alternative assessed in this EIS. It is noted that this Upgrade Alternative would be timed to minimize disruption of LANL’s interim small-scale pit production activities required to meet current U.S. Department of Defense (DOD) requirements.

- The classified appendix with information relevant to this EIS has been prepared and will be considered by the decisionmaker during this NEPA process. To the extent allowable, the MPF EIS summarizes this information in an unclassified manner.

3.2.2 Development of the Environmental Impact Statement Site Alternatives

Following the approval of the Critical Decision on Mission Need (CD-0) by the Secretary of Energy on May 24, 2002, NNSA developed a site screening process to develop the reasonable site alternatives that are evaluated in this MPF EIS. The purpose of the site-screening process was twofold: (1) to identify reasonable site alternatives for the MPF EIS; and (2) to identify unsuitable site alternatives and document why these alternatives were not reasonable for the MPF EIS.

A two-step screening process was employed: first, all potential sites were evaluated against "go/no go" criteria; and second, those sites satisfying the go/no go criteria were evaluated against desired, weighted criteria. The desired criteria and weights were developed by members of the MPF project office. Federal employees from NNSA and other relevant DOE program offices then "scored" the potential sites using the desired criteria. Aggregate scores for the alternatives were then tallied, and the reasonable site alternatives were determined.

Existing, major DOE sites were considered to serve as the host location for a MPF. Non-DOE or new sites were not considered to avoid potential contamination issues at a new location that had not previously been associated with plutonium or plutonium-bearing waste operations. Many DOE sites did not satisfy the go/no-go criteria and were eliminated during the first step of the screening process. The seven sites that were evaluated through both steps of the screening process were: Idaho National Engineering and Environmental Laboratory, LANL, NTS, Pantex, SRS, Carlsbad Site, and the Y-12 National Security Complex.

The site screening analysis considered the following criteria: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA presence at the site, and infrastructure. The first two criteria were deemed to be go/no go criteria; that is, a site either passed or failed on each of these two criteria. The sites that passed the go/no go criteria were then scored against all criteria. Based upon results from the site screening analysis, the following were determined to be reasonable alternatives for a MPF: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site, Nevada; (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas. Appendix G contains a copy of the site screening study.

3.3 REASONABLE ALTERNATIVES

NNSA conducted a site-screening process (Appendix G) to assure that alternative sites meet program requirements; this process is summarized in Section 3.2.2. Based upon results from the site screening process, the following sites were determined to be reasonable alternatives for a MPF: Los Alamos Site, SRS, NTS, Pantex Site, and Carlsbad Site.

3.3.1 No Action Alternative

Consistent with the 1996 SSM PEIS ROD (61 FR 68014) and the 1999 LANL SWEIS ROD (64 FR 50797), NNSA has been re-establishing an interim pit manufacturing capability at LANL. The establishment of the interim pit production capacity is expected to be completed in 2007. As required by the CEQ NEPA Regulations (40 CFR Parts 1500-1508) and the DOE NEPA Regulations (10 CFR 1021), the MPF EIS includes a No Action Alternative. The No Action Alternative would be to maintain the interim pit production capacity at LANL PF-4 in TA-55 and not build a MPF at any site. The No Action Alternative is encompassed within the Expanded Operations Alternative listed in the LANL SWEIS, which evaluated the impact of producing 50-80 ppy at PF-4, but selected a 20 ppy level in the respective Record of Decision. There would be no additional impact on the other four sites.

3.3.2 Modern Pit Facility Alternatives

This section presents the alternatives to build a MPF at each of the five alternative sites. In addition, if a MPF is built at any of these sites, including LANL, the interim pit capability at TA-55/PF-4 would not be relied on to meet future stockpile needs. For each of the sites, a representative or reference location for a MPF at that site has been chosen for analysis purposes only. When a decision is made as to whether to proceed with a MPF, and if so, at which site to locate a MPF, a site-specific EIS process will be completed. The site-specific process will analyze reasonable locations in the vicinity of the selected site.

Each reference location was chosen based on the following factors: the site is approximately 32 hectares (ha) (80 acres [ac]) in size, does not conflict with any ongoing or planned activities, is not potentially contaminated, and is located near an existing Category I Security Area (if possible). If the selected site did not have the requisite 32 ha (80 ac) (the maximum desired area inside a PIDAS), but still had enough space to accommodate the entire facilities footprint, it was deemed adequate for analysis purposes in this EIS. The proposed reference locations provide a basis for impact studies on the site and surrounding areas, which will allow reasonable comparisons between the various sites. If a decision is made to go forward with one of the MPF alternatives, a site will be selected, and the actual MPF location will be determined in a site-specific tiered EIS.

3.3.2.1 Los Alamos Site

The Los Alamos Site MPF Alternative would involve constructing a MPF at LANL as described in Section 3.1. For analysis purposes, it is assumed that a MPF would be located on an unused location in TA-55. This is shown in Figure 3.3.2.1–1. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

3.3.2.2 Nevada Test Site

The NTS MPF Alternative would involve constructing a MPF at NTS as described in Section 3.1. For analysis purposes, it is assumed that a MPF would be located on an unused location near the Device Assembly Facility. This is shown in Figure 3.3.2.2–1. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

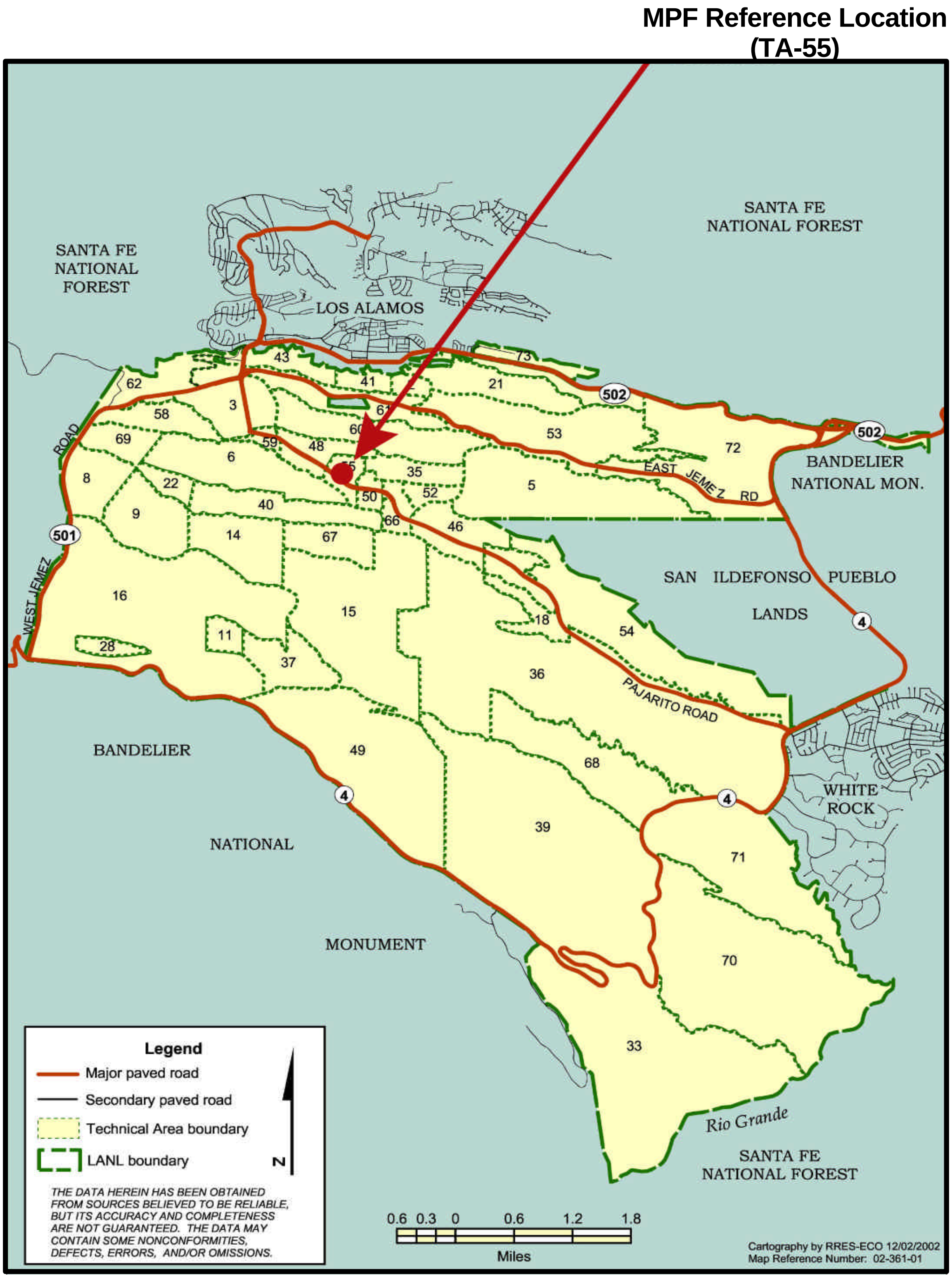


Figure 3.3.2.1–1. Los Alamos Site

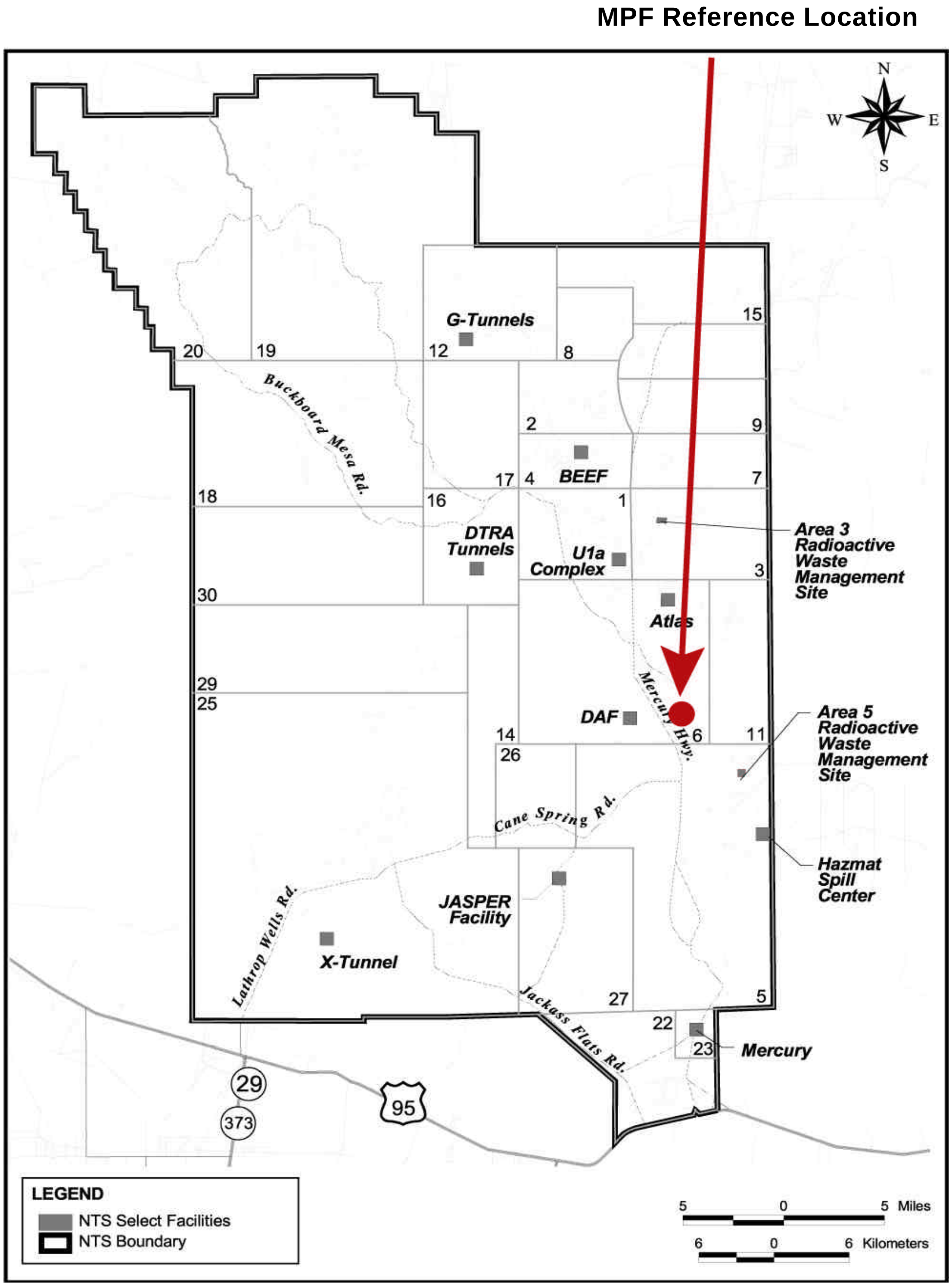


Figure 3.3.2.2–1. Nevada Test Site

3.3.2.3 Pantex Site

The Pantex Site MPF Alternative would involve constructing a MPF at Pantex as described in Section 3.1. For analysis purposes, it is assumed that a MPF would be located on an unused location in Area 11. This is shown in Figure 3.3.2.3–1. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

3.3.2.4 Savannah River Site

The SRS MPF Alternative would involve constructing a MPF at SRS as described in Section 3.1. For analysis purposes, it is assumed that a MPF would be located on an unused location southwest of the F Canyon area. This is shown in Figure 3.3.2.4–1. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

3.3.2.5 Carlsbad Site

The Carlsbad Site MPF Alternative would involve constructing a MPF at Carlsbad as described in Section 3.1. For analysis purposes, it is assumed that a MPF would be located on an unused location. This is shown in Figure 3.3.2.5–1. In addition, the interim pit production capability at LANL would not be relied on to meet future stockpile needs.

NNSA notes that legislation may be required to proceed with the construction and operation of a MPF at the Carlsbad Site either on land at the WIPP site or in the vicinity of the WIPP site.

The EPA’s current compliance certification of WIPP does not consider the potential impacts of a MPF on the long-term performance of the repository. If the Secretary were to decide to locate an MPF in the vicinity of WIPP, DOE would need to provide EPA with sufficient information for the Agency to determine whether the potential impacts of an MPF should be included in the performance assessment to ensure that they would not adversely impact the repository’s long-term performance. EPA’s consideration of an MPF’s potential impacts could result in a modification rulemaking involving the compliance certification.

3.3.3 TA-55 Upgrade Alternative

The TA-55 Upgrade Alternative (80 ppy) would involve expanding the pit production capability of PF-4 without expanding the size of the facility as described in Section 3.1 and the Summary of TA-55/PF-4 Upgrade Evaluation to Provide Long-term Pit Manufacturing Capacity contained in Appendix G. Two support facilities would also be constructed in TA-55 and one in TA-54. The interim pit production capability at LANL would be expanded to approximately 80 ppy through the upgrade process.

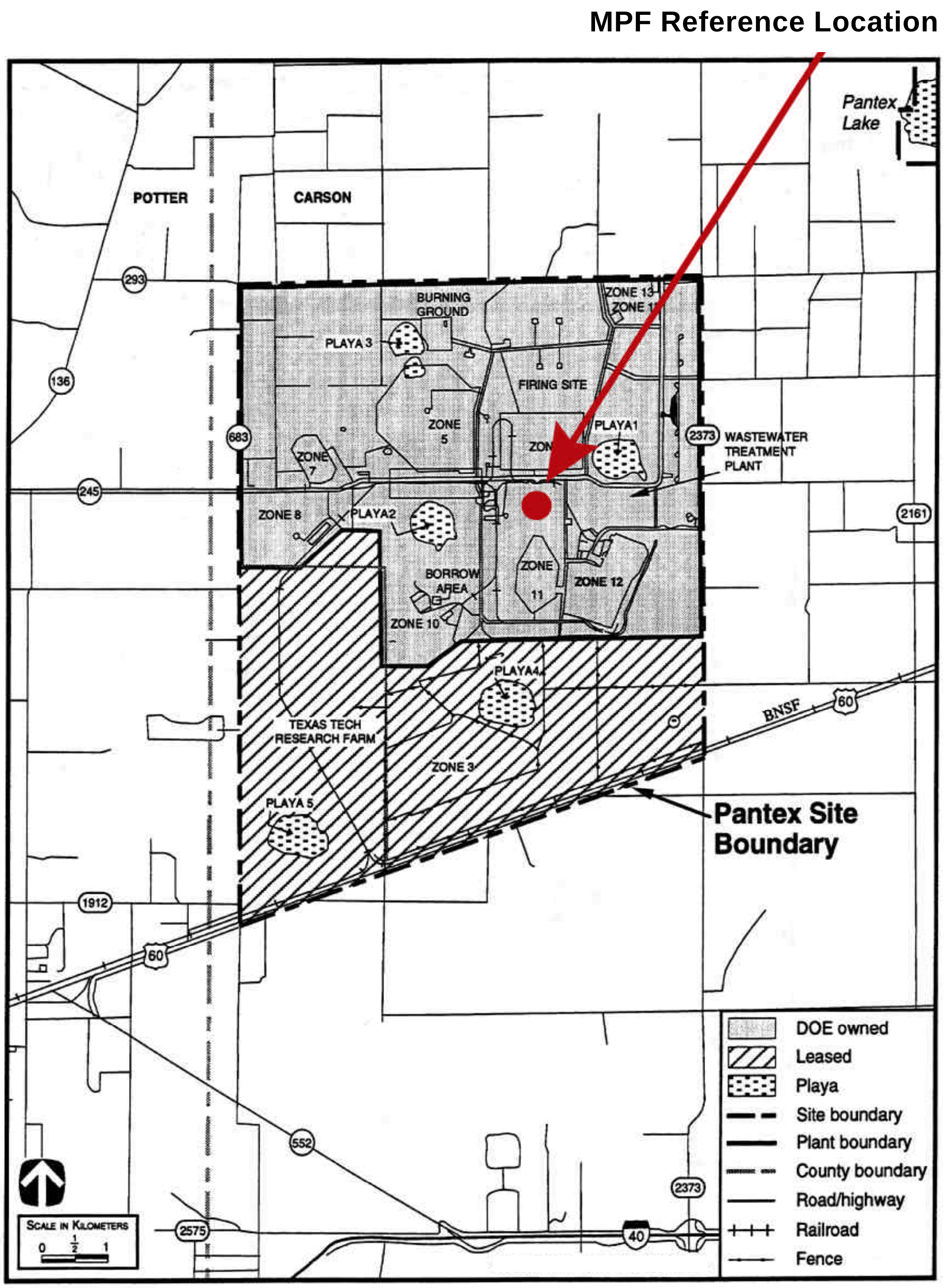


Figure 3.3.2.3–1. Pantex Site

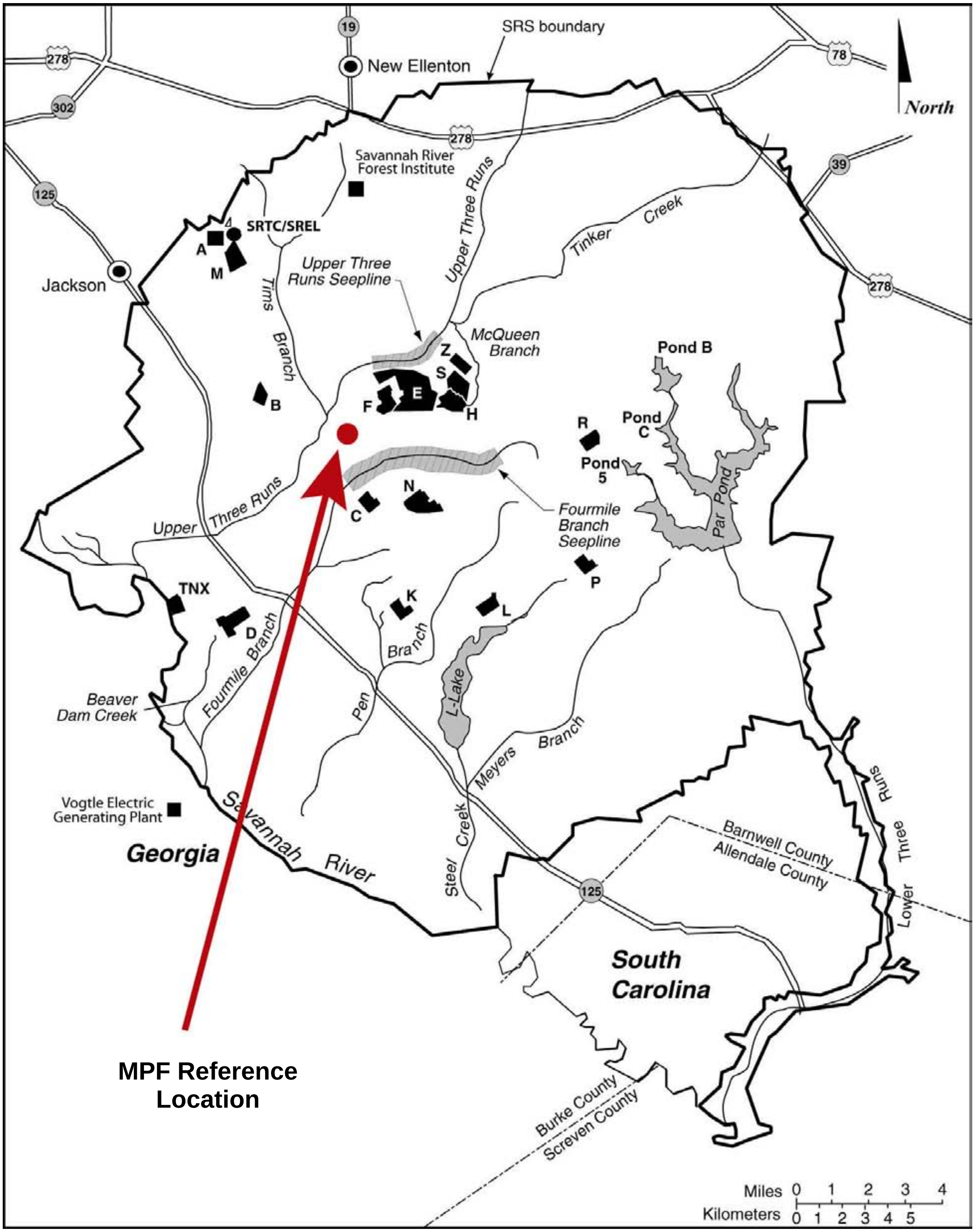


Figure 3.3.2.4–1. Savannah River Site

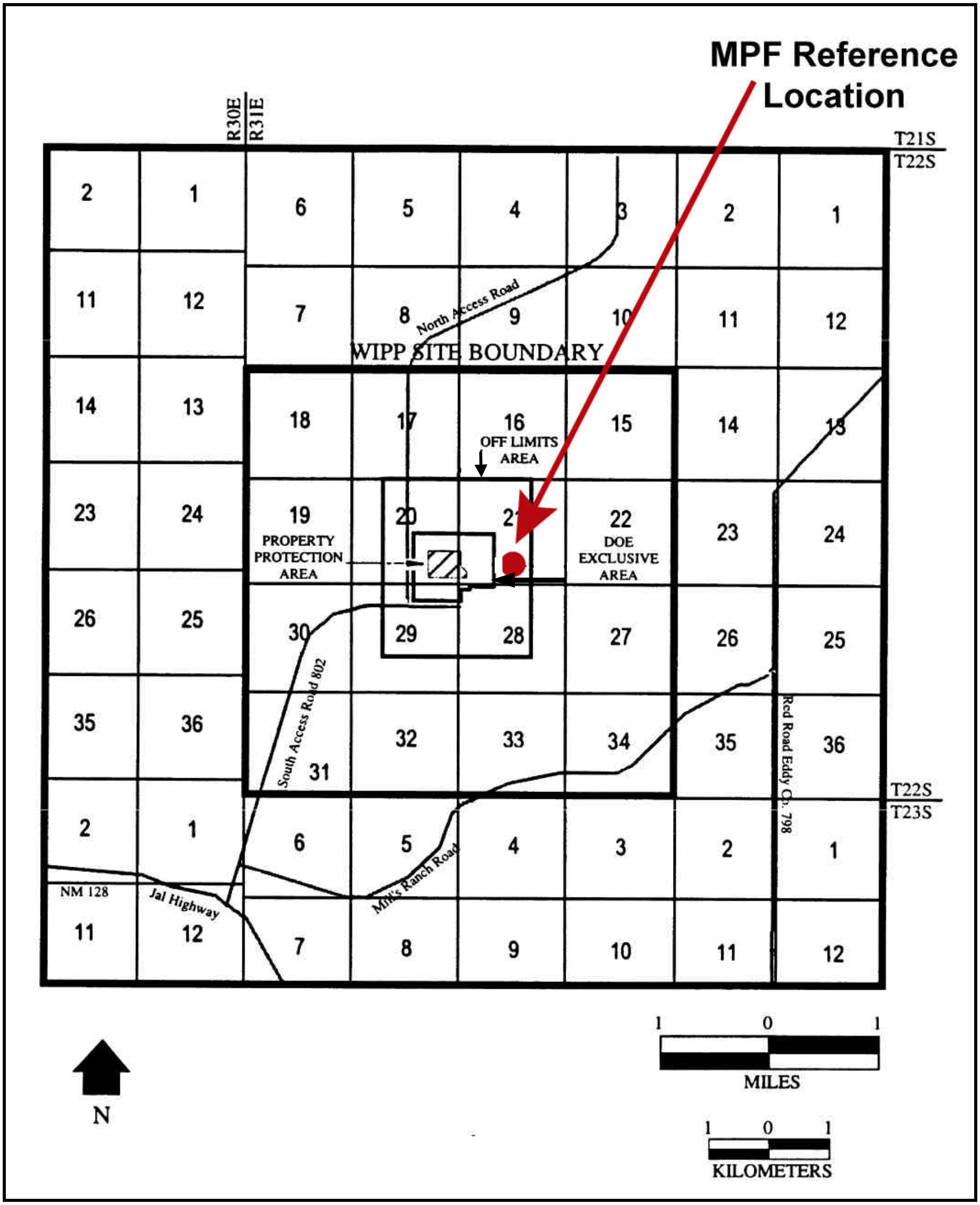


Figure 3.3.2.5–1. Carlsbad Site

3.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

3.4.1 Purchase Pits

While there is no national policy that prohibits purchase of defense materials such as pits from foreign sources, NNSA has determined that the uncertainties associated with obtaining pits from foreign sources render this alternative unreasonable for an assured long-term supply.

3.4.2 Utilizing the Pit Disassembly and Conversion Facility at the Savannah River Site

NNSA is currently planning for the permanent disposition of weapons-grade plutonium no longer required for defense purposes. In September 2000, the United States and Russia signed a Plutonium Management and Disposition Agreement (PMDA) in which each country agreed to permanently dispose of 34 metric tons (37 tons) of plutonium. The obligations under this "government-to-government" agreement equate to a pledge by each country to meet the terms put forth in the agreement. Under current plans, surplus nuclear weapons pits would be disassembled and the resulting plutonium metal converted into oxide in a planned Pit Disassembly and Conversion Facility (PDCF). The resulting plutonium oxide would then be fabricated into mixed oxide fuel at a second facility, the Mixed-Oxide Fuel Fabrication Facility, to be built at SRS and then irradiated in existing commercial reactors.

From a purely technical standpoint, the PDCF at SRS could be used to support a MPF project, if a MPF were ultimately built and located at SRS. For example, the PDCF and the MPF are expected to have redundant capabilities in shipping and receiving, secure storage, analytical support, and pit disassembly. As such, it is not unreasonable to consider the potential advantages of using the PDCF to support a MPF, although these capabilities represent only a fraction of the total capabilities to perform a MPF mission. However, the PMDA includes several restrictions that would likely impact synergy between the plutonium disposition program and a MPF. For example, facilities constructed under the PMDA are designated "disposition facilities" and the use of these facilities to process plutonium other than "disposition plutonium" (such as pit manufacturing, or other defense purposes) is prohibited. Article VI Paragraph 5 of the PMDA states, "Disposition facilities may <u>only</u> receive and process disposition plutonium and blend stock." (See Appendix G for more details regarding the PMDA and other potential restrictions.)

Further, using one facility to simultaneously dispose of nuclear weapons and produce nuclear weapons components would likely raise significant concerns from Russia and the international community. In addition, the PMDA contains bilateral and international monitoring and inspection provisions that would be inappropriate for a MPF. NNSA has decided that the international constraints on the PDCF render the facility at SRS incompatible with a MPF National Security mission. As such, this MPF EIS evaluates the potential environmental impacts of constructing and operating a MPF at SRS without regard to the synergy that might exist between the PDCF and a MPF. This will provide a conservative and bounding analysis of the potential environmental impacts. If SRS is chosen as the site for a MPF, the tiered, site-specific EIS could reassess, if desired, the reasonableness of utilizing the PDCF at SRS to support a MPF.

3.4.3 TA-55 Upgrade Alternatives

In August 2002, a multidisciplinary team comprised of national laboratory, NNSA production plant, and Federal Government personnel was chartered to: (1) determine the potential production rates that might be achieved at LANL with upgrades to PF-4; (2) estimate the implementation costs of these upgrade options; (3) address the advantages and disadvantages of upgrading PF-4 to higher production capacities; and (4) prepare information to support a determination on the "reasonableness" of the alternative of relying on an upgraded PF-4. The team was also tasked to prepare detailed environmental data for the MPF Draft EIS on any PF-4 upgrade alternative considered reasonable even though the 50-year life for a MPF may not be achievable for a TA-55 Upgrade.

The team evaluated three upgrade options for TA-55/PF-4 to increase production rate:

- TA-55 Upgrade Option 1 – No impact on current LANL missions in PF-4.
- TA-55 Upgrade Option 2 – Impact some current LANL nondefense-related missions in PF-4.
- TA-55 Upgrade Option 3 – Add floorspace (new wing) to PF-4 and impact some current LANL nondefense-related missions.

The team developed plans for required upgrades to implement these options and established estimates for: (1) production capability and agility of each PF-4 upgrade option; (2) schedule and cost for implementation of each option; and (3) impacts and issues of each option. Based on the team's evaluation, the following conclusions were applicable for all upgrade options:

- PF-4 will be 40 years old when planned capacity is achieved. The ability to meet nuclear facility safety and operating requirements over an additional 50 years will require significant investment.
- Due to increased floorspace use for pit manufacturing, any TA-55 Upgrade Alternative would reduce the agility of PF-4 to support potential future plutonium research and stockpile support missions.
- Physical constraints of upgrading an existing facility limit improvements and inclusion of improved technology in certain areas such as material handling and transport.
- Ingress and egress of an increased number of personnel would have to be addressed and could be problematic for support of higher production rates.
- Major modifications to an operational nuclear facility increase the probability of safety, contamination, or safeguards and security events and significantly increase the PAAA vulnerability of the institution.
- Major facility modifications, especially those associated with significant construction additions, increases vulnerability to changes in regulatory assumptions, interpretations, and requirements for the facility established at the time of original construction.

Based on the team's evaluation, NNSA determined that TA-55 Upgrade Option 1 would not result in an upgraded TA-55 production capacity that was greater than 50 ppy. Since production capacities in this range are already included in the bounding analyses for the No Action Alternative, no separate evaluation of TA-55 Upgrade Option 1 is necessary.

NNSA also determined that TA-55 Upgrade Option 3, which required construction of additional floor space on PF-4 and had hypothetical potential to achieve a maximum capacity of up to 150 ppy, was not a reasonable alternative. Option 3 approaches the cost and schedule of a small, newly-constructed MPF, but does not provide the agility or contingent capacity needed for the long term. As an upgrade to an existing facility, Option 3 does not provide as many opportunities for inclusion of new facility design approaches that can enhance production efficiency, reduce worker radiation exposures, and minimize safety and security risks. Since NNSA would need to maintain PF-4/TA-55 in an operational state during construction upgrades to support ongoing defense programmatic requirements, increased potential for incidents associated with construction in an operating nuclear facility could adversely impact either the upgrade process or ongoing missions. Additionally, Option 3 was deemed to have a large risk of exceeding the estimated project scope, cost, and schedule, making the option even more unattractive than a new facility of a comparable cost and significantly greater performance potential.

TA-55 Upgrade Option 2, estimated to achieve a nominal manufacturing capacity of approximately 80 ppy, was determined to be a reasonable alternative for evaluation in the MPF EIS. For details regarding the TA-55 Upgrade Alternative, see Section 3.1.4. While NNSA notes that Option 2 does not have the potential to reach the minimum production capacity (125 ppy) or agility required by a MPF, inclusion of this upgrade alternative provides a capacity greater than the No Action Alternative. This provides a "hedge" in the event of unforeseeable changes in stockpile size or pit lifetime that result in a significantly smaller pit production capacity requirement. It is noted that this Upgrade Alternative would need to be timed to minimize disruptions to LANL's interim small-scale production activities required to meet current DOD requirements.

A copy of the TA-55 upgrade evaluation is found in Appendix G of this EIS.

3.4.4 Upgrade Building 332 at Lawrence Livermore National Laboratory

Building 332 at the LLNL is located in what is known as the "Superblock." Building 332 is a plutonium R&D facility containing a wide breadth of plutonium processing and fabrication technologies but offering minimal production-like capability. Activities in Building 332 include developing and demonstrating improved technologies for plutonium metal preparation, casting, fabrication, and assembly; fabrication of components for subcritical tests; surveillance of LLNL pits; support for LANL pit surveillance and specimen fabrication, and fundamental and applied research in plutonium metallurgy. Building 332 does not have an existing pit-manufacturing mission and is small in comparison to TA-55/PF-4 at LANL. In order to produce a meaningful quantity of pits, drastic modifications to Building 332 would be required. Additionally, because of the significant population encroachment at LLNL, an upgrade alternative at LLNL is undesirable. Accordingly, the alternative to upgrade Building 332 was eliminated from detailed study.

3.4.5 Chemistry and Metallurgy Research Building Replacement (CMRR)

As explained in Section 1.4.9 of this EIS, NNSA is currently preparing an EIS for the Chemistry and Metallurgy Research Building Replacement Project (CMRR). The purpose of the CMRR EIS is to evaluate alternatives for replacing the existing Chemistry and Metallurgy Research Building (CMR) at LANL, where nuclear operations are scheduled to be shut down in approximately 2010. A new CMRR would provide analytical, chemical, and material characterization support to existing missions at LANL that are expected to continue for the long term. Such support is needed independent of the proposed action in the MPF EIS. While the CMRR could provide support to an eventual MPF at LANL (if LANL were the selected site), such support is not in the baseline design of the CMRR, nor is it required. Instead, because the baseline conceptual design for the MPF includes capabilities for analytical chemistry and metallurgical characterization, the MPF EIS analyzes the environmental impacts of such support capabilities. It is also noted that the environmental impacts of such providing chemical and metallurgical support for a MPF at LANL would be essentially the same whether such support were to occur within the CMRR or a MPF; thus, the MPF EIS includes this analysis as a direct impact in this MPF EIS. A cumulative impact section (Chapter 5, Section 5.8 of this EIS) provides an assessment of the environmental impacts of constructing and operating both the CMRR and a MPF at LANL. Under the No Action Alternative and the TA-55 Upgrade Alternative, direct analytical chemistry and metallurgical support would be provided by the existing CMR or the proposed CMRR. As such, the CMRR EIS includes an analysis of environmental impacts associated with pit production up to approximately 80 pits per year.

3.4.6 Savannah River Site Facilities

The F&H Canyon facilities, which are approximately 50+ years old, were originally designed to recover plutonium and uranium from reactor fuel rods. As such, the portions of these facilities that might be applicable to pit production are primarily in the areas where processing operations took place. Because the only F Area Canyon facility that is set up to purify plutonium material from recycled pits is the New Special Recovery Facility, extensive modifications would be required to generate an adequate capacity over the life of a MPF mission. A list of some of the major deficiencies associated with utilizing the Canyons to support a MPF follows:

- Modifications to existing contaminated facilities are very costly due to radiological control issues. Labor cost increases of 300-500 percent vs. “clean” work are commonly estimated.

- Project risks are increased when using existing facilities due to the higher number of unknown conditions that may be encountered during the project, and the challenges of coordinating construction activities with any ongoing facility operations.

- There is a high potential for hidden cost and regulatory risks associated with the long-term commitment to a legacy facility.

- The service life of the renovated facility would likely not meet the 50-year MPF design requirement.

- The existing robust canyon structures cannot be modified significantly and would therefore result in inefficient equipment arrangement, material handling and storage locations.

- Imbedded infrastructure such as shielding, ventilation systems, electrical cable/switchgear, and process piping/drains may not be suitable for a revised facility mission.

- Obstacles to adding distance and wall shielding in existing structures make achievement of the 500 millirem per year (mrem/yr) design goal, personnel exposure limit unlikely.

Based on these factors, NNSA determined that the F&H Canyon facilities are not reasonable alternatives for supporting a MPF mission. Likewise, NNSA considered whether use of the K-area Materials Storage Facility would be beneficial to a MPF, but concluded that no such advantages existed.

3.4.7 Other Department of Energy/National Nuclear Security Administration Sites

Section 3.2.2 describes the site screening process utilized to determine the reasonable site alternatives for the MPF EIS. As described in that section, all existing, major DOE sites were considered to serve as the host location for a MPF. A two-step screening process was employed: first, all potential sites were judged against “go/no go” criteria; and second, those sites satisfying the go/no go criteria were judged against desired, weighted criteria. Sites that did not satisfy the go/no go criteria, or which scored lowest against desired, weighted criteria were judged to be unreasonable site alternatives for a MPF.

3.4.8 Construct and Operate a Smaller Modern Pit Facility

As described in Chapter 2, the exact size and composition of the enduring stockpile is uncertain. Studies in the classified appendix have examined capacity requirements that would result from a wide range of enduring stockpile sizes and compositions, pit lifetimes, emergency production needs (referred to as “contingency” requirements), and facility full-production start dates. Although the precise future capacity requirements are not known with certainty, enough clarity has been obtained through these ongoing classified studies that NNSA has identified a range of pit production capacity requirements (125-450 ppy) that form the basis of the capacity evaluations in this EIS. The EIS evaluates the impacts of a MPF designed to produce three capacities: 125 ppy, 250 ppy, and 450 ppy. If there were significant further reductions in the nuclear weapons stockpile (beyond those already considered in the classified analyses), or if future technical studies demonstrate that pit lifetimes significantly exceed 45-60 years, then the need, capacity, and timing for a new MPF would need to be reassessed. With respect to these uncertainties, NNSA has chosen not to speculate beyond the assumptions described in this EIS. As such, this EIS does not propose to construct and operate a MPF with a capacity smaller than 125 ppy. However, as described in Sections 3.3.3.6, this EIS does evaluate a TA-55 Upgrade Alternative (80 ppy) as a “hedge” in the event of unforeseeable significant changes in stockpile size or pit lifetime.

3.5 COMPARISON OF ALTERNATIVES

3.5.1 Introduction

To aid the reader in understanding the differences among the various alternatives, this section presents a summary comparison of the potential environmental impacts associated with the alternatives for a MPF. The comparison concentrates on those resources with the greatest potential to be impacted.

The information in this section is a summary of the environmental impacts based on the information presented in Chapter 5 of this EIS. Table 3.5.1–1 at the end of this chapter provides quantitative information that supports the text below.

3.5.2 Environmental Impacts

Land Use

All action alternatives would result in land disturbance. As shown in Table 3.5.1–1, the amount of land disturbed for all alternatives would be less than 2 percent of the available land area. However, there would be no impacts to land use plans or policies.

Visual Resources

All action alternatives except SRS would result in no changes to current Class IV BLM Visual Resource Management ratings. Although SRS does not have a BLM Visual Resource Management rating, constructing and operating a MPF would be consistent with the currently developed areas of SRS.

Site Infrastructure

SRS has adequate electrical energy capacity and peak load capability for all three proposed MPF sizes. LANL has adequate electrical energy capacity and peak load capability for the TA-55 Upgrade (80 ppy). LANL would require additional peak load capability and Pantex Site would require additional energy capacity for the 450 ppy plant. Carlsbad Site would require additional peak load capability for all three sized plants and additional energy capacity for the 450 ppy plant. NTS would require additional energy capacity and peak load capability for all three sized plants.

Pantex Site, SRS and the Upgrade Alternative (80 ppy) at LANL have adequate process steam available to support all MPF size plants. The Carlsbad Site would require extension of a local gas pipeline and NTS would require the construction of a pipeline or a rail line to supply fuel for the process steam plant required for any of the three production capacity options.

Air Quality

All action alternatives would result in air quality levels that would be in attainment with the NAAQS for all criteria pollutants. However, surge operations of the 450 ppy plant at LANL would exceed the 24-hour nitrogen dioxide standard by approximately 5 percent. If the 450 ppy plant is built at LANL, mitigation measures would be designed and implement to bring these emissions into compliance. All sites are in attainment areas. A Prevention of Significant Deterioration analysis would be done in the site-specific tiered EIS.

Water Resources

The water requirements for the construction of all action alternatives would be within existing site water allotments. The existing site water allotment at NTS, Pantex Site, and SRS would be adequate to support the operation of all three plant sizes. Although the current water allotment at LANL would support the Upgrade Alternative and 125 ppy options, LANL would need to expand its water allotment for the 250 ppy and 450 ppy plant by purchasing more water. Carlsbad Site would need to purchase more water to expand its water allotment for the operation of all three plant sizes. Sufficient capacity exists for both LANL and Carlsbad Site to purchase additional water to support MPF operations.

Biological Resources

For all action alternatives, some habitats unique to each area would be modified or lost and there could be a decrease in quality of the habitat adjacent to the proposed development. It is not expected that any wetlands would be impacted by any alternative. There are no designated critical habitats for any listed threatened or endangered species at any of the site alternatives, and thus no impacts are expected.

Cultural and Paleontological Resources

Any ground disturbance has the potential to impact cultural and paleontological resources at any of the alternative sites. At the programmatic level, there are no significant differences between the alternative sites with respect to potential impacts to cultural and paleontological resources. Prior to any ground-disturbance activity, NNSA would identify and evaluate any cultural and paleontological resources that could potentially be impacted by the construction of a MPF or upgrade to the TA-55 Facility. If necessary, NNSA would implement appropriate measures to avoid, reduce, or mitigate any impacts.

Socioeconomics

New jobs would be created for all action alternatives. For the MPF alternatives, the number of direct jobs created during the peak year of construction would range from approximately 770-1,100, depending upon the capacity constructed. The number of indirect jobs created would vary depending upon the site. Table 3.5.1–1 displays an estimate of the total number of jobs (direct plus indirect) created during the peak year of construction for the various MPF site alternatives. The maximum population influx would not exceed 3 percent at any site.

During operations, the number of direct jobs created would range from approximately 990-1,800, depending upon the capacity of a MPF. As shown on Table 3.5.1–1, the total number of jobs would range from 1,230-3,090, depending upon the capacity of a MPF. During operations, all sites except NTS and SRS would have an increase in population for all plant sizes. The population increases are shown on Table 3.5.1–1. Due to the population increases, which would be less than 3 percent, there would be no impacts on community services, except at Carlsbad, where increases in some resources would be required to maintain comparable levels of community services.

The TA-55 Upgrade Alternative (80 ppy) would result in a maximum of 190 direct jobs during the peak year of construction and 660 direct jobs during operations. Table 3.5.1-1 displays the total number of jobs (direct plus indirect) associated with the TA-55 Upgrade Alternative.

Radiological Impacts

During normal MPF operations, radiological impacts to workers and the public would occur. Impacts to workers would be independent of a MPF site. At all MPF sites, the average individual dose to a worker would be 290 mrem/yr for the 125 ppy facility, 390 mrem/yr for the 250 ppy facility, and 510 mrem/yr for the 450 ppy facility. These doses would be below regulatory limits and limits imposed by DOE Orders. Statistically, for the average worker, a 290 mrem/yr dose translates into a risk of one fatal cancer every 8,620 years of operation; a 390 mrem/yr dose translates into a risk of one fatal cancer every 6,410 years of operation; a 510 mrem/yr dose translates into a risk of one fatal cancer every 4,900 years of operation.

For the TA-55 Upgrade Alternative, the average individual dose to a worker would be a 380 mrem/yr. Statistically, this translates into a risk of one fatal cancer every 6,580 years of operation.

Doses to the public would be site dependent. Sites with the smallest 80-km (50-mi) population would have the smallest impact. For example, the collective population dose to the population surrounding NTS and WIPP would be smaller than LANL, Pantex, and SRS due to the relative remoteness of NTS and WIPP. However, the collective population dose at any of the five sites is small in any event. The maximum collective population dose would occur at SRS for the 450 ppy facility. This dose would be 1.3 x 10^{-6} person-rem/year, which statistically would translate into one fatal cancer risk every 1.5 billion years of operation. The TA-55 Upgrade Alternative would also be bounded by this population dose. At all sites, the maximally exposed offsite individual would receive a dose less than 1 mrem per year.

Nonradiological Impacts

Statistically, nonradiological occupational impacts to workers during the construction and operation of a MPF would be expected to result in less than one fatality. The impacts to workers are estimated to be the same for all action alternatives except the TA-55 Upgrade Alternative (80 ppy) which would have the smallest potential impact due to the least amount of construction activity.

Accidents

Radiological. Potential impacts from accidents were estimated using computer modeling. In the event of any accidents, the projected annual risk of latent cancer fatality (LCF) at all MPF sites for the surrounding population would be less than one. For the bounding accident analyzed in the EIS, (explosion in a feed casting furnace) the highest potential annual risk to the population within 80-km (50-mi) would be an increase in LCFs of 0.125 at LANL from either a MPF or TA-55 Upgrade Alternative. Statistically, this would equate to one additional LCF among the

80-km (50-mi) population surrounding LANL every 8 years of operation. Statistically, this accident would be expected to occur once every 100 years. For this accident, the dose to the maximally exposed offsite individual would be 38 rem, which exceeds DOE exposure guidelines. The analyses in these cases for NEPA purposes are based on unmitigated releases of radioactive material to select a site for the MPF. Following the ROD and selection of a site, additional NEPA action would be taken that would identify specific mitigating features that would be incorporated in the MPF design to ensure compliance with DOE exposure guidelines. At NTS and the Carlsbad Site, this risk would be smallest due to the relative remoteness of these two sites.

Nonradiological. The impacts associated with the potential release of the most hazardous chemicals used at a MPF were modeled to determine whether any impacts could exceed site boundaries. Based upon those modeling results, it was determined that no chemical impacts would exceed site boundaries at SRS and NTS. At LANL, Pantex Site, and Carlsbad Site, an accidental chemical release had the potential to cause impacts beyond site boundaries. In such an event, emergency preparedness procedures would be employed to minimize potential impacts.

Transportation

During normal transportation of radiological materials (plutonium, enriched uranium, TRU waste and LLW), radiological impacts to transportation workers and the public would occur. Impacts to workers and the public would be dependent on a MPF site and the population along expected transportation routes. All pits would originate and terminate at Pantex and all enriched uranium components would be transported to a MPF site from the Y-12 National Security Complex at Oak Ridge, Tennessee, and back. Two locations (Pantex Site and Carlsbad Site) transport LLW offsite.

For all alternatives, the environmental impacts and potential risks of transportation would be small, e.g., less than one latent cancer fatality per year. As shown in Table 3.5.1–1, the average collective dose to transportation workers from incident free transportation would be a maximum of 10.2 person-rem/yr for the 450 ppy facility. Statistically, a 10.2 person-rem/yr dose translates into a risk of one fatal cancer every 245 years of operation. The average collective dose to the general public from incident free transportation would be a maximum of 12 person-rem/yr for the 450 ppy facility. Statistically, a 12 person-rem/yr dose translates into a risk of one fatal cancer every 167 years of operation.

In the event of a transportation accident, the maximum average collective dose to the general public from a transportation accident would be 0.29 person-rem/yr for the 450 ppy facility. Statistically, a 0.29 person-rem/yr dose translates into a risk of one fatal cancer every 6,897 years of operation.

Waste Management

The amount of waste generated by a MPF would be the same at all sites. These values and those from the TA-55 Upgrade Alternative (80 ppy) are shown in Table 3.5.1–1. The TRU waste from all sites would be transported to the Waste Isolation Pilot Plant or other similar type facility for disposal (the impact of this is included in the transportation section). All LLW at LANL and at

NTS would be handled in existing onsite burial LLW disposal facilities. The existing aboveground E Area retrievable vault storage facilities at SRS are not adequate and planned onsite disposal facilities would require additional capacity to handle the quantities of LLW generated by a MPF for the 250 ppy and 450 ppy facilities. Pantex Site and Carlsbad Site do not have any onsite LLW disposal facilities and would ship their MPF LLW to NTS. Pantex Site would need to expand its temporary LLW storage facility, and Carlsbad Site would need to construct a temporary LLW storage facility.

3.6 PREFERRED ALTERNATIVE

The CEQ regulations require an agency to identify its preferred alternative to fulfill its statutory mission, if one or more exists in a Draft EIS (40 CFR 1502.14[e]). For this MPF Draft EIS, constructing and operating a new MPF is the preferred alternative based on considerations of environmental, economic, technical, and other factors. A preferred host site for a MPF has not yet been determined, but will be identified in the Final EIS, if the Secretary decides to proceed with a MPF.

Table 3.5.1–1. Summary of Environmental Impacts

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
LAND USE							
Percent of available site disturbed	No change[a]	~ 0.03 %	~ 0.6–0.7%	~ 0.02%	~ 0.9–1.1%	~ 0.07–0.09%	~ 1.4–1.7%
SITE INFRASTRUCTURE (Operations)							
80 ppy							
Electrical Supply	No change[a]	Adequate	—	—	—	—	—
Fuel for Process Supply	No change[a]	Steam Available	—	—	—	—	—
125 ppy							
Electrical Supply	—	—	Adequate	Additional energy capacity and peak load capability would be needed	Adequate	Adequate	Additional peak load capacity would be needed
Fuel for Process Supply	—	—	Steam Available	Pipeline/Rail line required	Steam Available	Steam Available	Extension of existing pipeline required
250 ppy							
Electrical Supply	—	—	Adequate	Additional energy capacity and peak load capability would be needed	Adequate	Adequate	Additional peak load capability would be needed
Fuel for Process Supply	—	—	Steam Available	Pipeline/Rail line required	Steam Available	Steam Available	Extension of existing pipeline required
450 ppy							
Electrical Supply	—	—	Additional peak load capability would be needed	Additional energy capacity and peak load capability would be needed	Additional energy capacity would be needed	Adequate	Additional energy capacity and peak load capability would be needed
Fuel for Process Supply	—	—	Steam Available	Pipeline/Rail line required	Steam Available	Steam Available	Extension of existing pipeline required

Table 3.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
WATER RESOURCES							
Construction – All Capacity Sizes							
Adequate site water allotment	No change[a]	yes	yes	yes	yes	yes	yes
Operations							
80 ppy							
Adequate site water allotment	No change[a]	yes	—	—	—	—	—
125 ppy							
Adequate site water allotment	—	—	yes	yes	yes	yes	no
250 ppy							
Adequate site water allotment	—	—	no	yes	yes	yes	no
450 ppy							
Adequate site water allotment	—	—	no	yes	yes	yes	no
BIOLOGICAL RESOURCES							
Terrestrial – All Capacity Sizes							
	No impact	No impact	Approximately 56-69 ha of low value vegetation and potential habitat modified or lost; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha of primarily shrubland habitat cleared, modified, or lost; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha of shortgrass prairie and habitat cleared or modified; loss of shortgrass prairie plant community and wildlife habitat; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha of potential forested habitat modified or lost; decrease in quality of habitat adjacent to proposed development	Approximately 56-69 ha cleared, modified or lost of grass and shrub plant communities and wildlife habitat; decrease in quality of habitat adjacent to proposed development

Table 3.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
SOCIOECONOMICS[b]							
Construction – Jobs Created	No change[a]	—	—	—	—	—	—
80 ppy	—	Direct: 190 Indirect: 120	—	—	—	—	—
125 ppy	—	—	Direct: 770 Indirect: 480	Direct: 770 Indirect: 740	Direct: 770 Indirect: 660	Direct: 770 Indirect: 550	Direct: 770 Indirect: 280
250 ppy	—	—	Direct: 850 Indirect: 530	Direct: 850 Indirect: 820	Direct: 850 Indirect: 730	Direct: 850 Indirect: 610	Direct: 850 Indirect: 300
450 ppy	—	—	Direct: 1,100 Indirect: 690	Direct: 1,100 Indirect: 1,060	Direct: 1,100 Indirect: 940	Direct: 1,100 Indirect: 790	Direct: 1,100 Indirect: 390
Operations – Jobs Created	No change[a]	—	—	—	—	—	—
80 ppy	—	Direct: 660 Indirect: 220	—	—	—	—	—
125 ppy	—	–	Direct: 990 Indirect: 280	Direct: 990 Indirect: 620	Direct: 990 Indirect: 710	Direct: 990 Indirect: 950	Direct: 990 Indirect: 240
250 ppy	—	–	Direct: 1,360 Indirect: 390	Direct: 1,360 Indirect: 850	Direct: 1,360 Indirect: 980	Direct: 1,360 Indirect: 620	Direct: 1,360 Indirect: 330
450 ppy	—	–	Direct: 1,800 Indirect: 510	Direct: 1,800 Indirect: 1,130	Direct: 1,800 Indirect: 1,290	Direct: 1,800 Indirect: 820	Direct: 1,800 Indirect: 430
POPULATION AND HOUSING[c]							
Construction – Total Expected New Residents	No change[a]	—	—	—	—	—	—
80 ppy	—	150	—	—	—	—	—
125 ppy	—	—	1,600	No impact	1,400	140	1,700
250 ppy	—	—	1,900	No impact	1,600	350	1,900
450 ppy	—	—	2,500	No impact	2,300	1,000	2,600
Operations – Expected New Residents	No change[a]	—	—	—	—	—	—
80 ppy	—	335	—	—	—	—	—
125 ppy	—	—	1,100	No impact	1,400	No impact	1,900

Table 3.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
250 ppy	—	—	2,100	No impact	2,400	No impact	2,800
450 ppy	—	—	3,200	No impact	3,500	No impact	3,900
COMMUNITY SERVICES							
All Capacity Sizes	No impact	No impact	No impact	No impact	No impact	No impact	Potential impact
HUMAN HEALTH AND SAFETY							
Annual Radiological Impacts to Individual MPF Workers							
Individual Workers – Average individual dose, mrem/yr							
80 ppy	No change[a]	380	—	—	—	—	—
125 ppy	—	—	290	290	290	290	290
250 ppy	—	—	390	390	390	390	390
450 ppy	—	—	510	510	510	510	510
Average worker cancer fatality risk	No change[a]	—	—	—	—	—	—
80 ppy	—	1.5×10^{-4}	—	—	—	—	—
125 ppy	—	—	1.2×10^{-4}	1.2×10^{-4}	1.2×10^{-4}	1.2×10^{-4}	1.2×10^{-4}
250 ppy	—	—	1.6×10^{-4}	1.6×10^{-4}	1.6×10^{-4}	1.6×10^{-4}	1.6×10^{-4}
450 ppy	—	—	2.0×10^{-4}	2.0×10^{-4}	2.0×10^{-4}	2.0×10^{-4}	2.0×10^{-4}
Annual Radiological Impacts to MPF Worker Population							
Collective dose, person-rem	No change[a]	—	—	—	—	—	—
80 ppy	—	154	—	—	—	—	—
125 ppy	—	—	160	160	160	160	160
250 ppy	—	—	310	310	310	310	310
450 ppy	—	—	560	560	560	560	560
Cancer fatality risk	No change[a]	—	—	—	—	—	—
80 ppy	—	0.062	—	—	—	—	—
125 ppy	—	—	0.064	0.064	0.064	0.064	0.064
250 ppy	—	—	0.12	0.12	0.12	0.12	0.12
450 ppy	—	—	0.22	0.22	0.22	0.22	0.22

Table 3.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
Annual Radiological Impacts on Public							
Population within 80 km (50 mi)							
Collective dose, person-rem	No change[a]	—	—	—	—	—	—
80 ppy	—	2.5×10^{-8}	—	—	—	—	—
125 ppy	—	—	3.4×10^{-7}	2.7×10^{-8}	1.2×10^{-7}	4.2×10^{-7}	4.2×10^{-8}
250 ppy	—	—	5.5×10^{-7}	4.3×10^{-8}	2.0×10^{-7}	7.0×10^{-7}	6.8×10^{-8}
450 ppy	—	—	1.0×10^{-6}	7.7×10^{-8}	3.6×10^{-7}	1.3×10^{-6}	1.2×10^{-7}
LCFs	No change[a]	—	—	—	—	—	—
80 ppy	—	1.2×10^{-11}	—	—	—	—	—
125 ppy	—	—	1.7×10^{-10}	1.3×10^{-11}	6.2×10^{-11}	2.1×10^{-10}	2.1×10^{-11}
250 ppy	—	—	2.8×10^{-10}	2.1×10^{-11}	1.0×10^{-10}	3.5×10^{-10}	3.4×10^{-11}
450 ppy	—	—	5.0×10^{-10}	3.8×10^{-11}	1.8×10^{-10}	6.5×10^{-10}	6.2×10^{-11}
Offsite MEI – Dose (mrem)	No change[a]	—	—	—	—	—	—
80 ppy	—	3.0×10^{-9}	—	—	—	—	—
125 ppy	—	—	4.1×10^{-8}	1.6×10^{-9}	1.7×10^{-8}	2.6×10^{-9}	2.3×10^{-8}
250 ppy	—	—	6.6×10^{-8}	2.5×10^{-9}	2.8×10^{-8}	4.3×10^{-9}	3.6×10^{-8}
450 ppy	—	—	1.2×10^{-7}	3.8×10^{-9}	5.0×10^{-8}	8.0×10^{-9}	6.5×10^{-8}
Cancer fatality risk	No change[a]	—	—	—	—	—	—
80 ppy	—	1.5×10^{-15}	—	—	—	—	—
125 ppy	—	—	2.1×10^{-14}	8.0×10^{-16}	8.5×10^{-15}	1.3×10^{-15}	1.2×10^{-14}
250 ppy	—	—	3.3×10^{-14}	1.3×10^{-15}	1.4×10^{-14}	2.2×10^{-15}	1.8×10^{-14}
450 ppy	—	—	6.0×10^{-14}	2.3×10^{-15}	2.5×10^{-14}	4.0×10^{-15}	3.3×10^{-14}
Nonradiological Impacts							
Construction total fatalities for project duration	—	—	—	—	—	—	—
80 ppy	—	0.09	—	—	—	—	—
125 ppy	—	—	0.54	0.54	0.54	0.54	0.54
250 ppy	—	—	0.60	0.60	0.60	0.60	0.60
450 ppy	—	—	0.78	0.78	0.78	0.78	0.78

Table 3.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
Operations total fatalities per year	No change[a]	—	—	—	—	—	—
80 ppy	—	0.025	—	—	—	—	—
125 ppy	—	—	0.04	0.04	0.04	0.04	0.04
250 ppy	—	—	0.05	0.05	0.05	0.05	0.05
450 ppy	—	—	0.07	0.07	0.07	0.07	0.07
ACCIDENTS (Maximum Annual Cancer Risk for Highest Risk Accident)							
Population	No change[d]	0.125	0.125	0.003	0.023	0.035	0.0081
MEI	No change[d]	3.8×10^{-4}	3.8×10^{-4}	7.4×10^{-6}	8.8×10^{-5}	9.6×10^{-6}	3.1×10^{-4}
TRANSPORTATION							
Operations – Annual Incident Free-collective dose (person-rem/LCFs)							
Transportation Workers	0.23/ 9.1×10^{-5}	—	—	—	—	—	—
80 ppy	—	0.54/ 2.2×10^{-4}	—	—	—	—	—
125 ppy	—	—	$0.76/3.0 \times 10^{-4}$	$2.2/9.0 \times 10^{-4}$	$4.2/1.7 \times 10^{-3}$	$3.1/1.2 \times 10^{-3}$	$3.7/1.5 \times 10^{-3}$
250 ppy	—	—	$1.1/4.5 \times 10^{-4}$	$3.1/1.2 \times 10^{-3}$	$6.6/2.6 \times 10^{-3}$	$4.1/1.6 \times 10^{-3}$	$6.0/2.4 \times 10^{-3}$
450 ppy	—	—	$1.8/7.3 \times 10^{-4}$	$4.9/2.0 \times 10^{-3}$	$10/4.0 \times 10^{-3}$	$6.4/2.5 \times 10^{-3}$	$9.2/3.7 \times 10^{-3}$
General Public	0.36/ 1.8×10^{-4}	—	—	—	—	—	—
80 ppy	—	0.88/ 4.4×10^{-4}	—	—	—	—	—
125 ppy	—	—	$1.2/6.2 \times 10^{-4}$	$3.6/1.8 \times 10^{-3}$	$3.4/1.7 \times 10^{-3}$	$5.8/2.9 \times 10^{-3}$	$2.6/1.3 \times 10^{-3}$
250 ppy	—	—	$1.8/8.8 \times 10^{-4}$	$4.9/2.5 \times 10^{-3}$	$5.1/2.7 \times 10^{-3}$	$7.6/3.8 \times 10^{-3}$	$4.3/2.2 \times 10^{-3}$
450 ppy	—	—	$2.9/1.4 \times 10^{-3}$	$7.8/3.9 \times 10^{-3}$	$8.0/4.0 \times 10^{-3}$	$12.0/5.9 \times 10^{-3}$	$6.8/3.4 \times 10^{-3}$
Operations – Radiological Accident Impact	4.6×10^{-5}/ 2.3×10^{-8}	—	—	—	—	—	—
80 ppy	—	1.3×10^{-4}/ 6.4×10^{-8}	—	—	—	—	—
125 ppy	—	—	1.7×10^{-4}/ 8.6×10^{-8}	9.2×10^{-4}/ 4.6×10^{-7}	1.1×10^{-3} 5.5×10^{-7}	0.011/ 5.4×10^{-6}	4.3×10^{-4}/ 2.2×10^{-7}

Table 3.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
250 ppy	—	—	2.2×10^{-4}/ 1.1×10^{-7}	1.2×10^{-3}/ 5.8×10^{-7}	1.6×10^{-3}/ 8.1×10^{-7}	0.013/ 6.7×10^{-6}	6.9×10^{-4}/ 3.5×10^{-7}
450 ppy	—	—	3.3×10^{-4}/ 1.6×10^{-7}	1.8×10^{-3}/ 8.8×10^{-7}	2.5×10^{-3}/ 8.1×10^{-7}	0.021/ 1.0×10^{-5}	1.1×10^{-3}/ 5.3×10^{-7}
WASTE MANAGEMENT – *Annual Operations (m^3)*							
80 ppy							
TRU Waste–solid	—	445[e]	—	—	—	—	—
LLW–solid	—	1,445[e]	—	—	—	—	—
Mixed LLW–solid and liquid	—	53[e]	—	—	—	—	—
Hazardous waste–solid and liquid	—	205[e]	—	—	—	—	—
Adequate onsite LLW disposal facilities	—	Adequate	—	—	—	—	—
125 ppy							
TRU Waste–solid	—	—	590 m^3	590 m^3	590 m^3	590 m^3	590 m^3
LLW–solid	—	—	2,070 m^3	2,070 m^3	2,070 m^3	2,070 m^3	2,070 m^3
Mixed LLW–solid and liquid	—	—	1.7 m^3	1.7 m^3	1.7 m^3	1.7 m^3	1.7 m^3
Hazardous waste–solid and liquid	—	—	2.8 m^3	2.8 m^3	2.8 m^3	2.8 m^3	2.8 m^3
Adequate onsite LLW disposal facilities	—	—	Adequate	Adequate	No onsite disposal; additional onsite capacity would be needed until LLW transferred	Adequate	No onsite disposal capability for MPF LLW waste
250 ppy							
TRU Waste–solid	—	—	740 m^3	740 m^3	740 m^3	740 m^3	740 m^3
LLW–solid	—	—	3,300 m^3	3,300 m^3	3,300 m^3	3,300 m^3	3,300 m^3
Mixed LLW–solid and liquid	—	—	2.4 m^3	2.4 m^3	2.4 m^3	2.4 m^3	2.4 m^3
Hazardous waste–solid and liquid	—	—	3.4 m^3	3.4 m^3	3.4 m^3	3.4 m^3	3.4 m^3

Table 3.5.1–1. Summary of Environmental Impacts *(continued)*

Resource/Material Categories	No Action Alternative	TA-55 Upgrade Alternative (80 ppy)	Los Alamos Site Alternative	NTS Alternative	Pantex Site Alternative	SRS Alternative	Carlsbad Site Alternative
Adequate onsite LLW disposal facilities	—	—	Adequate	Adequate	No onsite disposal; additional onsite capacity would be needed until LLW transferred	Additional capacity required for currently planned LLW facilities	No onsite disposal capability for MPF LLW waste
450 ppy							
TRU Waste–solid	—	—	1,130 m^3	1,130 m^3	1,130 m^3	1,130 m^3	1,130 m^3
LLW–solid	—	—	5,030 m^3	5,030 m^3	5,030 m^3	5,030 m^3	5,030 m^3
Mixed LLW–solid and liquid	—	—	4.2 m^3	4.2 m^3	4.2 m^3	4.2 m^3	4.2 m^3
Hazardous waste–solid and liquid	—	—	5.6 m^3	5.6 m^3	5.6 m^3	5.6 m^3	5.6 m^3
Adequate onsite LLW disposal facilities	—	—	Adequate	Adequate	No onsite disposal; additional onsite capacity would be needed until LLW transferred	Additional capacity required for currently planned LLW facilities	No onsite disposal capability for MPF LLW waste

[a] No change from current operations.
[b] Differences in the number of indirect jobs created at each site are based upon unique Bureau of Economic Analysis multipliers for each site region.
[c] Total population impacts were determined by multiplying the number of workers required from outside the ROI by the average household size for the United States. The number of in-migrating workers was determined based on the current ROI labor force composition and unemployment rates.
[d] No Action accidents addressed by existing documentation.
[e] Operational waste valves for the upgrade include the removal of 140 gloveboxes over a 10-year period, and additional hazardous waste from the pyrochemical process.
Offsite MEI = Maximally Exposed Offsite Individual.
LCF = Latent Cancer Fatality.

4.0 AFFECTED ENVIRONMENT

In Chapter 4, the affected environment descriptions provide the context for understanding the environmental consequences described in Chapter 5. They serve as a baseline from which any environmental changes brought by implementing the proposed action can be evaluated; the baseline conditions are the currently existing conditions. The affected environment at Los Alamos Site, Nevada Test Site (NTS), Pantex Site (Pantex), Savannah River Site (SRS), and the Carlsbad Site are described for the following impact areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemical environment, transportation, and waste management.

4.1 INTRODUCTION

In accordance with the Council on Environmental Quality (CEQ) under the *National Environmental Policy Act* (NEPA) regulations (40 *Code of Federal Regulations* [CFR] 1500-1508) for preparing an environmental impact statement (EIS), the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with the environment." The affected environment descriptions presented in this chapter provide the context for understanding the environmental impacts described in Chapter 5. They serve as a baseline from which any environmental changes brought about by implementing the proposed action can be evaluated; the baseline conditions are the currently existing conditions.

For this EIS, the five candidate sites for the construction and operation of the Modern Pit Facility (MPF) are the Los Alamos Site, NTS, Pantex Site, SRS, and the Carlsbad Site. The affected environment is described for the candidate sites for the following resource areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemical environment, transportation, and waste management. The level of detail presented varies depending on the potential for impacts on a particular resource as result of the MPF.

Recent site-specific, project-specific, resource-related environmental documents, relevant laws and regulations, and site environmental reports, were used in describing the existing environment at each of the candidate sites. These documents are cited as appropriate. A listing of the information and references used to develop this chapter and the EIS is included in Chapter 8, References.

The U.S. Department of Energy (DOE) evaluated the environmental impacts of the construction and operation of the MPF within defined regions of influence (ROIs) at each of the candidate sites and along potential transportation routes. The ROIs are specific to the type of effect evaluated, and encompass geographic areas within which any significant impact would be expected to occur. Detailed descriptions of the ROIs and the method used to evaluate the impacts on each environmental resource are presented in Appendix F, Methodology.

4.2 LOS ALAMOS SITE

This section discusses the affected environment at the Los Alamos National Laboratory (LANL) for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, and socioeconomics. In addition, radiation and hazardous chemical environment, transportation, and waste management are described.

4.2.1 Land Use and Visual Resources

4.2.1.1 Land Use

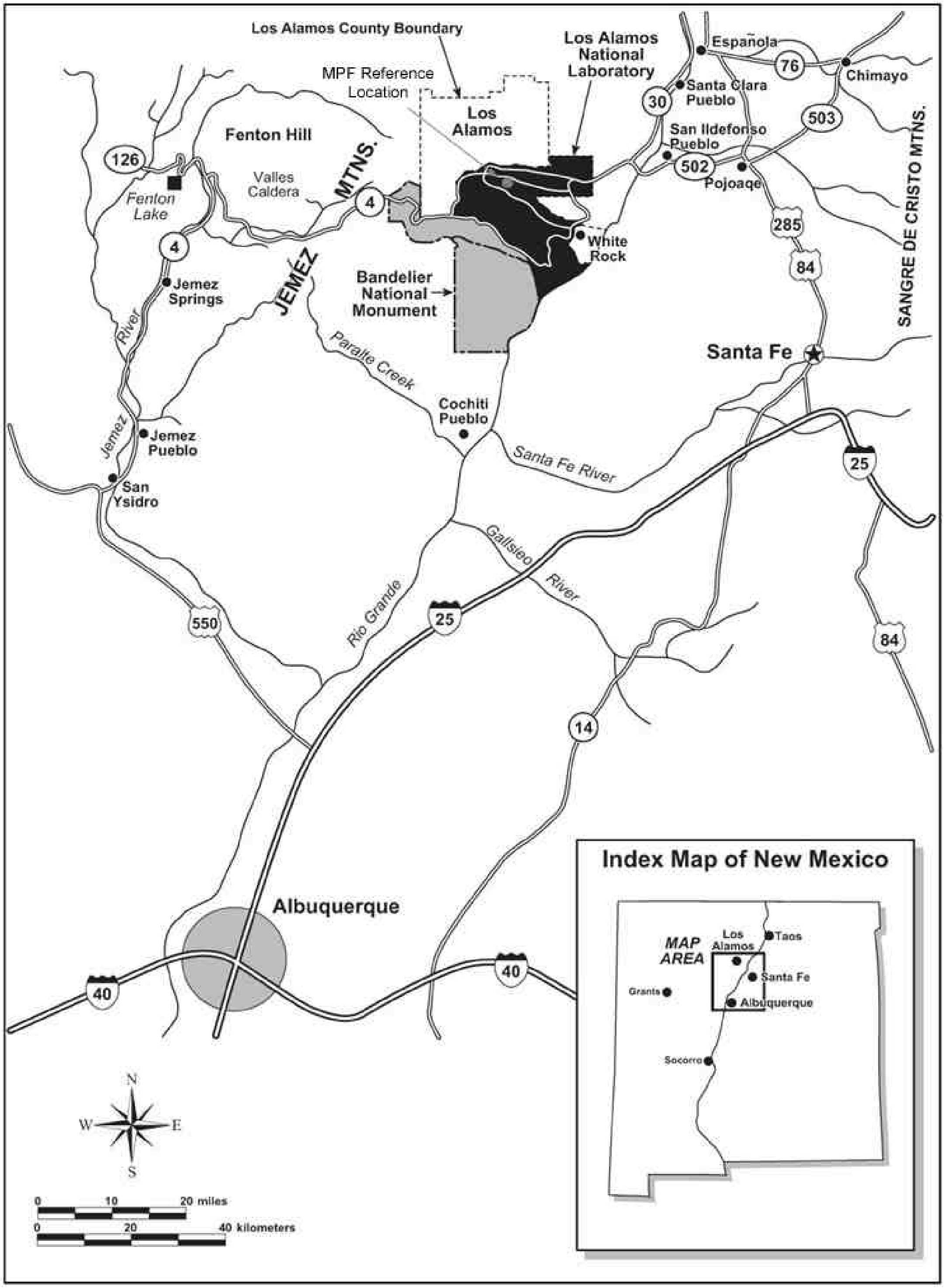
LANL, comprised of 10,400 hectares (ha) (25,600 acres [ac]), is located in north-central New Mexico, 96 kilometers (km) (60 miles [mi]) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Española in Los Alamos and Santa Fe Counties (see Figure 4.2.1.1–1). LANL is owned by the Federal Government and administered by DOE's National Nuclear Security Administration (NNSA). It is operated by the University of California under contract to DOE.

LANL and the surrounding region are characterized by forested areas with mountains, canyons, and valleys, as well as diverse cultures and ecosystems. The area is dominated by the Jemez Mountains to the west and the Sangre de Cristo Mountains to the east. The Santa Fe National Forest, which includes the Dome Wilderness Area, lies to the north, west, and south of LANL (see Figure 4.2.1.1–2).

The American Indian Pueblo of San Ildefonso and the Rio Grande River border the site on the east, and the Bandelier National Monument and Bandelier Wilderness Area lie directly south. Land use in this region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation (e.g., skiing, fishing), agriculture, and the state and Federal governments for its economic base. Area communities are generally small and primarily support urban uses including residential, commercial, light industrial, and recreational facilities. The region also includes Native American communities. Lands of the Pueblo of San Ildefonso share LANL's eastern border, and a number of other pueblos are clustered nearby.

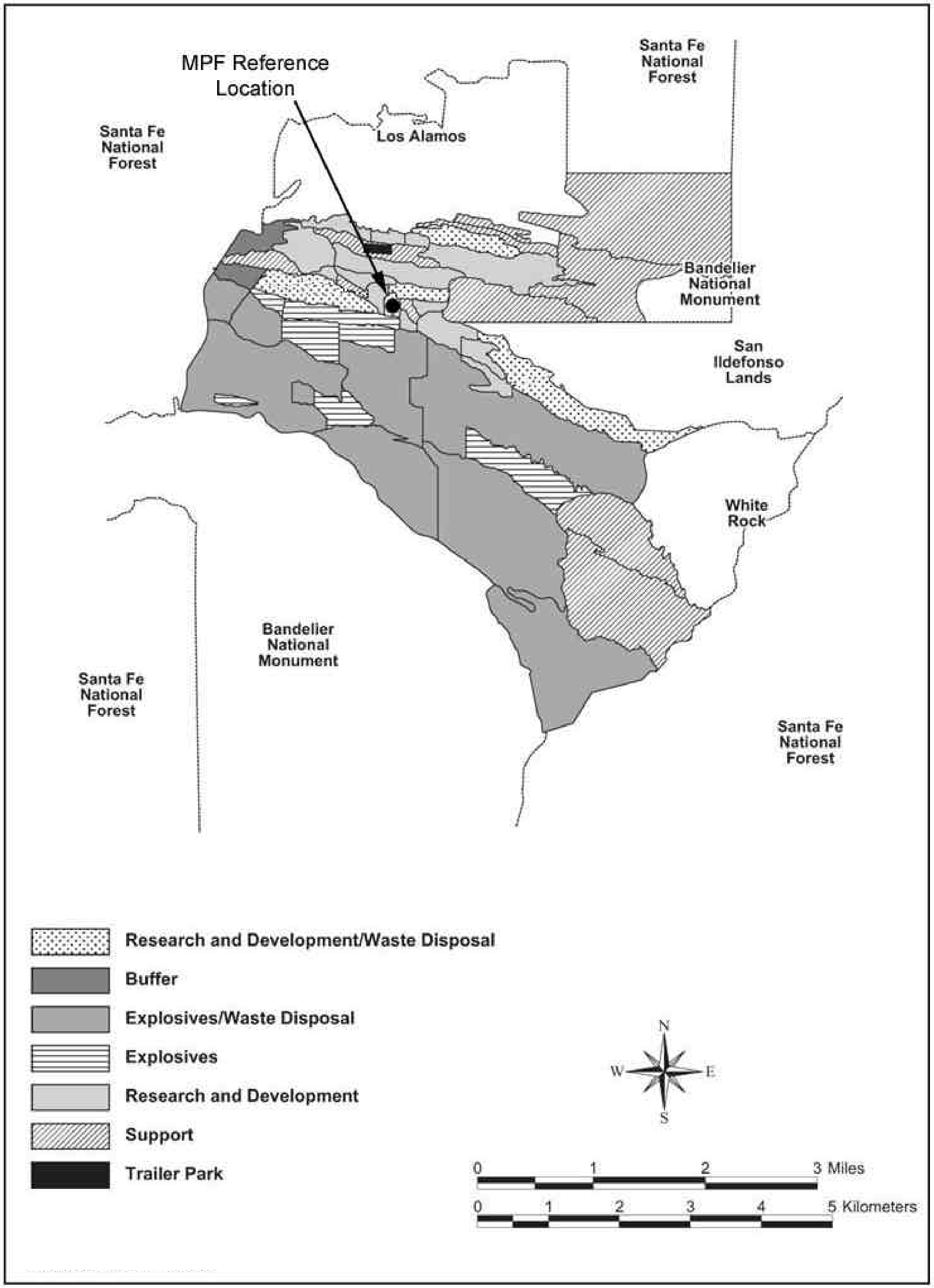
Major governmental bodies that serve as land stewards and determine land uses within Los Alamos and Santa Fe Counties include the county governments, DOE, the U.S. Forest Service, the National Park Service, the State of New Mexico, the U.S. Bureau of Land Management (BLM), and several Native American pueblos. Bandelier National Monument and Santa Fe National Forest border LANL primarily to the southwest and northwest, respectively; however, small portions of each also border the site to the northeast (see Figure 4.2.1.1–2).

LANL is divided into technical areas (TAs) that are used for building sites, experimental areas, and waste disposal locations (see Figure 4.2.1.1–3). However, those uses account for only a small part of the total land area of the site. Most of the site is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL



Source: DOE 2002k.

Figure 4.2.1.1–1. Location of Los Alamos National Laboratory



Source: DOE 2002k.

Figure 4.2.1.1–2. Land Use at Los Alamos National Laboratory

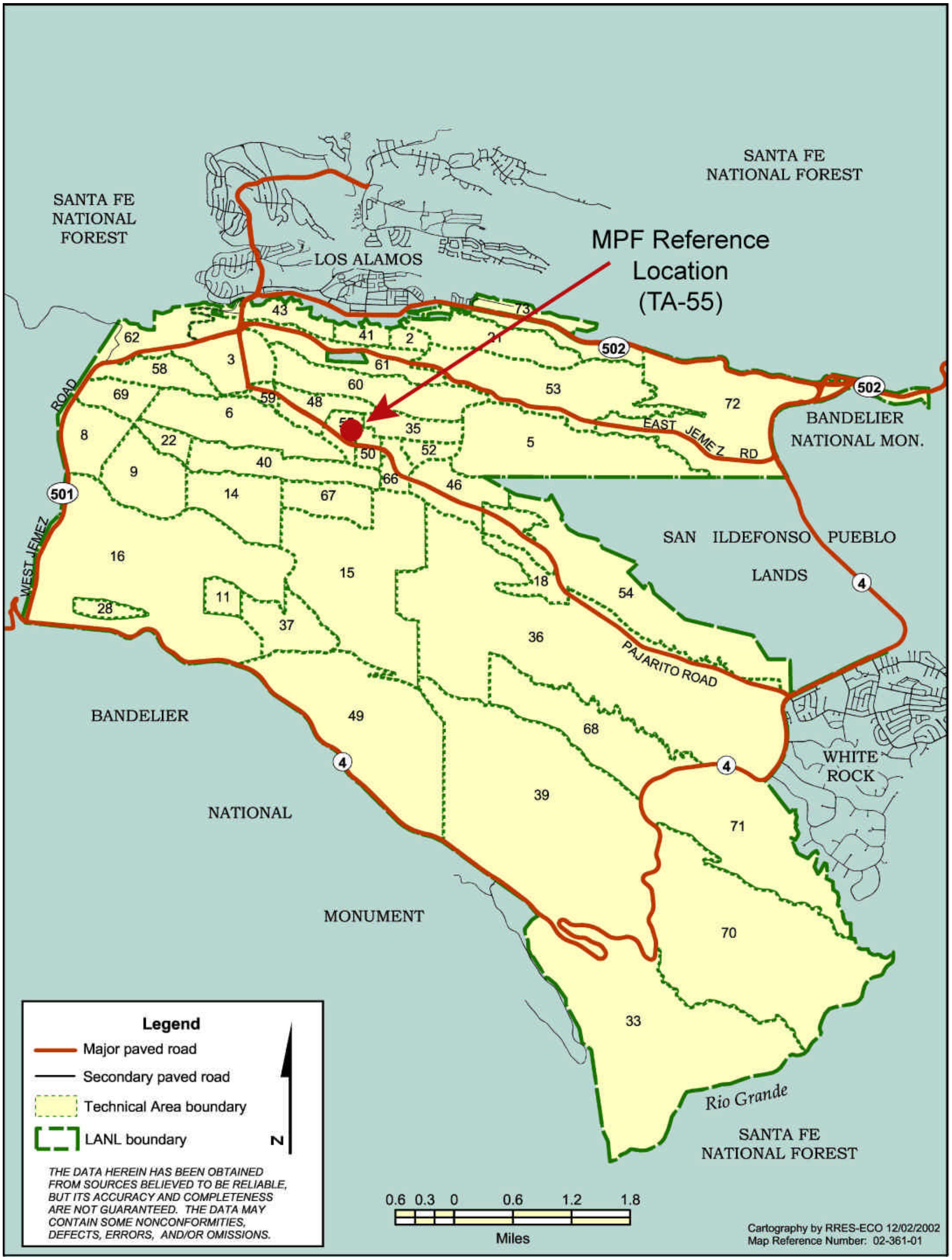


Figure 4.2.1.1–3. Los Alamos Site

as a National Environmental Research Park, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on pinyon-juniper woodland ecosystems (DOE 1996e). In 1999, the White Rock Canyon Wildlife Reserve was dedicated. It is about 405 ha (1,000 ac) in size and is located on the southeast perimeter of LANL. The reserve is managed jointly by DOE and the National Park Service (LANL 2000c).

Land use characterization at LANL is based on the most hazardous activities in each TA and may be organized into six categories: Support, Research and Development (R&D), Waste Disposal, Explosives, Explosives/Waste Disposal, and Buffer (see Figure 4.2.1.1–2). Any actual future consideration of changing land use within a particular LANL land use category location would be guided by LANL's 10-Year Comprehensive Site Plan (LANL 2002d).

TA-55, the reference location for the MPF, is located within the R&D land use category (see Figures 4.2.1.1–2 and 4.2.1.1–3). Facilities at TA-55 are located on a 16-ha (40-ac) site that is situated 1.8 km (1.1 mi) south of the city of Los Alamos. Forty-seven percent of the site has been developed. The main complex has five connected buildings; the Nuclear Materials Storage Facility is separate from the main complex but shares an underground transfer tunnel.

Section 632 of the "Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, FY1998," (Public Law 105-119) directs the Secretary of Energy to convey parcels of land that are identified by DOE as being suitable for conveyance or transfer. These parcels would be those that are not now required to meet the national security mission of DOE or would not be required for that purpose before the end of the next 10-year period. Ten parcels of land totaling approximately 1,619 ha (4,000 ac) are no longer considered necessary to LANL's mission and have been identified for transfer. The land is to be transferred to Los Alamos County or the San Ildefonso Pueblo for community self-sufficiency, economic diversification or historical, cultural, or environmental preservation. As mandated remediation efforts are completed, the land parcels are transferred. The first transfer, approximately 13.4 square kilometers ($km^{2)}$ (5.2 square miles [mi^2]), occurred on October 1, 2002.

In May 2000, a wildfire known as the Cerro Grande Fire, burned approximately 17,462 ha (43,150 ac), of which 3,110 ha (7,684 ac) were within the boundaries of LANL. Within LANL, 45 structures (trailers, transportables, and storage units) were totally destroyed and 67 were damaged. The fire also affected land use in the Los Alamos townsite, where about 230 housing units were totally destroyed (LANL 2000a, DOE 2000f).

The Los Alamos County Comprehensive Plan, which establishes land-planning issues and objectives, addresses private and county lands comprising 3,488 ha (8,613 ac). Twenty-nine percent of this land is located within the Los Alamos townsite and 26 percent is located in the community of White Rock. The remaining 45 percent of the land is undeveloped and is used for recreational activities and open space. LANL is autonomous from a planning perspective and, therefore, is not addressed in the county plan. Land use designations in the Santa Fe County Plan are based on groundwater protection goals. Therefore, this plan designates LANL as "Agricultural and Residential," although, as noted above, there are no agricultural activities on site, nor are there any residential uses within LANL boundaries (DOE 1996e).

4.2.1.2 Visual Resources

The topography in northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the land form. Often, little vegetation grows on these steep slopes, exposing the geology, with contrasting horizontal planes varying from fairly bright reddish orange to almost white in color. Undeveloped lands within LANL have a U.S. Department of Interior BLM Visual Resource Management rating of Class II and III. Table 4.2.1.2–1 below lists and defines the rating system. Management activities within these classes may be seen but should not dominate the viewshed (the topographically bounded area that may be viewed from this location).

Table 4.2.1.2–1. Bureau of Land Management Visual Resource Management Classification Objectives

Classification	Objective
Class I	To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

Source: DOI 2001.

Views from various locations in Los Alamos County and its immediate surroundings have been altered by the Cerro Grande Fire. Although the visual environment is still diverse and panoramic, portions of the visual landscape since the Cerro Grande Fire are dramatically stark. Rocky outcrops forming the mountains are now visible through the burned forest areas. The eastern slopes of the Jemez Mountains, instead of presenting a relatively uniform view of dense green forest, are now a mosaic of burned and unburned areas. Local effects include reduced visual appeal of trails and recreation areas (DOE 2000f).

The majority of TAs are located on mesas. At lower elevations, at a distance of several miles away from LANL, the facility is primarily distinguishable in the daytime by views of its water storage towers, emission stacks, and occasional glimpses of older buildings that are very austere and industrial in appearance. At elevations above LANL, along the upper reaches of the Pajarito Plateau rim, the view of LANL is primarily of scattered austere buildings and the nested multi-story buildings of TA-3. Developed areas within LANL are consistent with a Class IV Visual Resource Management rating, in which a major modification of previous natural landscape dominates the view and is the focus of viewer attention. At night, the lights of LANL are directly visible from various locations across the viewshed as far away as the towns of Española and Santa Fe.

TA-55 is located on a mesa about 1.6 km (1 mi) southeast of TA-3. While not visible from lower elevations, TA-55 is visible from higher elevations to the west along the upper reaches of the Pajarito Plateau rim. It appears as one of several scattered built-up areas among the heavily forested areas of the site. Developed portions of TA-55 would have a Class IV Visual Resource Management rating.

4.2.2 Site Infrastructure

An extensive network of existing infrastructure provides services to LANL activities and facilities as shown in Table 4.2.2–1. These services are discussed in detail in the following sections. Two categories of infrastructure—transportation access and utilities—are described below for LANL. Transportation access includes roads, railroads, and airports while utilities include electricity and fuel (e.g., natural gas, gasoline, and coal).

Table 4.2.2–1. LANL Site-wide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	130[a]	NA
Railroads (km)	0	NA
Electricity[b]		
Energy consumption (MWh/yr)	491,186	963,600
Peak load (MWe)	83	107
Fuel		
Natural gas (m^3/yr)	70,000,000[c]	229,400,000[d]
Liquid fuels (L/yr)	Negligible	Not limited
Coal (t/yr)	0	NA

NA = not applicable.
[a] Includes paved roads and paved parking lots only.
[b] Usage and capacity values are for the entire Los Alamos Power Pool.
[c] Usage value for LANL plus baseline usage for other Los Alamos County users.
[d] Entire service area capacity which includes LANL and other Los Alamos area users.
Source: DOE 2002k.

4.2.2.1 Transportation

Two state roads provide access to LANL. New Mexico State Highway (NM) 501 (West Jemez Road) enters the region from the south and NM 502 enters from the east. The roads used to access the site have some sharp curves due to the location of LANL on a mesa approximately 213-305 m (700-1,000 ft) above the canyon floor. NM 502 is a two- to five-lane highway that winds steeply as it rises from the canyon floor. Other roads into the LANL area, NM 501, East Jemez Road, and Pajarito Road are all two-lane roads. There are approximately 130 km (80 mi) of paved roads and paved parking areas at LANL. The site has no rail service and the nearest commercial rail system is in Lamy, New Mexico, 83 km (52 mi) south of LANL (DOE 1999g). Los Alamos has a small airport which is located parallel to East Road at the southern edge of the Los Alamos community. The airport is owned by the Federal Government but is operated and maintained by Los Alamos County. The airport provides limited commercial services through specialized contract carriers (DOE 1999a). Larger commercial airports are located in Albuquerque and Santa Fe.

4.2.2.2 Electrical Power

Electricity is supplied to LANL via two regional 115-kilovolt (kV) transmission lines, the Norton-Los Alamos Line and the Reeves Line, by the Los Alamos Power Pool, a group of hydroelectric, coal, and natural gas power generators located throughout the western United States (DOE 2002k). A gas-fired steam/power plant located in TA-3 also can generate additional power on an as-needed basis. DOE maintains various low-voltage transformers at LANL facilities and approximately 55 km (34 mi) of 13.8-kV distribution lines (DOE 2000b, DOE 2002k).

Contractually, LANL receives 73 megawatts (MW) of electricity during the winter months and approximately 95 MW during spring and early summer months from the Los Alamos Power Pool (LANL 2000b). Onsite electrical power generation capacity from the TA-3 gas-fired steam/power plant is approximately 12 MW in the summer and 15 MW during winter. The steam/power plant provides the additional electricity necessary to meet peak load demands exceeding the allowable supply. The TA-3 steam/power plant and much of the electrical distribution system at LANL have past or are nearing the end of their design life and require replacing or upgrading. Construction and operation of a new 115-kV power line is planned and would originate at the existing Norton Substation near White Rock and terminate at the proposed DOE-administered West Technical Area Substation (DOE 2000b, DOE 2002k).

Electricity consumption and peak demands have historically fluctuated due to the power demand of the Los Alamos Neutron Science Center. Site electrical capacity is 963,600 megawatt hour per year (MWh/yr), based on a summer peak load capacity of 110 megawatt electric (MWe) (DOE 1999g). Peak load usage was 83 MWe in fiscal year 2000 (DOE 2002k).

4.2.2.3 Fuel

Natural gas is the primary fuel used by the Los Alamos townsite and at LANL. At LANL, natural gas is burned to produce steam to heat buildings and meet peak demands (LANL 2000b). The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. In August 1999, DOE sold a 209-km (130-mi) long main gas supply line and metering stations for the Los Alamos townsite and vicinity to the Public Service Company of New Mexico (LANL 2000b). Contractually, LANL receives 229 millioncubic meters (m^3) (8.07 billion cubic feet [ft^3]) of natural gas per year. In addition to natural gas, small quantities of oil are used as a backup fuel source (DOE 1999g, DOE 2002k).

4.2.3 Air Quality and Noise

4.2.3.1 Climate and Meteorology

Los Alamos has a semiarid, temperate mountain climate. This climate is characterized by seasonable, variable rainfall with precipitation ranging from 25 to 51 centimeters (cm) (10 to 20 inches [in]) per year. The climate of the Los Alamos townsite is not as arid (dry) as that part near the Rio Grande River, which is arid continental. Meteorological conditions within Los Alamos are influenced by the elevation of the Pajarito Plateau. Climatological averages for atmospheric variables such as temperature, pressure, winds, and precipitation presented are based on observations made at the official Los Alamos meteorological weather station from 1961-1990. Normal (30-year mean) minimum and maximum temperatures for the community of Los Alamos range from a mean low of -8.1 degrees Celsius (°C) (17.4 degrees Fahrenheit [°F]) in January to a mean high of 27°C (80.6°F) in July. Normal (30-year mean) minimum and maximum temperatures for the community of White Rock, range from a mean low of -9.7ºC (14.6ºF) in January to a mean high of 29.8ºC (85.6ºF) in July. Temperatures in Los Alamos vary with altitude, averaging 3 °C (5°F) higher in and near the Rio Grande Valley, which is 1,981 m (6,500 ft) above sea level, and 3 to 5.5°C (5 to 10°F) lower in the Jemez Mountains, which are 2,600 to 3,050 m (8,500 to 10,000 ft) above sea level. Los Alamos townsite temperatures have dropped as low as -28°C (-18°F) and have reached as high as 35°C (95°F). The normal annual precipitation for Los Alamos is approximately 48 cm (19 in). Annual precipitation rates within the county decline toward the Rio Grande Valley, with the normal precipitation for White Rock at approximately 34 cm (14 in). The Jemez Mountains receive over 64 cm (25 in) of precipitation annually. The lowest recorded annual precipitation in the Los Alamos townsite was 17 cm (7 in) and the highest was 100 cm (39 in).

Thirty-six percent of the annual precipitation for Los Alamos County and LANL results from thundershowers that occur in July and August. Winter precipitation falls primarily as snow. Average annual snowfall is approximately 150 cm (59 in), but can vary considerably from year to year. Annual snowfall ranges from a minimum of 24 cm (9 in) to a maximum of 389 cm (153 in).

Los Alamos County winds average 3 meters per second (m/s) (7 mile per hour [mph]). Wind speeds vary throughout the year, with the lowest wind speeds occurring in December and January. The highest winds occur in the spring (March through June), due to intense storms and cold fronts. The highest recorded wind in Los Alamos County was 34 m/s (77 mph). Surface winds often vary dramatically with the time of day, location, and elevation, due to Los Alamos' complex terrain.

In addition to seasonal changes in wind conditions, surface winds often vary with the time of day. An up-slope airflow often develops over the Pajarito Plateau in the morning hours. By noon, winds from the south usually prevail over the entire plateau. The prevalent nighttime flow ranges from the west-southwest to northwest over the western portion of the plateau. These nighttime winds result from cold air drainage off the Jemez Mountains and the Pajarito Plateau. Analyses of Los Alamos Canyon wind data indicate a difference between the atmospheric flow in the canyon and the atmospheric flow over the Pajarito Plateau. Cold air drainage flow is observed about 75 percent of the time during the night and continues for an hour or two after sunrise until an up-canyon flow forms. Wind conditions are discussed further in the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (LANL SWEIS) (DOE 1999a).

Thunderstorms are common in Los Alamos County, with an average of 60 thunderstorms occurring in a year. Lightning can be frequent and intense. The average number of lightning-caused fires in the 1,104 ha (2,727 ac) of Bandelier National Monument from 1990-1994 was 12 per year. There are no recorded instances of large-scale flooding in Los Alamos County. However, flash floods from heavy thunderstorms are possible in areas such as arroyos, canyons, and low-lying areas. No tornadoes are known to have touched the ground in the Los Alamos area.

4.2.3.2 Nonradiological Releases

LANL operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. LANL is located within the Upper Rio Grande Valley Intrastate Air Quality Control Region (AQCR). The area encompassing LANL and Los Alamos County is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) (40 CFR 81.332).

In addition to the National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (EPA), the State of New Mexico has established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates, hydrogen sulfide, and total reduced sulfur. Additionally, New Mexico established permitting requirements for new or modified sources of regulated air pollutants. Air quality permits have been obtained from the State Air Quality Bureau for beryllium operations, a rock crusher, an asphalt plant, a diesel generator, and power plant that were modified or constructed after August 31, 1972. In accordance with Title V of the *Clean Air Act*, as amended, and New Mexico Administrative Code 20.2.70.402, the University of California and DOE submitted a site-wide operating permit application to the New Mexico Environment Department (NMED) in December 1995. The NMED ruled this application complete but did not process it. LANL submitted an updated Title V application in November 2002, which replaced the 1995 application. NMED ruled this application complete in December 2002 and is currently processing it.

Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers, emergency generators, and motor vehicles. Table 4.2.3.2–1 presents information regarding the primary existing sources. Toxic air pollutant emissions from LANL activities are released primarily from laboratory, maintenance, and waste management operations. Unlike a production facility with well-defined operational processes and schedules, LANL is a R&D facility with great fluctuations in both the types of chemicals emitted and their emission rates. DOE has a program to review new operations for their potential to emit air pollutants.

Table 4.2.3.2–1. Air Pollutant Emissions at LANL in 2001

Pollutant	LANL Emissions [a] (metric tons per year)
Carbon monoxide	26
Nitrogen dioxide	85
Sulfur dioxide	0.7
PM_{10}	5
VOC	22

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
VOC = Volatile organic compounds. VOC emissions are ozone precursors.
[a] Emissions from the following were included: TA-3 Steam Plant; TA-21 Steam Plant; TA-16 Boilers; TA-48 Boiler; TA-53 Boiler; TA-59 Boiler; paper shredder; TA-3 Asphalt Plant; TA-54 Water Pump; and TA-55 Boilers. The inventory did not include various small sources such as residential-size boilers, standby emergency generators, and small heating units which burn propane or natural gas.
Source: LANL 2002b.

Only a limited amount of monitoring of the ambient air has been performed for nonradiological air pollutants within the LANL region. The NMED operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) levels (see Table 4.2.3.2–2). LANL and the NMED discontinued operation of this station in FY95 because recorded values were well below applicable standards. Beryllium monitoring performed in 1999 at 9 onsite stations, 10 perimeter stations, and 6 regional stations showed that beryllium levels were low. The New Mexico beryllium ambient standard has been repealed.

Table 4.2.3.2–2. LANL Nonradiological Ambient Air Monitoring Results

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Ambient Concentrations[b] (micrograms per m^3)
Nitrogen dioxide	Annual	73.7[c]	4
	24-hour	147[c]	9
Sulfur dioxide	Annual	41[c]	2
	24-hour	205[c]	18
	3-hour	1,030[d]	Not applicable
PM_{10}	Annual	50[d]	8
	24-hour	150[d]	29
Ozone	1-hour	235[d]	138

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] 1994 ambient concentrations from monitoring site near Bandelier National Monument at TA-49.
[c] State standard.
[d] Federal standard (NAAQS).
Source: DOE 1999a.

Criteria pollutant concentrations attributable to existing LANL activities were estimated for the LANL SWEIS and are presented in Table 4.2.3.2–3.

For toxic air pollutants, a bounding analysis was performed for the LANL SWEIS (DOE 1999a), indicating that the pollutants of concern for exceeding the guideline values at LANL were emissions from the High Explosives Firing Site operations and emissions that contributed to additive risk from all TAs on receptors near the Los Alamos Medical Center. These combined cancer risks were dominated by the chloroform emissions from the Health Research Laboratory. It was shown that pollutants released under the No Action Alternative in the LANL SWEIS are not expected to cause air quality impacts that would affect human health and the environment (DOE 1999a).

As reported in a special environmental analysis for the Cerro Grande Fire in 2000 (DOE 2000f), there may be some temporary increase in suspended particulate matter as a result of removal of vegetation cover, but air quality would be expected to be within the parameters analyzed in the LANL SWEIS.

In accordance with the *Clean Air Act*, as amended, and New Mexico regulations, the Bandelier Wilderness Area have been designated as a Class I area (i.e., wilderness areas that exceed 4,047 ha [10,000 ac]), where visibility is considered to be an important value (40 CFR 81 and 20 NMAC 2.74) and requires protection. Visibility is measured according to a standard visual range, i.e., how far an image is transmitted through the atmosphere to an observer some distance away. The National Park Service at the Bandelier National Monument has officially monitored visibility in the area since 1988. The view distance at Bandelier Wilderness Area has been recorded from approximately 77-166 km (40-103 mi). The visual range has not deteriorated during the period for which data are available.

Table 4.2.3.2–3. Modeled Ambient Air Concentrations from LANL Sources

Pollutant	Averaging Period	Most Stringent Standard [a] (micrograms per m^3)	Maximum Estimated Concentration [b] (micrograms per m^3)
Carbon monoxide	8-hour	7,800 [c]	1,440
	1-hour	11,700 [c]	2,710
Lead	Calendar Quarter	1.5	0.00007
Nitrogen dioxide	Annual	73.7 [c]	9
	24-hour	147 [c]	90
Sulfur dioxide	Annual	41 [c]	18
	24-hour	205 [c]	130
	3-hour	1,030 [d]	254
PM_{10}	Annual	50 [d]	1
	24-hour	150 [d]	9
Total Suspended Particulates	Annual	60 [c]	2
	24-hour	150 [c]	18

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] The more stringent of the Federal and state standards is presented, if both exist, for the averaging period. The NAAQS (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million (ppm). These values have been converted to micrograms per cubic meter (μg/m^3) with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 m [7,005 ft]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] Based on the Expanded Operations Alternative in the LANL SWEIS. The annual concentrations were analyzed at locations to which the public has access—the site boundary or nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of certain technical areas to which the public has short access.

[c] State standard.

[d] Federal standard (NAAQS).

Source: DOE 1999a.

4.2.3.3 Radiological Releases

Radiological air emissions in 2001 from all LANL TAs are presented in Table 4.2.3.3–1. The airborne releases in 2001 were smaller than the annual projections given in the LANL SWEIS (DOE 1999a). The difference in the projected and actual releases is attributable to the fact that the facilities in the areas were operated well below their capacities in 2001.

Table 4.2.3.3–1. LANL Radiological Airborne Releases to the Environment in 2001[a]

Emission Type	Radionuclide	LANL emission (curies)
Noble gases	Argon-41	1.6×10^{1}
Airborne particulates	Galluim-68	1.2×10^{-3}
	Germanium-68	1.2×10^{-3}
	Arsenic-73	4.2×10^{-5}
	Arsenic-74	1.1×10^{-5}
	Mercury-197	1.0×10^{-1}
	Uranium-234/235/238	7.3×10^{-6}
	Plutonium-238/239/240	9.3×10^{-6}
	Americum-241	2.7×10^{-7}
Halogens	Bromine-76	2.6×10^{-4}
	Bromine-82	4.2×10^{-3}
Nitrogens and oxygens	Nitrogen-13	1.3×10^{2}
Tritium and carbons	Tritium (Hydrogen-3)	9.4×10^{3}
	Carbon-11	2.0×10^{0}

[a] Radionuclides with half-lives less than about 10 minutes are not included in the table (e.g., short-lived carbon, oxygen, and nitrogen isotopes). Also, not included are radionuclides for which less than 10^{-6} curies are released per year.
Source: LANL 2002b.

4.2.3.4 Noise

Existing LANL-related publicly detectable noise levels are generated by a variety of sources, including truck and automobile movements to and from the LANL TAs, high explosives testing, and security guards' firearms practice activities. Noise levels within Los Alamos County unrelated to LANL are generated predominately by traffic movements and, to a much lesser degree, other residential-, commercial-, and industrial-related activities within the county and surrounding areas. Limited data currently exist on the levels of routine background ambient noise levels, air blasts, or ground vibrations produced by LANL operations that include explosives detonations.

Noise generated by LANL operations, together with the audible portions of explosives air blasts, is regulated by county ordinance and worker protection standards. The standard unit used to report sound pressure levels is the decibel (dB); the A-weighted frequency scale (dBA) is an expression of adjusted pressure levels by frequency that accounts for human perception of loudness. Los Alamos County has promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA during daytime hours (between 7 a.m. and 9 p.m.) and 53 dBA during nighttime hours (between 9 p.m. and 7 a.m.). Between 7 a.m. and 9 p.m., the permissible noise level can be increased to 75 dBA in residential areas, provided the noise is limited to 10 minutes in any one hour. Activities that do not meet the noise ordinance limits require a permit.

Traffic noise contributes heavily to the background noise heard by humans over most of the county. Although some measurements of sound specifically targeting traffic-generated noise have been made at various county locations in recent studies, these sound levels are found to be highly dependent upon the exact measuring location, time of day, and meteorological conditions. There is, therefore, no single representative measurement of ambient traffic noise for LANL. Noise generated by traffic has been computer modeled to estimate the impact of incremental traffic for various studies, including recent NEPA analyses, without demonstrating meaningful change from current levels due to any new activities. While very few measurements of nonspecific background ambient noise in the LANL area have been made, two such measurements have been taken at a couple of locations near the LANL boundaries next to public roadways. Background noise levels were found to range from 31-35 dBA at the vicinity of the entrance to Bandelier National Monument and NM 4. At White Rock, background noise levels range from 38-51 dBA (1-hour equivalent sound level); this is slightly higher than was found near Bandelier National Monument, probably due to higher levels of traffic and the presence of a residential neighborhood, as well as the different physical setting. Traffic noise from truck and automobile movements around the LANL TAs is excepted under Los Alamos County noise regulations, as is the traffic noise generated along public thoroughfares within the county.

The detonation of high explosives represents the peak noise level generated by LANL operations. The results of these detonations are air blasts and ground vibrations. The primary source of these detonation activities is the high explosives experiments conducted at the LANL Pulsed High-Energy Radiation Machine Emitting X-Rays Facility and surrounding TAs with active firing sites. Within the foreseeable future, the Dual Axis Radiographic Hydrodynamic Test Facility will begin operation (followed by a corresponding reduction of Pulsed High-Energy Radiation Machine Emitting X-Rays Facility operations) and will become a source of high explosives testing. Air blasts consist of higher-frequency, audible air pressure waves that accompany an explosives detonation. This noise can be heard by both workers and the area public. The lower-frequency air pressure waves are not audible, but may cause secondary and audible noises within a testing structure that may be heard by workers. Air blasts and most LANL-generated ground vibrations result from testing activities involving aboveground explosives research. The effects of vibration from existing activities at LANL are discussed further in the LANL SWEIS (DOE 1999a).

The forested condition of much of LANL (especially where explosives testing areas are located), the prevailing area atmospheric conditions, and the regional topography that consists of widely varied elevations and rock formations all influence how noise and vibrations can be both attenuated (lessened) and channeled away from receptors. These regional features are jointly responsible for there being little environmental noise pollution or ground vibration concerns to the area resulting from LANL operations. Sudden loud “booming” noises associated with explosives testing are similar to the sound of thunder and may occasionally startle members of the public and LANL workers alike.

Loss of large forest areas from the Cerro Grande Fire in 2000 has had an adverse effect on the ability of the surrounding environment to absorb noise. However, types of noise and noise levels associated with LANL and from activities in surrounding communities have not changed significantly as a result of the fire (DOE 2000f).

The Los Alamos County Community Development Department has determined that LANL does not need a special permit under the Los Alamos County Code because noise related to explosives testing is not prolonged, nor is it considered unusual to the Los Alamos community.

4.2.4 Water Resources

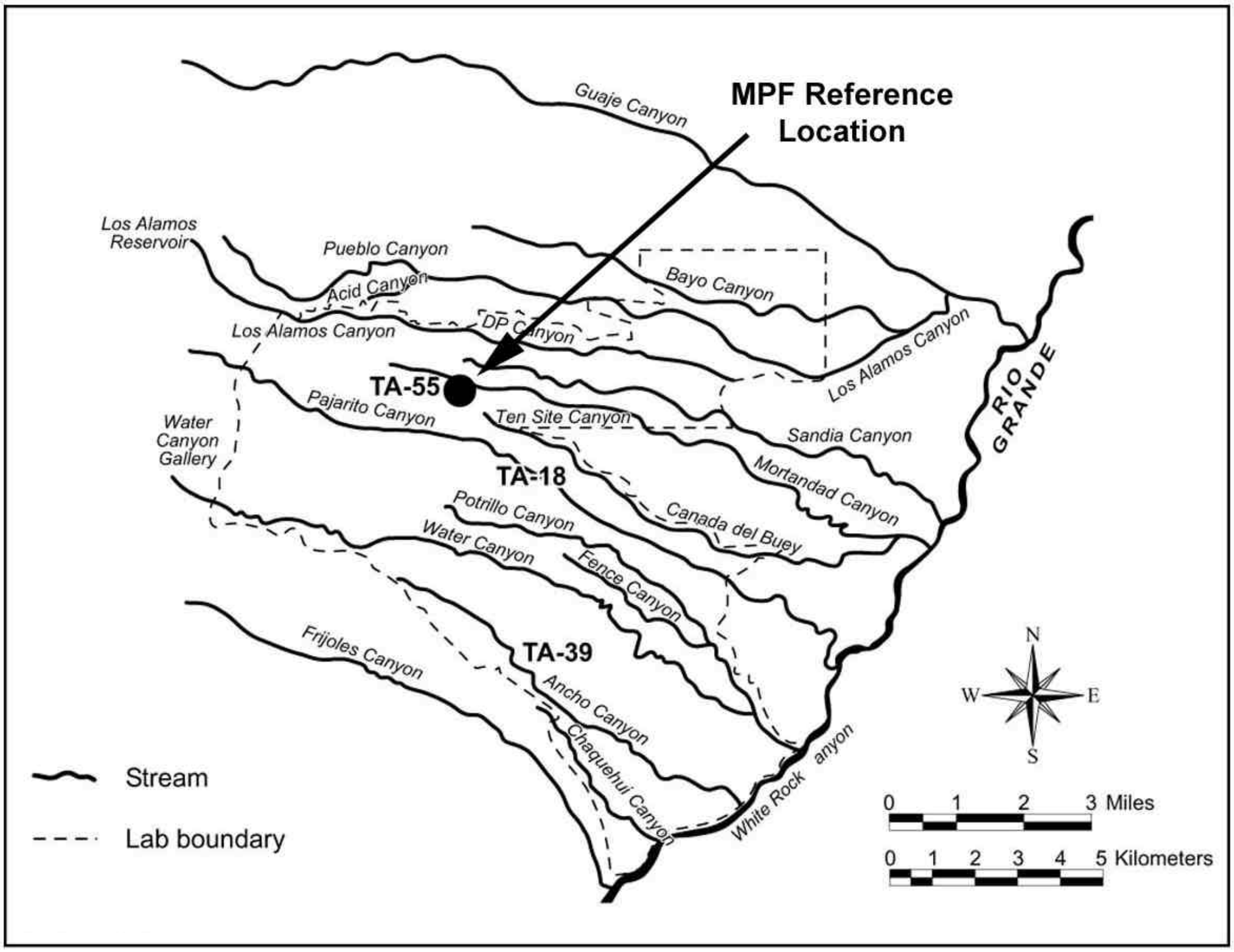
4.2.4.1 Surface Water

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams (i.e., arroyos). Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across LANL before they are depleted by evaporation, transpiration, and infiltration. Figure 4.2.4.1–1 shows the surface water features of the area. Runoff from heavy thunderstorm or heavy snowmelt reaches the Rio Grande River, the major river in north-central New Mexico, several times a year in some drainages. Pueblo, Los Alamos, Sandia, and Mortandad Canyons receive or have received effluents from sanitary sewage, industrial water treatment plants, and cooling-tower blowdown. All of the watersheds in the LANL region are tributaries to an 18-km (11-mi) segment of the Rio Grande between Otowi Bridge and Frijoles Canyon. The Rio Grande passes through Cochiti Lake, approximately 18 km (11 mi) below Frijoles Canyon. The Los Alamos Reservoir, in upper Los Alamos Canyon, has a capacity of 51,000 m^3 (41 acre-foot [ac-ft]). The reservoir water was used for recreation, swimming, fishing, and landscape irrigation in the Los Alamos townsite until the Cerro Grande Fire occurred in 2000. The reservoir is now used as a floodwater and silt retention structure and is closed to the public. The Pajarito Plateau Canyons, which serve as collection points for the regional watersheds, originate either along the eastern rim of the Sierra de Los Valles or on the Pajarito Plateau (DOE 2002k).

Within LANL boundaries, only Los Alamos, Pajarito, Water, Ancho, Sandia, Pueblo, and Chaquehui Canyons contain reaches or stream with sections that have continuous flow. Intermittent streams within LANL property are not classified, but are protected by the State of New Mexico for livestock watering and wildlife habitat use (DOE 2002k). Surface water within the boundaries of LANL is not the source for municipal, industrial, or irrigation water, but is used by wildlife that live within, or migrate through, the region.

Surface Water Quality

Most of the effluent from LANL is discharged into normally dry arroyos, and LANL is required to meet effluent limitations under the National Pollutant Discharge Elimination System (NPDES) permit program that requires routine monitoring. During 2001, permit compliance was determined from an analysis of 1,085 industrial outfall samples and 134 samples from the Sanitary Wastewater System Facility (Outfall 13S) for parameters including metals, radionuclides, and conventional parameters (e.g., pH, total suspended solids, oil and grease, and biological oxygen demand). Monitoring results were submitted to EPA and NMED. The NPDES permit compliance rate in 2001 for all discharge points was 99.6 percent, with a total of four industrial outfall samples exceeding permit limits (DOE 2002k).



Source: DOE 2002k.

Figure 4.2.4.1–1. Surface Water Features at LANL

LANL also operated under 11 NPDES stormwater discharge permits in 2001, including 10 issued for construction activities and one multisector general permit for stormwater discharges associated with industrial activity for which DOE and the University of California are co-permittees. As required under the multisector general permit, LANL performed stormwater monitoring in 2001 and developed and implemented 20 stormwater pollution prevention plans for its industrial activities (DOE 2002k). LANL (with DOE and the University of California as co-permittees) was re-issued a NPDES permit (No. NM0028355) in December 2000 that covers all onsite industrial and sanitary effluent discharges.

As a result of a subsequent outfall reduction program, the number of outfalls requiring monitoring under the permit was reduced from 36 (including 1 sanitary outfall from the Sanitary Wastewater System Facility and 35 industrial wastewater outfalls) to 21 in the recently re-issued permit. This reduction was achieved by removing process flows for seven industrial outfalls and completing the lease transfer of the drinking water system, including nine associated outfalls, to Los Alamos County.

LANL monitors surface waters from regional and Pajarito Plateau stations to evaluate the environmental effects of facility operations. Historical activities and resulting effluent discharges have affected water courses and associated sediments particularly in Acid, Pueblo, Los Alamos, and Mortandad Canyons and, consequently, continue to affect surface water and runoff quality in these areas (DOE 2002k). Surface water grab samples are collected annually from locations where effluent discharges or natural runoff maintains stream flow. Runoff samples are also collected and, since 1996, they have been collected using stream gauging stations, some with automated samplers. Samples are collected when a significant rainfall event causes flow in a monitored portion of a drainage. Many runoff stations are located where drainages cross the LANL boundaries.

In 2001, 44 snowmelt samples and 29 base flow samples were collected. None of the base flow or snowmelt samples analyzed contained radiochemical activities greater than the DOE Derived Concentration Guidelines (DCGs) for public exposure (see Table 4.2.4.1–1). Four samples of snowmelt contained radiochemical activities greater than New Mexico or EPA water quality standards. All of these samples came from areas below historical Laboratory effluent discharges. A sample collected on March 28, 2001 contained 139 pCi/L of dissolved gross beta, which is greater than the EPA primary drinking water standard of 50 pCi/L. The same sample also contained 76.6 pCi/L of dissolved strontium-90, which is greater than EPA primary drinking water standard of 8pCi/L. A different sample collected from another location on April 11, 2001 contained 14.9 pCi/L of dissolved strontium-90. Two unfiltered snowmelt samples collected on March 15 contained up to 26.8 pCi/L of gross alpha, 1.5 to 1.8 times the NM livestock watering standard.

A base flow sample collected on April 18, 2001 contained 12.1 pCi/L of strontium-90 and 92.9 pCi/L of gross beta activity, which are above EPA primary drinking water standards. Americium-241 found in the same sample was 165 pCi/L, which is 5.5 times the DOE drinking water standard of 30 pCi/L. An unfiltered base flow sample collected in 2001 along LANL's western boundary contained gross alpha activity of 16.7 pCi/L, which is greater than the EPA primary drinking water standard and the New Mexico livestock watering standard of 15 pCi/L.

A sample collected on March 28, 2001 contained 632 mg/L of total dissolved solid (TDS), which is above the EPA secondary drinking water standard of 500 mg/L. The total suspended solid (TSS) concentration in base flow and snowmelt samples collected in 2001 were usually less than 400 mg/L, which has no EPA drinking water standard for TSS.

Only one sample analyzed for trace metals contained a metal concentration greater than New Mexico Water Quality Control Commission (NMWQCC) standards for livestock watering or wildlife habitat. The analysis detected selenium at a concentration of 5.6 μg/L, slightly above the NMWQCC standard of 5.0 μg/L.

Storm runoff samples were collected on 30 days during the 2001 season, with over 100 storm runoff samples collected from April through October. The 2001 samples had the highest ever recorded plutonium-239, -240, uranium-234, -235, -238, gross alpha and gross beta concentrations. In most cases, the enhanced radioactivity is attributed to increased storm runoff after the Cerro Grande Fire in 2000. In unfiltered samples, gross alpha were greater than public exposure DCG levels (30 pCi/L) and state of New Mexico livestock watering standards (15 pCi/L) in about three-fourths of all samples collected. The plutonium-239, -240 DCG for public exposure was exceeded in three samples. The calculated plutonium-239, -240 for the suspended sediment carried by these storm runoff events are 4.4 pCi/g, 1.6 pCi/g, and 1.2 pCi/g.

Table 4.2.4.1–1. LANL Snowmelt and Baseflow Radiological Constituents Sampling of Surface Water in 2001

Location and Radioactive Constituent	DCG (or MCL)	Result Range (pCi/L)
Los Alamos Canyon		
Strontium-90	1,000 pCi/L	0.361-14.9
Americum-241	NS	0.0379-0.189
Plutonium-239 and Plutonium-240	30 pCi/L	0.048-0.579
Gross Alpha	15 pCi/L	22.7-26.8
Gross Beta	4 mrem/yr	26.4-165
Tritium	2,000,000 pCi/L	184-235
Sandia Canyon		
Strontium-90	1,000 pCi/L	0.281-0.325
Mortandad Canyon		
Strontium-90	1,000 pCi/L	12.1
Americum-241	NS	6.54
Plutonium-239 and Plutonium-240	30 pCi/L	1.52-1.78
Cesium-137	200 pCi/L	10.8
Tritium	2,000,000 pCi/L	3140
Gross Beta	4 mrem/yr	92.9
Pajarito Canyon		
Strontium-90	1,000 pCi/L	0.211-2.47
Cesium-137	200 pCi/L	8.43-8.79

MCL= Maximum Contaminant Level; State Primary Water Regulations. MCL is the maximum permissible level of a contaminant in water that is delivered to the free flowing outlet of the ultimate user of a public water system.
DCG= DOE Derived Concentration Guides for Water (DOE Order 5400.5). DCG values are based on committed effective dose of 100 millirem per year (mrem/yr); however, because drinking water MCL is based on 4 mrem/yr, value listed is 4 percent of DCG.
NS= No Standard.
Source: LANL 2002b.

All filtered samples contained radionuclide levels below the EPA and DOE drinking water standards, with one exception. One sample contained dissolved strontium-90 at 1.1 times greater than the EPA standard.

For nearly every metal, the level of both filtered (dissolved) and unfiltered (total) storm runoff samples for 2001 were significantly higher than in prior years. As with the radionuclides, the increase in total metals concentrations is largely due to the increased sediment load in runoff after the Cerro Grande Fire. However, it is uncertain what the source of the larger dissolved metals concentration might be. Selenium exceeded the New Mexico wildlife habitat standard of 5 μg/L in nearly half of the unfiltered storm runoff samples. Mercury was detected at levels greater than the New Mexico wildlife habitat standard of 0.77 μg/L at one location. Aluminum concentration in four samples were greater than NMWQCC livestock watering standard and two samples had vanadium concentration greater than NMWQCC livestock watering standard. Two unfiltered samples contained arsenic at levels greater than the EPA arsenic drinking water standard of 10 µg/L.

TSS concentration in storm runoff samples collected in 2001 were highly variable, depending on location and runoff magnitude. The largest TSS concentration were recorded in Guaje and Rendija Canyons, which averaged 78,000 mg/L, with a maximum of 144,000 mg/L.

Surface Water Quality Effects of the Cerro Grande Fire

Among the environmental effects produced by the Cerro Grande Fire was an increased potential for stormwater runoff through the canyons that cross LANL property as a result of the loss of vegetation and soil organic matter. During the summer of 2000 and 2001, there was an increase in storm runoff from precipitation. Most storm runoff events at LANL in 2001 were less intense than in 2000, partially because of below normal amounts of precipitation during the summer thunderstorm season and possibly because of partial recovery of fire-impacted areas in the watershed (DOE 2002k).

Floodplains at LANL

DOE has delineated all 100-year floodplains within LANL boundaries, which are generally associated with canyon drainages. There are a number of structures within the 100-year floodplain. Most may be characterized as small storage buildings, guard stations, well heads, water treatment stations, and some light laboratory buildings. There are no waste management facilities in the 100-year floodplain. Some facilities are characterized as “moderate hazard” due to the presence of sealed sources or x-ray equipment, but most are designated “low hazard” or “no hazard.”

The 500-year floodplain has been designated for Los Alamos Canyon. Overall, the majority of laboratory development is on mesa tops, with only a few facilities located in the canyons (DOE 2002k). Nevertheless, for practical purposes the Cerro Grande Fire has increased the extent of all delineated floodplains in and below burned watershed areas (i.e., predominantly Los Alamos, Sandia, Mortandad, Pajarito, and Water Canyons) due to vegetation loss. This will allow more stormwater runoff to reach the canyon bottom and could subject LANL facilities located within or near the pre-fire delineated floodplain areas to increased erosion or sediment and debris deposition (DOE 2002k).

4.2.4.2 Groundwater

Groundwater in the Los Alamos area occurs as perched groundwater near the surface in shallow canyon bottom alluvium and at deeper levels in the main (regional) aquifer (DOE 2002k). Aquifers are classified by Federal and state authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively (DOE 1999g). Class III is not considered a potential source of drinking water and is of limited beneficial use. Most aquifers underlying LANL and the vicinity, except for perched groundwater bodies, are considered Class II aquifers. Alluvial groundwater bodies within LANL boundaries have been primarily characterized by drilling wells on a localized basis where LANL operations are conducted. Wells in Mortandad, Los Alamos, Pueblo, and Pajarito Canyons and in Cañada del Buey indicate the presence of alluvial aquifers. Groundwater flow is generally to the east.

Intermediate perched groundwater bodies of limited extent are known to occur within the conglomerates and basalts beneath the alluvium in portions of Pueblo, Los Alamos, Sandia, and Mortandad Canyons, in volcanic rocks on the sides of the Jemez Mountains to the west of LANL (from which it discharges at spring heads), and on the western portion of the Pajarito Plateau (DOE 2002k). The location and extent of perched groundwater bodies have not been fully characterized at LANL, but investigations are continuing, and unidentified perched aquifers may exist. The depth to perched groundwater from the surface ranges from approximately 27 m (90 ft) in the middle of Pueblo Canyon to about 137 m (450 ft) in lower Sandia Canyon.

The regional aquifer, below the perched aquifer zone, exists in the sedimentary and volcanic rocks of the Española Basin, with a lateral extent from the Jemez Mountains in the west to the Sangre de Cristo Mountains in the east. The hydrostratigraphic (water-bearing) units comprising the regional aquifer include the interconnected Puye Formation and the Tesuque Formation of the Santa Fe Group. The regional aquifer is hydraulically separated from the overlying alluvial and intermediate perched groundwater bodies by unsaturated volcanic tuff and sedimentary strata, with the regional water table surface lying at a depth below land surface that varies from approximately 366 m (1,200 ft) along the western boundary of the Pajarito Plateau to approximately 183 m (600 ft) along its eastern edge. Thus, these hydrogeologic conditions tend to insulate the regional aquifer from near-surface waste management activities. Water in the regional aquifer is under artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande.

Recharge of the regional aquifer has not been fully characterized and its sources are uncertain. Data suggest that the regional aquifer of the Española Basin is not strongly interconnected across its extent. Recent investigations further suggest that the majority of water pumped to date has been from storage, with minimal recharge of the regional aquifer (DOE 2002k). While the regional aquifer is present beneath all watersheds across the LANL region, it is also generally considered to receive negligible recharge from surface water stream in the watersheds. The regional aquifer is the only body of groundwater in the region that is sufficiently saturated and permeable to transmit economic quantities of water to wells for public use. All drinking water for Los Alamos County, LANL, and Bandelier National Monument comes from the regional aquifer.

Springs in the LANL area originate from alluvial and intermediate perched groundwater bodies and the regional aquifer and occur in the Guaje, Pueblo, Los Alamos, Pajarito, Frijoles, and White Rock Canyon watersheds. In particular, 27 springs discharge from the regional aquifer into White Rock Canyon. A perched aquifer yields a relatively high flow to a former potable water supply gallery in Water Canyon (DOE 2002k).

LANL receives its water from the Los Alamos water supply system, which consists of 12 deep wells, 246 km (153 mi) of main distribution lines, pump stations, storage tanks, and 9 chlorination stations. DOE transferred operation of the system from LANL to the county under a lease agreement in 1998 with a subsequent transfer of ownership in 2001. With the transfer, the county had full responsibility for operating the water system, including ensuring compliance with Federal and state drinking water regulations (LANL 2000c). Under the provisions of the transfer agreement, LANL retained responsibility for operating the distribution system within the site boundaries (DOE 2002k). As part of the transfer agreement, 70 percent of the total water right was assigned to the County, with DOE retaining 30 percent. The DOE-retained portion was then leased to the County. Per the water sales agreement with the County, DOE agrees to purchase, and the County agrees to provide, all of the water needed by the DOE for LANL operations, which is approximately 30 percent of the total water rights (equivalent to about 2.05 billion L [542 million gal] annually).

Groundwater Quality

Groundwater monitoring is conducted annually within and near LANL and encompasses the alluvial zone, intermediate perched groundwater zone, regional aquifer, supply wells, and springs. The LANL *Resource Conservation and Recovery Act* (RCRA) permit specifically requires monitoring of the canyon alluvial groundwater system in Pueblo, Los Alamos, Sandia, Mortandad, Potrillo, Fence, and Water Canyons. One of the objectives of LANL's Environmental Surveillance and Compliance Programs is to provide indications of the potential for human and environmental exposure from contaminated groundwater resources. Groundwater may accumulate contaminants from discharges to surface water or from leakage of liquid effluent storage system.

Sampling for radiological constituents in the regional aquifers in 2001 shows that all of the results were below DOE DCG standards. There are no Federal or state radiological standards for the constituents detected (see Table 4.2.4.2–1). DCGs reflect the concentrations of individual nuclides in water or air that would result in an effective dose equivalent of 100 millirem per year (mrem/yr) caused by ingestion of water or inhalation of air at average annual intake rates. DCGs are not exposure limits, but are simply reference values provided to allow for comparisons of radionuclide concentrations in environmental media. Most of the results were near or below the detection limits of the analytical method used.

The test wells in the regional aquifer showed levels of several nonradiological constituents that approach or exceed standards for drinking water distribution systems (test wells are for monitoring purposes only and are not part of the water supply system). In 2001, iron approached or exceeded the EPA secondary drinking water standards for four test wells and exceeded the New Mexico groundwater standard in one test well. Manganese approached or exceeded the EPA secondary drinking water standard in two test wells. Two test wells had lead concentrations above the EPA action level, and one test well had an aluminum concentration above the EPA secondary drinking water standard.

During 2001, nitrate concentrations in alluvial groundwater at only one well were above the New Mexico nitrate groundwater standard of 10 mg/L. Fluoride concentrations at two wells exceeded NMWQCC groundwater standard of 1.6 mg/L. Perchlorate was detected in groundwater at every alluvial groundwater well sampled in 2001. Perchlorate concentrations ranged from 53 μg/L to 220 μg/L (there is no drinking water standard for perchlorate). The Cerro Grande Fire caused high manganese, aluminum, and iron concentrations in many alluvial perched groundwater samples. One sample had high aluminum and iron values, probably related to a high TSS of about 25 mg/L. Higher than usual manganese concentrations were found in Pueblo Canyon and Pajarito Canyon, which were both extensively burned in the Cerro Grande Fire (LANL 2002b).

Table 4.2.4.2–1. LANL Radiological Constituent Sampling of Groundwater

Location and Radioactive Constituent	DCG (pCi/L)	Result Ranges (pCi/L)
Regional Aquifer Wells		
Tritium	2,000,000	-133-186
Strontium-90	1,000	-0.71-0.0571
Cesium-137	200	-0.232-2.3
Uranium-234	500	0.0352-1.94
Uranium-235 and Uranium-236	600	0.0023-0.0562
Uranium-238	600	0.0222-1.07
Los Alamos Canyons		
Tritium	2,000,000	-27.9-455
Strontium-90	1,000	0.0478-52.1
Cesium-137	200	-1.33-0.964
Uranium-234	500	0.0044-0.168
Uranium-235 and Uranium-236	600	-0.00325-0.0245
Uranium-238	600	0.00442-0.0444
Mortandad Canyon		
Tritium	2,000,000	4,790-6,690
Strontium-90	1,000	-0.82-38.1
Cesium-137	200	-0.768-3.81
Uranium-234	500	0.887-0.917
Uranium-235 and Uranium-236	600	0.0361-0.0825
Uranium-238	600	0.292-0.333
Pajarito Canyon		
Tritium	2,000,000	-85.5-28.6
Strontium-90	1,000	0.107-0.393
Cesium-137	200	-0.079-0.942
Uranium-234	500	0.386-1.08
Uranium-235 and Uranium-236	600	-0.0142-0.0694
Uranium-238	600	-0.014-0.869
Santa Fe Water Supply Wells		
Tritium	2,000,000	ND
Strontium-90	1,000	-0.0861-0.146
Cesium-137	200	ND
Uranium-234	500	3.49-92.6
Uranium-235 and Uranium-236	600	0.113-0.692
Uranium-238	600	0.67-6.79

MCL= Maximum Contaminant Level; State Primary Water Regulations.
DCG= DOE Derived Concentration Guides for Water (DOE Order 5400.5). DCG values are based on committed effective dose of 100 millrem per year; however, because drinking water MCL is based on 4 mrem/yr, value listed is 4 percent of DCG.
ND = No Data.
Source: LANL 2002b.

4.2.5 Geology and Soils

4.2.5.1 Geology

LANL and the communities of Los Alamos and White Rock are located on the Pajarito Plateau in the Jemez Mountains of north-central New Mexico (see Figure 4.2.1.1–1). The Pajarito Plateau is 13-26 km (8-16 mi) wide and 48-64 km (30-40 mi) long, lying between the Jemez Mountains to the west and the Rio Grande to the east (DOE 1999a). The surface of the Pajarito Plateau is divided into numerous narrow, finger-like mesas separated by deep east-to-west oriented canyons that drain toward the Rio Grande River. The representative site being evaluated for the MPF is on the top of one of these mesas.

A primary geologic feature in the region is the Rio Grande Rift, which begins in northern Mexico, trends northward across central New Mexico, and ends in central Colorado. The north-trending Pajarito Fault system is part of the Rio Grande Rift and consists of a group of interconnecting faults that are nearly parallel (see Figure 4.2.5.1–1).

Rocks in the LANL region were predominantly produced by volcanic and sedimentary processes.

Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of the ground and infrastructure at LANL and includes potential volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

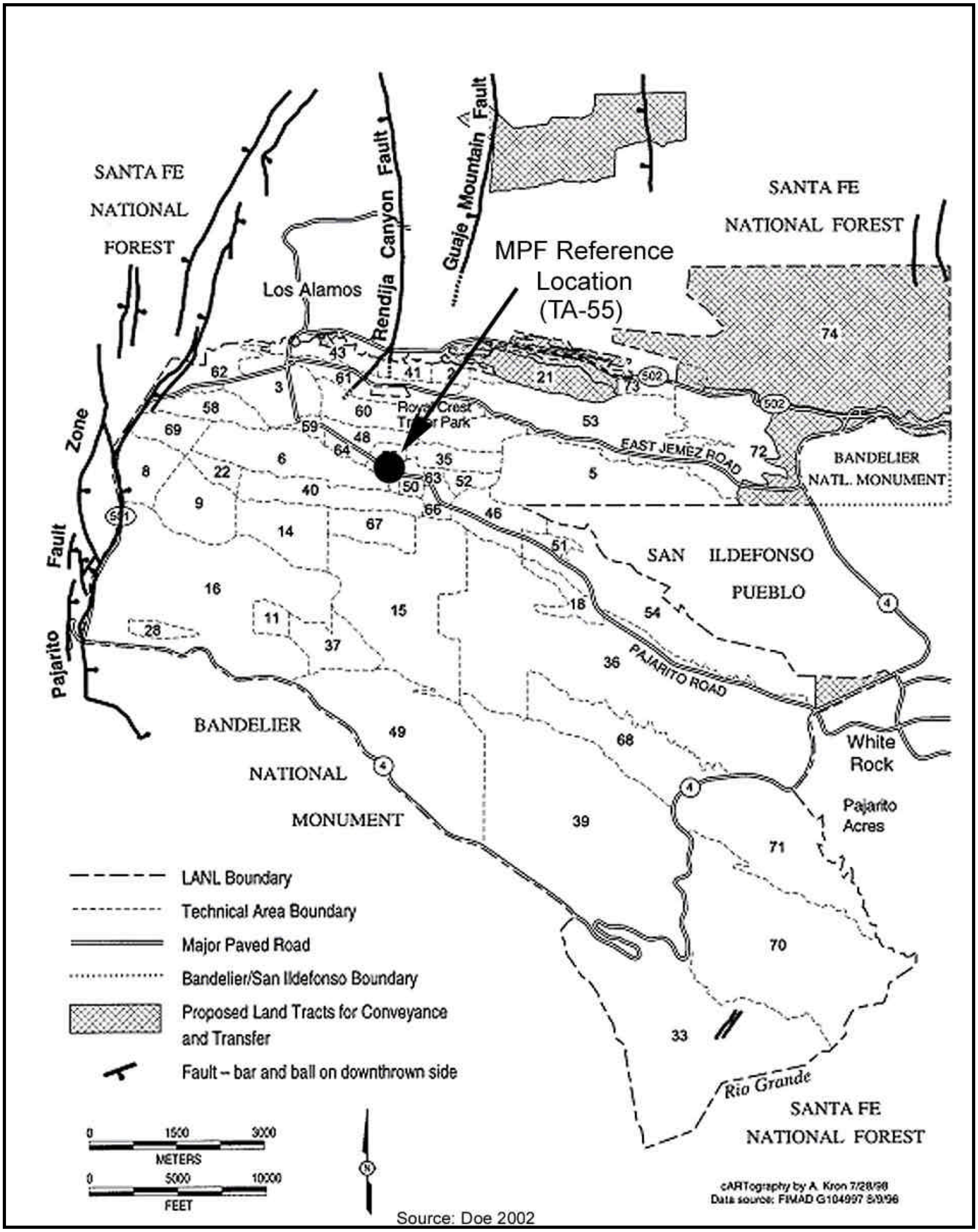
Volcanism

Volcanism in the Jemez Mountains' volcanic field, west of LANL, has a 13 million-year history. The Jemez Mountains currently show an unusually low amount of seismic activity, which suggests that no magma migration is occurring. Seismic signals may be partially absorbed deep in the subsurface due to elevated temperatures and high heat flow. Such masking of seismic signals would add difficulty in predicting volcanism in the LANL area. There are plans to install additional seismograph stations in the vicinity of the Valles Caldera to improve predictive capabilities (DOE 1999a).

Seismic Activity

A comprehensive seismic hazards study was completed in 1995 at LANL (DOE 1999a). This study provided estimates of the ground-shaking hazards and the resulting ground motions that may be caused by these earthquake sources.

The major faults in Los Alamos County are the Pajarito, Rendija Canyon, and Guaje Mountain Faults, and their characteristics are summarized in Table 4.2.5.1–1. Fault locations are shown on Figure 4.2.5.1–1.



Source: DOE 2002k.

Figure 4.2.5.1–1. Major Surface Faults in the Los Alamos Region

Table 4.2.5.1–1. Summary of Major Faults in the LANL Region

Name	Approximate Length (mi)	Type	Most Recent Movement	Maximum Earthquake[a] Potential
Pajarito Fault Zone	26	Normal, down-to-the-east[b]	Approximately 45,000 to 55,000 years ago	7
Rendija Canyon Fault	6	Normal, down-to-the-west	8,000 to 9,000 or 23,000 years ago	6.5
Guaje Mountain Fault	8	Normal, down-to-the-west	4,000 to 6,000 years ago	6.5

[a] Richter magnitude.
[b] The crustal block on the east side of the Pajarito Fault slips downward toward the east when fault movement occurs. This results in a fault plane for the Pajarito Fault, for example, that runs under LANL toward the east. A normal west fault involves the crustal block on the west side of the fault slipping downward toward the west.
Source: DOE 1999a.

The seismic hazards results indicate that the Pajarito Fault system represents the greatest potential seismic risk to facilities at LANL, with an estimated maximum earthquake Richter magnitude of about 7. Although large uncertainties exist, an earthquake with a Richter magnitude greater than or equal to 6 is estimated to occur once every 4,000 years; an earthquake with a magnitude greater than or equal to 7 is estimated to occur once every 100,000 years along the Pajarito Fault system. Earthquakes of this magnitude have an associated Modified Mercalli Intensity of IX and X, causing considerable damage to structures and underground pipes. Table 4.2.5.1–2 defines the Modified Mercalli Scale and approximate correlations to the Richter Scale.

Slope Stability, Subsidence, and Soil Liquefaction

The topography of this area is rugged. The nearly flat, gently sloped mesa tops are cut by deep canyons. In some cases, the canyon slopes are nearly vertical. Rockfalls and landslides are two geologic processes related to slope stability in the area. The primary risk factors most likely to affect slope stability are wall steepness, canyon depth, and stratigraphy. Because of this, land near a cliff edge or in a canyon bottom is potentially susceptible to slope instability. The largest slope instability may be triggered by any process that might destabilize supporting rocks. These processes include, but are not limited to, excessive rainfalls, erosion, and seismic activity.

Subsidence (lowering of the ground surface) and soil liquefaction are two geologic processes that are less likely to affect LANL than rockfalls or landslides. The potential for subsidence is minimal due to the firm rock beneath LANL. Bedrock, soils, and unconsolidated deposits that are unsaturated, such as those that occur beneath LANL, are unlikely to undergo liquefaction.

4.2.5.2 Soils

Several distinct soils have developed in Los Alamos County as a result of interactions between the bedrock, topography, and local climate. Soils that formed on mesa tops of the Pajarito Plateau include the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Prieta, Seaby, and Tocal soil series (DOE 1999a). Soils consisting of sediments derived from the mesa tops occur along most

Table 4.2.5.1–2. The Modified Mercalli Intensity Scale of 1931, with Approximate Correlations to the 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: DOE 2001e.

segments of LANL canyons as narrow bands of canyon-bottom deposits, which can be transported by surface water during runoff events.

All of the soils in the aforementioned soil series are well-drained and range from very shallow (0-25 cm [0-10 in]) to moderately deep (51-102 cm [20-40 in]), with the greatest depth to the underlying Bandelier Tuff being 102 cm (40 in) (DOE 1999a). There are no prime farmlands at LANL (LANL 1996).

Soil Erosion

Soil erosion can have serious consequences to the maintenance of biological communities and also can be a mechanism for moving contaminants across LANL and off the site. Soil erosion rates normally vary considerably on the mesa tops at LANL, with the highest rates occurring in drainage channels and areas of steep slopes and the lowest rates occurring on gently sloping portions of the mesa tops away from the channels (DOE 1999a).

Areas where runoff is concentrated by roads and other structures are especially prone to high erosion rates. The Cerro Grande Fire, which started in May 2000, burned approximately 17,401 ha (43,000 ac) along the eastern flank of the Pajarito Plateau destroying much of the forest canopy and ground cover above these soils. In addition, the fire also altered soil characteristics that further increased the potential for erosion. As part of the emergency response actions taken during and immediately after the Cerro Grande Fire, sites were recontoured, reseeded, mulched, and hydromulched. Silt fences were installed to allow seedlings to take hold. In strategic places, rock and log check dams were installed. LANL and surrounding communities remain more vulnerable to the occurrence of flooding, mudflows, and avalanche (DOE 2000f).

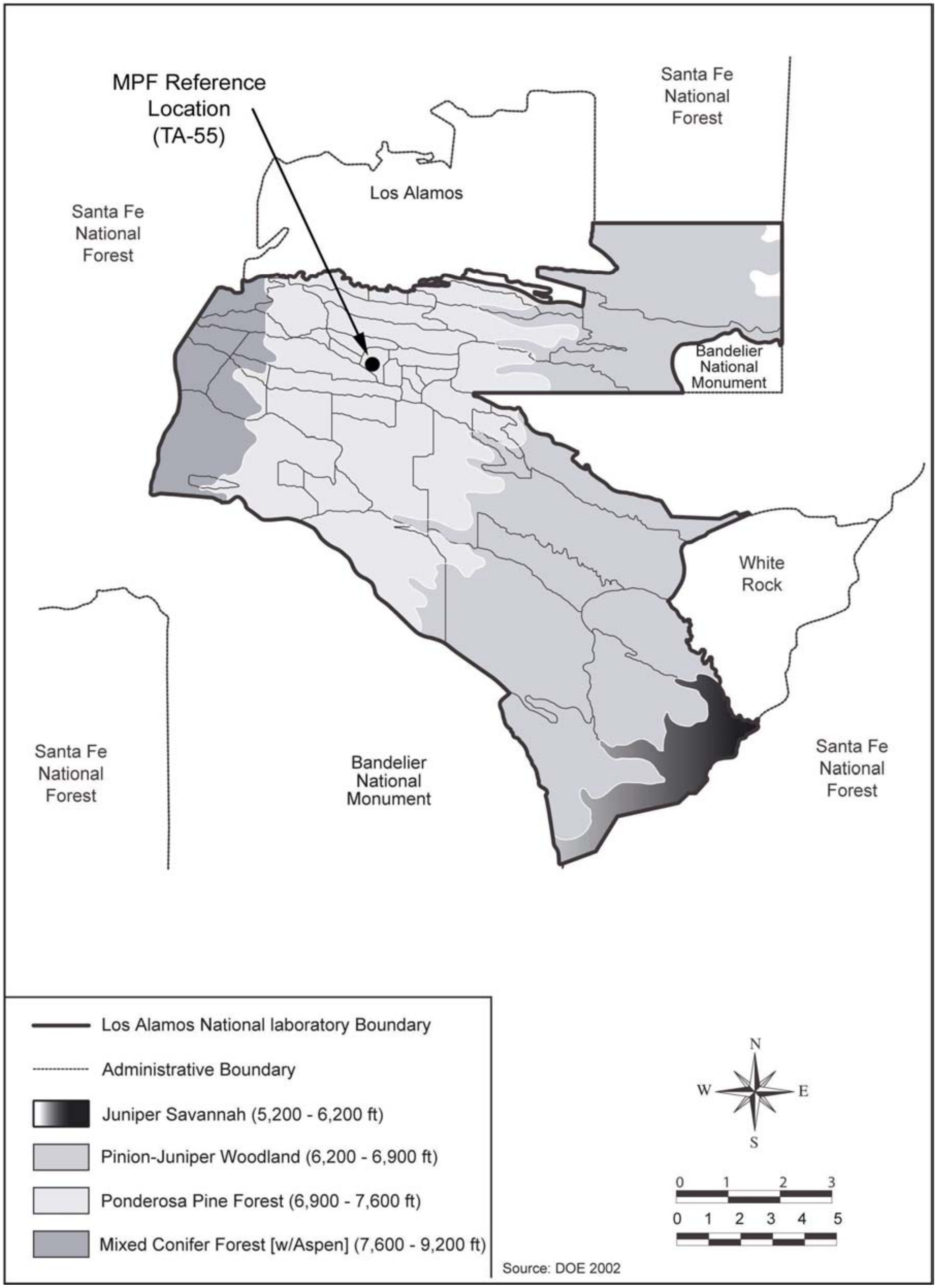
Mineral Resources

There are no active mines, mills, pits, or quarries in Los Alamos County or on DOE land at LANL. Sand, gravel, and pumice are mined throughout the surrounding counties.

4.2.6 Biological Resources

4.2.6.1 Terrestrial Resources

LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site are quite diverse, due partly to the 1,525-m (5,000-ft) elevation gradient from the Rio Grande River on the southeastern boundary to the Jemez Mountains, which are 20 km (12.4 mi) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed (DOE 2002k). In fact, only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). The remaining land has been classified into four major vegetation zones, which are defined by the dominant plants present, and occur within specific elevation zones. These include mixed conifer forest, ponderosa pine (*Pinus ponderosa*) forest, pinyon (*P. edulis*)-juniper (*Juniperus* spp.) woodland, and juniper savannah (see Figure 4.2.6.1–1). The vegetative communities on and near LANL are very diverse, with over 900 species of vascular plants identified in the area.



Source: DOE 2002k.

Figure 4.2.6.1–1. Los Alamos National Laboratory Vegetation Zones

Terrestrial animals associated with vegetation zones in the LANL area include 57 species of mammals, 200 species of birds, 28 species of reptiles, and 9 species of amphibians. Common animals found on LANL include the collared lizard (*Crotaphytus collaris*), eastern fence lizard (*Sceloporus undulatus*), black-headed grosbeak (*Pheucticus melanocephalus*), western bluebird (*Sialia mexicana*), elk (*Cervus elephus*), and raccoon (*Procyon lotor*) (DOE 2002k). The most important and prevalent big game species at LANL are mule deer (*Odocoileus hemionus*) and elk (*Cervus elephas*).

The native populations of Rocky Mountain elk were eliminated from the entire State of New Mexico by 1909. In 1948, 28 elk were reintroduced into the Jemez Mountains, and an additional 58 elk were reintroduced into Los Alamos County from 1964-1965. The Jemez Mountain elk population, since 1997-2002, has fluctuated around 4,400-6,500 animals. Hunting is not permitted on LANL. Numerous raptors, such as the red-tailed hawk (*Buteo jamaicensis*) and great-horned owl (*Bubo virginianus*), and carnivores, such as the black bear (*Ursus americanus*) and bobcat (*Lynx rufus*), are also found on LANL. A variety of migratory birds have been recorded at the site.

The Cerro Grande Fire dramatically altered the habitat of many animals when it burned across 3,110 ha (7,684 ac) of forest area within LANL. Additionally, fire suppression activities resulted in the clearing of an additional 52 ha (130 ac). While initially eliminating or fragmenting the habitats of many animals (e.g., reptiles, amphibians, small mammals, and birds), with time, the effects of the fire will also increase and improve the habitat for other species (e.g., large mammals) by creating more foraging areas. During the fire, individuals of many species died. Population recovery is expected within the next several breeding seasons. Elk and mule deer populations are expected to increase in the next several years in response to the additional foraging areas resulting from the post-fire vegetation regrowth (DOE 2002k).

Throughout LANL's history, developments within various TAs have caused significant alterations in the terrain and the general landscape of the Pajarito Plateau. These alterations have resulted in significant changes in land use by most groups of wildlife, particularly birds and larger mammals that have large seasonal and/or daily ranges. Certain buildings or building complexes required the segregation of large areas such as mesa tops and, in some cases, these project areas were secured by fences around their perimeters. These alterations have caused some species of wildlife, such as elk and mule deer, to alter their landuse patterns by cutting off or changing seasonal or daily travel corridors to wintering areas, breeding habitats, foraging habitats, and breeding areas (DOE 2002k).

TA-55 is located in the ponderosa pine forest vegetation zone; however, 43 percent of the site is developed. Animal species likely to be present in this area include the prairie lizard (*Sceloporus undulates*), white-breasted nuthatch (*Sitta carolinensis*), Audubon's warbler (*Dendroica coronata*), deer mouse (*Peromyscus maniculatus*), and raccoon. Due to the presence of security fencing, no large animals would be found within developed portions of TA-55.

4.2.6.2 Wetlands

A 1996 field study identified an estimated 20 ha (50 ac) of wetlands within LANL. The LANL survey determined that more than 95 percent of the identified wetlands are located in the Sandia, Mortandad, Pajarito, and Water Canyon watersheds.

Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates, and potentially contribute to the overall habitat requirements of a number of Federal- and state-listed species. The majority of the wetlands in the area are associated with canyon stream channels or are present on mountains or mesas as isolated meadows containing ponds or marshes, often in association with springs or seeps. There are also some springs bordering the Rio Grande River within White Rock Canyon. Cochiti Lake, located downstream from LANL, supports lake-associated wetlands.

Currently, about 5 ha (13 ac) of wetlands within LANL boundaries are caused or enhanced by process effluent wastewater from 21 NPDES-permitted outfalls. These artificially created wetlands are afforded the same legal protection as wetlands that stem from natural sources. In 1996, the effluent from NPDES outfalls, both stormwater and process water, contributed 407 million L (108 million gal) to wetlands within LANL boundaries, and nearly half of the outfalls are probable sources of drinking water for large mammals.

During the Cerro Grande Fire, 6.5 ha (16 ac), or 20 percent of the wetlands occurring on LANL, were burned at a low or moderate intensity. No wetlands within LANL were severely burned. Secondary effects from the fire to wetlands may also occur as a result of increased runoff due to the loss of vegetation. Wetlands were not disturbed by fire suppression activities; however, a number of projects were undertaken after the fire to control runoff and erosion. Two projects involving the enlargement of culverts in lower Pajarito Canyon, one about 0.4 km (0.25 mi) downstream from TA-18 and the other at NM 4, resulted in removal of about 0.6 ha (1.5 ac) of wetland vegetation composed primarily of willow trees. Wetland vegetation is likely to regenerate over the next several years if the area is not silted in or scoured away by floodwaters (DOE 2002k).

There are three wetlands located within TA-55. These wetlands result from natural sources and are characterized by riparian vegetation and faunal components. Wetland plant species present include rush (*Juncus* spp.), willow (*Salix* spp.), and broad-leafed cattail (*Typha latifolia*). Animals observed using this wetland include the many-lined skink (*Eumeces multivigratus*), western chorus frog (*Pseudacris triseriata*), red-winged blackbird (*Agelaius phoeniceus*), violet-green swallow (*Tachycineta thalassiana*), long-tailed vole (*Iklicrotus longicaudus*), and vagrant shrew (*Sorex vagrans*).

4.2.6.3 Aquatic Resources

While the Rito de Los Frijoles in Bandelier National Monument (located to the south of LANL) and the Rio Grande are the only truly perennial streams in the region, several of the canyon floors on LANL contain reaches of perennial surface water, such as the perennial streams draining lower Pajarito and Ancho Canyons to the Rio Grande. Surface water flow occurs in canyon bottoms seasonally, or intermittently, as a result of spring snowmelt and summer rain. A few short sections of riparian vegetation of cottonwood, willow, and other water-loving plants are present in scattered locations on LANL, as well as along the Rio Grande in White Rock Canyon. The springs and streams at LANL do not support fish populations; however, many other aquatic species are present in these waters, i.e., insects and amphibians (DOE 2002m). Terrestrial wildlife use onsite streams for drinking and associated riparian habitat for nesting and feeding. There are no aquatic resources located in TA-55.

4.2.6.4 Threatened and Endangered Species

A number of regionally protected and sensitive (rare or declining) species have been documented in the LANL region (see Table 4.2.6.4–1). These consist of 3 federally-endangered species (the whooping crane [*Grus americana*], southwestern willow flycatcher [*Empidonax traillii eximus*], and the black-footed ferret [*Mustela nigripes*]), 2 federally-threatened species (the bald eagle [*Haliaeetus leucocephalus*] and Mexican spotted owl [*Strix occidentalis lucida*]), and 19 species of concern (species that may be of concern to U.S. Fish and Wildlife Service [USFWS] but have not received recognition under the *Endangered Species Act*, and that the USFWS encourages agencies to include in NEPA studies). Species listed as endangered, threatened, rare, or sensitive by the State of New Mexico are also included in Table 4.2.6.4–1. The New Mexico "sensitive" taxa are those taxa that deserve special consideration in management and planning, and are not listed as threatened or endangered by the State of New Mexico. In addition, critical habitat for the threatened Mexican spotted owl has been designated on Santa Fe National Forest lands that are contiguous with LANL's western boundary.

As mentioned in Section 4.2.6.2, there are three wetlands at TA-55. Threatened and endangered species and species of concern that are associated with these types of wetlands and which may be found in the vicinity include the Northern goshawk, which is listed as a species of concern, the federally-threatened Mexican spotted owl, the state-threatened spotted bat, the federally-endangered southwestern willow flycatcher, and the checkered lily, which is also listed as a species of concern.

In addition, TA-55 contains core and buffer Areas of Environmental Interest for the Mexican spotted owl. Areas of Environmental Interest are established under LANL's Habitat Management Plan (LANL 1998) and are areas within LANL that are being managed and protected because of their significance to biological or other resources. Habitats of threatened and endangered species that occur or may occur at LANL are designated as Areas of Environmental Interest. In general, an Area of Environmental Interest consists of a core area that contains important breeding or wintering habitat for a specific species and a buffer area around the core area. The buffer protects the area from disturbances that would degrade the value of the core area to the species.

Table 4.2.6.4–1. Listed Threatened and Endangered Species of Concern, and Other Unique Species that Occur or May Occur at LANL

Species	Federal Classification	State Classification	Occurrence on LANL
Mammals			
American marten *Martes americana origenes*	Unlisted	Threatened	Reported without verification in the Jemez Mountains; habitat not present on LANL
Big free-tailed bat *Nyctinomops macrotis*	Special Concern	Special Concern	Migratory visitor
Fringed myotis *Myotis thysanodes*	Special Concern	Special Concern	Observed on LANL, BNM, and SFNF lands
Goat peak pika *Ochotona princeps nigrescens*	Special Concern	Special Concern	Observed on LAC and BNM lands
Long-eared myotis *Myotis evotis*	Special Concern	Special Concern	Summer resident
Long-legged myotis *Myotis volans*	Special Concern	Special Concern	Summer resident
New Mexico jumping mouse *Zapus hudsonius luteus*	Special Concern	Threatened	Permanent resident on LAC and SFNF lands
Occult little brown bat *Myotis lucifugus occultus*	Special Concern	Special Concern	Observed on SFNF lands
Pale Townsend's big-eared bat *Plecotus townsendii pallescens*	Special Concern	Special Concern	Observed LANL and BNM lands
Small-footed myotis *Myotis ciliolabrum*	Special Concern	Special Concern	Observed LANL, BNM, and SFNF lands
Spotted bat *Euderma maculatum*	Special Concern	Threatened	Permanent resident on BNM and SFNF lands; Seasonal resident on LANL
Yuma myotis *Myotis yumanensis*	Special Concern	Special Concern	Summer resident
Birds			
American peregrine falcon *Falco peregrinus aratum*	Special Concern	Threatened	Forages on LANL
Baird's sparrow *Ammodramus bairdii*	Special Concern	Threatened	Observed on SFNF lands
Bald eagle *Haliaeetus leucocephalus*	Threatened	Threatened	Winter visitor
Ferruginous hawk *Buteo regalis*	Special Concern	Protected	Observed as a breeding resident
Gray vireo *Vireo vicinior*	Special Concern	Threatened	Observed on LAC, BNM, and SFNF lands

Table 4.2.6.4–1. Listed Threatened and Endangered Species of Concern, and Other Unique Species that Occur or May Occur at LANL (*continued*)

Species	Federal Classification	State Classification	Occurrence on LANL
Birds *(continued)*			
Loggerhead shrike *Lanius ludovicianus*	Special Concern	Special Concern	Observed on LAC, BNM, and SFNF lands
Mexican spotted owl *Strix occidentalis lucida*	Threatened	Special Concern	Breeding resident on LANL, LAC, BNM, and SFNF lands; Critical habitat designated on SFNF lands
Northern goshawk *Accipiter gentilis*	Special Concern	Special Concern	Observed as a breeding resident
Southwestern willow flycatcher *Empidonax traillii eximus*	Endangered	Endangered	Potential presence on LANL and White Rock Canyon; Potential nesting area on LANL; Present in Jemez Mountains; Present in riparian zone near Espanõla
White-faced ibis *Plegadis chihi*	Special Concern	Unlisted	Summer resident
Whooping crane *Grus americana*	Endangered	Endangered	Potential migration winter visitor within Rio Grande rift valley
Amphibians			
Jemez Mountain Salamander *Plethodon neomexicanus*	Special Concern	Threatened	Permanent resident
Fish			
Flathead club *Platygobio gracilis*	Special Concern	Unlisted	Permanent resident of the Rio Grande between Espanõla and the Cochiti Reservoir
Plants			
Checkered lily *Fritillaria atropurpurca*	Unlisted	Special Concern	Observed on LAC, BNM, and SFNF lands
Helleborine orchid *Epipactis gigantea*	Unlisted	Special Concern	Rare
Wood lily *Lilium philadelphicum* var. *andinum*	Unlisted	Endangered	Observed on LAC, BNM, and SFNF lands
Yellow lady's slipper orchid *Cyprepedium calceolus* var. *pubescens*	Unlisted	Endangered	Observed on BNM lands
Invertebrates			
Pearly Chesterspot Butterfly *Charidryas acastus*	Special Concern	Unlisted	Potential occurrence in SFNF

LAC = Los Alamos County.
BNM = Bandelier National Monument.
SFNF = Santa Fe National Forest.
Source: DOE 2002k.

It is unlikely that the results of the Cerro Grande Fire will cause a long-term change to the overall number of federally-listed threatened and endangered species inhabiting the region. However, it is likely that the results of the fire will change the distribution and movement of various species, including the Mexican spotted owl. The areas of LANL that have been proposed as critical habitat suffered heavy damage during the fire. Specifically, two primary areas considered as critical habitat for the Mexican spotted owl located on U.S. Forest Service land near LANL suffered almost 100 percent vegetation mortality. The fire may also have long-term effects on the habitat of several state-listed species, including the Jemez Mountain salamander. As noted in Section 4.2.6.2, two projects undertaken after the fire to enlarge culverts in the lower Pajarito Canyon disturbed about 0.6 ha (1.5 ac) of wetland vegetation composed primarily of willow trees. This wetland habitat area is used by the southwestern willow flycatcher at LANL. It was not, however, a confirmed nesting habitat and was of marginal quality (DOE 2000f).

4.2.7 Cultural and Paleontological Resources

4.2.7.1 Cultural Resources

All undertakings at LANL are conducted in compliance with relevant cultural resource Federal legislation, particularly Sections 110 and 106 of the *National Historic Preservation Act* (NHPA), and DOE orders and policies that address cultural resource protection and management. LANL compliance procedures are outlined in the *LANL Cultural Resource Overview and Data Inventory 1995* (LANL 1995b). Management of the site's cultural resources is augmented through consultation with Native American tribes, particularly through the Pueblo Accord agreements signed in 1992 by DOE and the Pueblos of Jemez, Cochiti, San Ildefonso, and Santa Clara. Also, DOE and LANL are active participants in the East Jemez Resource Council, formed to foster conservation and preservation of the natural and cultural resources of the east Jemez Mountains. The ROI for cultural resources is the entire LANL site.

Prehistoric Resources

Archaeological surveys have been conducted of approximately 90 percent of the land within LANL, with 85 percent of the area surveyed receiving 100 percent coverage, to identify cultural resources present. A total of 1,777 prehistoric sites has been recorded on LANL (DOE 2003). These sites include multiroom pueblos, field houses, talus houses, caveates, rock shelters, shrines, animal traps, hunting blinds, water control features, agricultural fields and terraces, quarries, rock art, trails, and limited activity sites (DOE 1996c). Of these sites, 439 have been evaluated for eligibility for listing on the National Register of Historic Places (NRHP). Of the evaluated sites, 379 sites have been determined eligible for listing, 2 sites as potentially eligible, and 60 sites as not eligible. The remaining 1,338 sites that have not been evaluated are treated as though potentially eligible until they are evaluated (DOE 2003).

Historic Resources

Historic resources identified at LANL include: 1 from the U.S. Territorial period, 9 from the Statehood period, 71 from the Homestead period, 5 from the Post-Homestead period, 1 from the Historic Pueblo period, 36 from the undetermined Historic period, 56 from the Manhattan

Project period, and 527 from the Early and Late Cold War periods. Thus, a total of 706 historic resources have been identified at LANL. Some of these resources have been recorded through site surveys, and others were identified by reviewing construction documents and the site cultural resources database.

Native American Resources

Consultations to identify traditional cultural properties and sacred sites were conducted with 19 Native American tribes and two Hispanic communities in connection with the preparation of the LANL SWEIS (DOE 1999a). These consultations identified 15 ceremonial archaeological sites, 14 natural features, 10 ethnobotanical sites, 7 artisan material sites, and 8 subsistence features of importance on LANL (DOE 2002k). In addition to tangible cultural entities, concern has been expressed that “spiritual,” “unseen,” or “undocumentable” aspects can be present at LANL that are an important part of Native American culture and may be adversely impacted by LANL’s presence and operations (DOE 1999a). Additional consultations regarding traditional cultural properties and sacred sites are ongoing for LANL. In 1992, DOE entered into formal agreements, called the Pueblo Accords, with four nearby pueblos (Jemez, Cochiti, San Ildefonso, and Santa Clara). These accords contain provisions for coordination among the four pueblos and DOE to improve communication and cooperation between the Federal and tribal governments (DOE 1999a).

Cultural Resources on the Reference Location

The reference location at LANL is located in TA-55. Approximately half of this TA-55 has been disturbed during development of various facilities and infrastructure. All of TA-55 has been surveyed for cultural resources. TA-55 contains 11 historic resources. The New Mexico State Historic Preservation Officer (SHPO) has concurred that one of these resources is eligible for listing on the NRHP and two resources are not eligible. The remaining eight resources have not yet been evaluated (DOE 2003).

4.2.7.2 Paleontological Resources

The Pajarito Plateau consists primarily of Pleistocene volcanic tuffs and compacted pumice and ashfalls of the Bandelier Formation. This formation was not conducive to preserving ancient plant and animal remains because the deposits were extremely hot when deposited (DOE 2002k, DOE 1999g). None of the formations at Bandelier are known to be fossiliferous (DOE 1996c). One paleontological resource has been found within LANL boundaries, but not in TA-55 (DOE 2003).

4.2.8 Socioeconomics

Socioeconomic characteristics addressed at LANL include employment, income, population, housing, and community services. These characteristics are analyzed for a three-county ROI consisting of Los Alamos, Rio Arriba, and Santa Fe Counties in New Mexico, where almost 90 percent of site employees reside (DOE 2002k), as shown in Table 4.2.8–1.

Table 4.2.8–1. Three-County ROI Where LANL Employees Reside

County	Number of Employees	Percent of Total
Los Alamos	5,381	50.8
Rio Arriba	2,149	20.3
Santa Fe	1,967	18.6
ROI Total	**9,497**	**89.7**

Source: DOE 2002k.

4.2.8.1 Employment and Income

The service sector employs the greatest number of workers in the ROI with more than 35 percent of the workforce. Other important sectors of employment include government (25 percent); retail trade (16.9 percent); and finance, insurance, and real estate (7.2 percent) (BEA 2002).

The labor force in the ROI increased 17.7 percent from 1990 to 2001, an average of 1.6 percent each year. In comparison, the state labor force increased at a greater rate, a total of 18.4 percent over the same time period. Total employment in the ROI increased at a faster pace than the labor force, a total of 19.7 percent. Unemployment fell from 5.0 percent in 1990 to 3.3 percent in 2001. In comparison, the state-wide average unemployment fell from 6.5 in 1990 to 4.8 in 2001 (BLS 2002a).

Per capita income in the ROI ranged from a high of $40,482 in Los Alamos County to a low of $15,115 in Rio Arriba County in 2001. The average per capita income in the ROI was approximately $27,700, compared to the New Mexico average of $21,931. Per capita income increased by almost 51 percent from 1990 to 2000, compared to a state-wide increase of 46.8 percent (BEA 2002).

4.2.8.2 Population and Housing

From 1990 to 2000, the ROI population grew from 151,408 to 188,825, an increase of 24.7 percent. This was a higher rate of growth than the rate for the entire State of New Mexico, which grew by 20.1 percent during the same time period. Santa Fe County had the highest rate of growth at 30.7 percent, while Los Alamos County had the lowest rate of growth at only 1.3 percent (Census 2002).

In 2000, the total number of housing units in the ROI was 83,654 with 75,023 occupied. There were 54,160 owner-occupied housing units and 20,863 occupied rental units. In 2000, the homeowner vacancy rate in the ROI ranged from a high of 1.5 percent in Santa Fe County to a low of 1.1 percent in Los Alamos County, while the rental vacancy rate ranged from 11.3 percent in Los Alamos County to 5.6 percent in Santa Fe County. This is comparable to the state rates of 2.2 percent homeowner vacancy and 11.6 percent rental vacancy. The greatest number of housing units in the ROI is in Santa Fe County with almost 69 percent of the total housing units (Census 2002).

4.2.8.3 Community Services

There are a total of 7 school districts in the ROI serving over 25,000 students. The student-to-teacher ratio in these districts ranges from a high of 16.8 in the Española Municipal District in Rio Arriba County to a low of 11.7 in the Dulce Independent District in Rio Arriba County. The average student-to-teacher ratio in the ROI is 14.5 (NCES 2002).

The ROI is served by 5 hospitals with a capacity of 457 beds. The largest hospital in the ROI is St. Vincent Hospital in Santa Fe. The closest hospital to LANL is the Los Alamos Medical Center (AHA 1995). There are approximately 427 doctors in the ROI, with most of them concentrated in Santa Fe County.

4.2.9 Radiation and Hazardous Chemical Environment

4.2.9.1 Radiation Exposure and Risk

Because there are many sources of radiation in the human environment, evaluations of radioactive releases from nuclear facilities must consider all ionizing radiation to which people are routinely exposed.

An individual's radiation exposure in the vicinity of LANL amounts to approximately 425 mrem/yr as shown in Table 4.2.9.1–1 and is comprised of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; weapons test fallout; consumer and industrial products; and nuclear facilities. Doses of radiation are expressed as mrem, rem (1,000 mrem), and person-rem (sum of dose to all individuals in population). All radiation doses mentioned in this EIS are effective dose equivalents. Effective dose equivalents include the dose from internal deposition of radionuclides and the dose attributable to sources external to the body.

Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to LANL operations.

Releases of radionuclides to the environment from LANL operations provide another source of radiation exposure to individuals in the vicinity of LANL. Types and quantities of radionuclides released from LANL operations in 2001 are listed in *Environmental Surveillance at Los Alamos During 2001* (LANL 2002b). The doses to the public resulting from these releases are presented in Table 4.2.9.1–2. The offsite maximally exposed individual (MEI) is a hypothetical member of the public who, while not on LANL property, received the greatest dose from LANL operations. The location of the offsite MEI in 2001 was at East Gate along NM 502 entering the east side of Los Alamos County. The radionuclide emissions contributing the majority of the dose to the offsite MEI are those emissions associated with the Los Alamos Neutron Science Center (LANSCE). During LANSCE operations, short-lived positron emitters such as carbon-11, nitrogen-13, and oxygen-15 are released from the stacks and diffuse from the buildings. LANSCE stack emissions were larger in 2001 as a result of changes to the 1 L-target water-cooling system. Therefore, the offsite MEI dose was 1.9 mrem this year compared with 0.64 mrem in 2000. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

Table 4.2.9.1–1. Sources of Radiation Exposure to Individuals in the LANL Vicinity Unrelated to LANL Operations

Source	Radiation Dose (mrem /yr)
Natural Background Radiation	
Total external (cosmic and terrestrial)	120
Internal terrestrial and global cosmogenic	40[a]
Radon in homes (inhaled)	200[a]
Other Background Radiation[a]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	425

[a] An average for the United States.
Source: Derived from data in NCRP 1987.

Table 4.2.9.1–2. Radiation Doses to the Public from Normal LANL Operations in 2001 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Offsite MEI (mrem)	10	1.9	4	0	100	1.9
Population within 80 km (person-rem)	None	1.6	None	0	None	1.6

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-mrem/yr limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.
Source: LANL 2002b.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the offsite MEI of the public due to radiological releases from LANL operations is estimated to be 9.5×10^{-7}, or 9.5 cancer deaths in a population of 10,000,000. The estimated probability of this offsite MEI dying of cancer at some point in the future from radiation exposure associated with one year of LANL operations is less than one in 1 million (it takes several to many years from the time of radiation exposure for a cancer to potentially manifest itself).

According to the same risk estimator, 8×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of LANL from normal LANL operations. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 2001 from all causes in the population of 277,000 living within 80 km (50 mi) of LANL was 554. This expected number of fatal cancers is much higher than the 8×10^{-4} fatal cancers estimated from LANL operations in 2001.

External radiation doses have been measured in areas of TA-55 that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed average doses within TA-55 of about 150 mrem (LANL 2002b).

LANL workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at LANL from operations in 2001 are presented in Table 4.2.9.1–3. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among LANL workers from normal operations in 2001 is 0.045. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 4.2.9.1–3. Radiation Doses to Workers from Normal LANL Operations in 2001 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (mrem)	5,000[a]	85
Collective radiation worker dose[b] (person-rem)	None	112.9

[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 mrem/yr (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] There were 1,330 workers with measurable doses in 2001.
Source: DOE 2001f.

4.2.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to the Occupational Safety and Health Administration (OSHA) and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

During 2001, LANL designed and implemented a new air-monitoring program to provide enhanced nonradiological air monitoring data under normal conditions. The objectives of this program are to:

- Develop the capability for collecting nonradiological air monitoring data.
- Conduct monitoring to develop a database of typical background levels of selected nonradiological species in the communities nearest LANL.
- Measure LANL's potential contribution to nonradiological air pollution in the surrounding communities.

This program samples environmental levels of nonradiological air constituents in Los Alamos County. Constituents monitored include: total suspended particulate matter, PM_{10}, particles with diameters of 2.5 micrometers or less ($PM_{2.5}$), volatile organic compounds (VOC), and inorganic elements on particulate matter. In 2001, the VOCs included up to 160 compounds, and the inorganics included up to 15 elements (arsenic, antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, and zinc) (LANL 2002b). The results of this program indicate that the ambient air quality in and around LANL meets all EPA and DOE standards for protecting the public and workers.

4.2.10 Traffic and Transportation

4.2.10.1 Regional Transportation Infrastructure

Northern New Mexico is bisected by Interstate 25 (I-25) in a generally northeast-southwest direction, connecting Santa Fe and Albuquerque. As indicated in Figure 4.2.10.1–1, access to Los Alamos from I-25 follows the Santa Fe bypass (NM 599) to United States Highway (U.S.) 84/285 north to NM 502. From the town of Española to LANL, commuters take NM 30 to NM 502. From the west, commuters take NM 4, with NM 501 providing access to the northern part of the site. The State of New Mexico has designated the route that hazardous and radioactive shipments must take. These shipments must leave the site on East Jemez Road, travel north on NM 4 to NM 502 and back to I-25 as previously described.

4.2.10.2 Local Traffic Conditions

Due to the remoteness of LANL and its location on top of the Pajarito Plateau, the roads in the region have some sharp curves. NM 502 is a winding, rather steep, two-lane highway as it rises up from the canyon floor. In other locations, such as at the interchange with NM 4, NM 502 is a five-lane road. However, overall capacity is limited by the two-lane sections. The other roads in the region are all two-lane roads. Therefore, road capacities in the region are not large.

Most commuter traffic originates from Los Alamos County or areas east of Los Alamos County. Therefore, NM 502 and NM 4 (from White Rock) are heavily influenced by LANL commuters. Only 2 percent of commuters arrive from the west on NM 4. Traffic on area roads is light except during periods influenced by LANL commuters and the noon hour, during which congestion is heavy but shortlived. Average daily traffic conditions on the four access roads to LANL are 28,000 vehicles on NM 502 at the LANL boundary (Diamond Drive across the Los Alamos Canyon Bridge); 8,000 vehicles on NM 4 between White Rock and NM 502 (Pajarito Road); 6,000 vehicles on NM 4 near the western LANL boundary (East Jemez Road); and 1,000 vehicles on NM 501 between NM 4 and East Jemez Road (NM 4/West Jemez Road from the west) (DOE 2002n).

Figure 4.2.10.1–1. Highways in the Region of LANL

4.2.11 Waste Management

This section describes the DOE waste generation baseline that will be used to gauge the relative impact of MPF construction and operations on the overall waste generation at LANL and on DOE's capability to manage such waste. LANL manages the following types of waste: transuranic (TRU) waste, including mixed TRU waste; low-level waste (LLW); mixed LLW; hazardous waste; and nonhazardous or sanitary waste. Table 4.2.11–1 provides the routine waste generation rates at LANL. Table 4.2.11–2 summarizes the waste management capabilities at LANL.

Table 4.2.11–1. Annual Routine Waste Generation from LANL Operations (m^3)

Waste Type	1996	1997	1998	1999	2000	2001
Transuranic	80.8	93.8	99.1	122	114	63.2
Low-level	531	532	566	717	401	376
Mixed	6.82	5.80	4.50	5.84	5.03	7.52
Hazardous[a]	89.0	122	269	32.9	21.7	46.0
Sanitary[b]	2,060	2,240	2,090	2,540	2,370	1,990

[a] Includes state-regulated waste. Hazardous waste reported in metric tons.
[b] From DOE 2002o (1996 data) and DOE's Central Internet Database (available at: http://cid.em.doe.gov/). Sanitary waste reported in metric tons.
Source: DOE 2002o.

Table 4.2.11–2. Waste Management Facilities at LANL

Facility Name/ Description	Capacity	Status	Applicable Waste Types				
			LLW	Mixed LLW	TRU Waste	Hazardous Waste	Nonhazardous Waste
Treatment facility (m^3/yr)							
LLW compaction	76	Online	X				
Sanitary wastewater treatment	1,060,063	Online					X
Storage facility (m^3)							
LLW storage	663	Online	X				
MLLW storage	583	Online		X			
TRU waste storage	15,182	Online			X		
Hazardous waste storage	1,864	Online				X	
Disposal facility							
TA-54 Area G LLW disposal (m^3)	252,500	Online	X				
Sanitary tile fields (m^3/yr)	567,750	Online					X

Source: DOE 2002k, LANL 2002a.

4.2.11.1 Low-Level Radioactive Waste

Solid LLW generated by the LANL's operating divisions is characterized and packaged for disposal at the onsite LLW disposal facility at TA-54, Area G. Waste minimization strategies are intended to reduce the environmental impact associated with LLW operations and waste disposal by reducing the amount of LLW generated and/or by minimizing the volume of LLW that will require storage or disposal onsite (LANL 2001b).

A 1998 analysis of the LLW landfill at TA-54, Area G indicated that at previously planned rates of disposal, the LLW landfill's disposal capacity would be exhausted in a few years. Reduction in LANL's LLW generation has extended this time to about 5 years; however, potentially large volumes of waste from planned construction upgrades and the LANL Environmental Restoration/Decontamination and Decommissioning Program could fill the remaining available landfill rapidly (LANL 2001b).

As part of implementation of the Record of Decision (ROD) (64 FR 50797; September 20, 1999) for the LANL SWEIS (DOE 1999a), DOE will continue disposal of LANL-generated LLW using the existing footprint of the Area G LLW disposal area and will expand disposal capacity into Zones 4 and 6 at Area G. This expansion would cover up to 29 ha (72 ac). Additional sites for LLW disposal at Area G would provide onsite disposal for an additional 50-100 years (LANL 2001b).

4.2.11.2 Mixed Low-Level Waste

Mixed LLW generation at LANL is very small, about 5 cubic meters (m^3) (176 cubic feet [ft^3]) per year. Most of LANL's routine mixed LLW results from stockpile stewardship and management and from R&D programs. Most of the nonroutine waste generated by off-normal events such as spills is stored in legacy-contaminated areas. Typical LANL mixed LLW items include contaminated lead-shielding bricks, R&D chemicals, spent solution from analytic chemistry operations, mercury cleanup-kit waste from broken fluorescent bulbs and mercury thermometers, circuit boards from electronic equipment removed from a TRU waste radiation area, discarded lead-lined gloveboxes, and some contaminated water removed from sumps.

Typically, mixed LLW is transferred to a satellite storage area after it is generated. Whenever possible, the materials are surveyed to confirm the radiological contamination levels, and if decontamination will eliminate either the radiological or the hazardous component. If decontamination is possible, materials are then decontaminated and removed from the mixed LLW category.

Mixed LLW is managed in accordance with appropriate waste management and Department of Transportation requirements and shipped to TA-54. From TA-54, the mixed LLW is sent to commercial and DOE treatment and disposal facilities. The waste is treated/disposed of by various processes (e.g., segregation of hazardous components and macro-encapsulation or incineration). A small fraction of the LANL-generated mixed LLW has no disposal path. Typically, this waste is radiation-contaminated mercury or mercury compounds (LANL 2001b).

4.2.11.3 Transuranic and Alpha Waste

TRU waste at LANL can be classified as either legacy waste or newly generated waste. Legacy waste is that waste generated before September 30, 1998. Newly generated waste is defined as waste generated after September 30, 1998. The newly generated wastes are subdivided further into solid and liquid wastes, as well as routine (operations) and nonroutine (environmental restoration, decontamination and decommissioning [D&D]) wastes.

TRU solid wastes are accumulated, initially assayed, and characterized at the generation site. The waste is packaged for disposal in metal 208-L (55-gal) drums, standard waste boxes, and oversized containers. The 208-L (55-gal) drums are stored in an auxiliary building at TA-55. The standard waste boxes and oversized containers are staged on an asphalt pad behind Plutonium Facility, Building 4 (PF-4) to await shipment to the waste characterization areas at TA-54 or TA-50 (LANL 2001b).

Detailed characterization of TRU waste occurs at TA-54, Building 34, the Radioassay and Nondestructive Testing (RANT) facility; and at TA-50, Building 69, the Waste Compaction, Reduction, and Repackaging Facility (WCRRF). Samples from drums are sent to the Chemistry and Metallurgy Research (CMR) building for characterization in some cases. The TRU waste is stored at TA-54, Area G, until it is certified and shipped to WIPP for disposal. LANL TRU waste shipments to WIPP began on March 25, 1999, and are expected to continue through the foreseeable future (LANL 2001b).

Liquid TRU wastes from the LANL nitric-acid (acidic) and hydrochloric-acid (caustic) aqueous processes are transferred from TA-55 to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) via separate, doubly encased transfer lines for processing and further removal of plutonium by flocculent precipitation. The precipitate is cemented into 208-L (55-gal) drums and transported to TA-54 for storage and ultimate disposal at WIPP as TRU solid waste. In 2000, approximately 11,700 L (3,080 gal) of liquid TRU waste were processed at the TA-50 RLWTF. Of this volume, 76 percent came from the acid waste stream and the remaining 24 percent came from the caustic waste stream. Implementation of the Nitric Acid Recovery System in 2001 is reducing the volume of the acidic liquid TRU waste stream (LANL 2001b).

LANL receives small amounts of TRU waste from other sites. Some of that waste is from nondefense activities and is currently ineligible for disposal at WIPP. Such nondefense TRU waste is stored at LANL pending the development of disposal options.

DOE has developed a plan to accelerate the characterization and disposal of all New Mexico legacy TRU waste (including TRU waste from LANL, Sandia National Laboratory, and Lovelace Respiratory Research Institute). The risk-based plan consists of early characterization and shipping of approximately 2,000 high activity drums that account for about 60 percent of the risk of dispersible radioactivity in storage at TA-54. The proposal would accelerate the Site Treatment Plan milestones and complete the shipment of the legacy TRU waste by 2010 (Ramsey 2002).

4.2.11.4 Hazardous Waste

LANL produces three types of hazardous waste: RCRA waste, the *Toxic Substances Control Act* (TSCA) waste (e.g., polychlorinated biphenyls [PCBs] and asbestos), and state-regulated special waste (as required by the *New Mexico Solid Waste Act* of 1990 and defined by the New Mexico Solid Waste Management Regulations, 20 NMAC 9.1, which includes certain types of solid wastes that have unique handling, transportation, or disposal requirements).

Hazardous waste commonly generated at LANL includes many types of laboratory research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This waste may include equipment, containers, structures, and other items that are intended for disposal and are contaminated with hazardous waste (e.g., compressed gas cylinders). Also included are asbestos waste from the abatement program, wastes from removal of PCB components, contaminated soils, and contaminated wastewaters that cannot be sent to the sanitary wastewater system or the high explosives wastewater treatment plants.

Hazardous waste is initially collected at less-than-90-day storage areas. This waste is then either directly shipped to offsite waste management facilities or sent to TA-54, Area L, from which it will be subsequently shipped to an offsite facility. Most LANL hazardous wastes are disposed of through LANL subcontractors. These companies send the LANL waste to permitted treatment, storage, or treatment storage disposal facilities, recyclers, energy recovery facilities for fuel blending or burning for energy recovery, or other licensed vendors (as in the case of mercury recovery).

4.2.11.5 Sanitary Waste

LANL sanitary wastes are collected in dumpsters, which go to the Materials Recovery Facility. At this facility, items that can be recycled (e.g., cardboard, metal, wood) are segregated from the dumpster waste and sent to recycle. Items that cannot be recycled are sent to the Los Alamos County Landfill (LANL 2001b).

Both LANL and Los Alamos County use the same landfill located within LANL boundaries. The landfill is operated under a special permit by Los Alamos County. Los Alamos has also contracted with Española to receive selected waste from that community. The Los Alamos County Landfill received about 20 million kg (22,000 tons) of solid waste from all sources during the period of July 1995 through June 1996, with LANL contributing about 22 percent, the city of Española contributing about 32 percent, and Los Alamos County contributing about 46 percent of the solid waste. An assessment performed in 1996 estimated the anticipated life of the landfill to be about 18 years (DOE 1999a).

Since the Cerro Grande Fire, the generation of wastes from community and LANL clean-up activities have increased several fold. The Los Alamos County Landfill is scheduled for closure on June 30, 2004. A replacement facility, which would be located offsite, would then be used by LANL for nonhazardous waste disposal. It is currently anticipated that the replacement facility would be located within 160 km (100 mi) of LANL. Both LANL and Los Alamos County would need to transport their wastes to the new facility (DOE 2002k).

4.2.11.6 Wastewater

LANL has three primary sources of wastewater: sanitary liquid wastes, high explosives-contaminated liquid wastes, and radioactive liquid wastes. These wastes are managed in three onsite wastewater treatment facilities: Sanitary Wastewater Systems (SWS) Plant, RLWTF, and the High Explosives Wastewater Treatment Facility (HEWTF).

Sanitary Liquid Wastes

Sanitary liquid wastes are delivered by dedicated pipelines to the SWS Plant at TA-46. The plant has a design capacity of 2.27 million L (600,000 gal) per day, and in 2000 processed a maximum of about 950,000 L (250,000 gal) per day. Some septic tank pumpings are delivered periodically to the plant for treatment via tanker truck. Sanitary waste is treated by an aerobic digestion process (i.e., a digestion process which utilizes living organisms in the presence of oxygen). After treatment, the liquid from this process is recycled to the TA-3 power plant for use in cooling towers or is discharged to Sandia Canyon, adjacent to the power plant, under an NPDES permit and groundwater discharge plan. Under normal operating conditions, the solids from this process are dried in beds at the SWS Plant as authorized by the existing NPDES permit (DOE 2002k).

In addition to the SWS Plant, there are 36 approved septic systems still in use at facilities located in 16 TAs. Separate from the LANL sanitary waste treatment system, Los Alamos County sanitary waste is processed at two separate facilities. The Bayo Canyon facility processes sewage from the Los Alamos townsite and the DOE Los Alamos Area Office building. This facility has a design capacity of 5.2 million L/day (1.37 million gal/day) of waste and in 1996 was processing approximately 3.4 million L/day (0.9 million gal/day). The White Rock sewage treatment facility processes sewage from the White Rock community and has a design capacity of 3.1 million L (0.82 million gal/day). In 1996, the facility processed about 1.9 million L/day (0.5 million gal/day) (DOE 1999a).

Radioactive Liquid Wastes

Liquid LLW is transferred through a system of pipes and by tanker trucks to the RLWTF at TA-50, Building 1. The radioactive components are removed and disposed of as solid LLW at TA-54, Area G. Nonradioactive contaminants (e.g., nitrates, perchlorate) are also removed. The remaining liquid is discharged to a permitted outfall (LANL 2001b).

High Explosives Contaminated Liquid Wastes

Wastewater contaminated with high explosives is filtered and recycled to meet current and new regulatory standards for wastewater discharge. To process the high explosives wastewater, solvents are extracted at the processing facility at TA-16. Then, the high explosives wastewater is filtered and recycled using new equipment (located in an adjacent facility). The wastewater will be trucked, as needed, to the HEWTF, which further treats the wastewater through filtering and then discharges the wastewater to a NPDES-permitted outfall. The environmental assessment for the HEWTF provides a detailed description of the high explosives wastewater treatment system upgrade and impacts associated with its installation and use (DOE 1995e).

Industrial Effluent

Industrial effluent that does not go through the LANL centralized treatment facilities is discharged to the environment through outfalls. In 1996, DOE decided to eliminate the effluent from several industrial outfalls at LANL to comply with new regulatory requirements and the discharge limitations specified in the NPDES permit.

In 1996, there were 88 outfalls at LANL covered by NPDES Permit NM0028355. The permit contains discharge limitations for each category of outfall based on physical and chemical characteristics of each wastewater type. DOE decided to eliminate industrial effluent from 27 LANL outfalls. That decision includes rerouting industrial effluent from about 14 outfalls to the SWS Plant. Industrial effluent from other outfalls would be eliminated by replacing once-through cooling water systems with recirculation systems, or, in a few instances, making operational changes to eliminate the source of the industrial effluent. After the industrial effluents were discontinued, the affected outfalls were removed from the NPDES Permit. The *Environmental Assessment and Finding of No Significant Impact for Effluent Reduction at LANL* provides a detailed description of the activities undertaken and an evaluation of their consequences (DOE 1996f).

4.2.11.7 Pollution Prevention

LANL's Environmental Stewardship Office manages LANL pollution prevention program. This is accomplished by eliminating waste through source reduction or material substitution, by recycling potential waste materials that cannot be minimized or eliminated, and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal.

The total waste (routine waste as well as environmental restoration and D&D waste) generated by LANL was 32,900 m^3 (1,161,863 ft^3) in fiscal year (FY) 2001, accounting for 5 percent of DOE's overall waste generation. Implementing pollution prevention projects reduced the total amount of waste generated at LANL in 2001 by approximately 4,050 m^3 (143,026 ft^3). Examples of LANL pollution prevention projects completed in 2001 include: the reduction of hazardous waste by 200 metric tons (220 tons) by identifying a reuse for gamma ray detectors and their housings from a completed study at TA-53; and a reduction of mixed LLW by 14 m^3 (494 ft^3) by transferring electronic components from LANL's radiological control areas to the Oak Ridge National Recycling Center for recycling (DOE 2002g).

4.2.11.8 Waste Management Programmatic Environmental Impact Statement Records of Decision

The *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Waste Management PEIS) RODs affecting LANL are shown in Table 4.2.11.8–1.

Table 4.2.11.8–1. Waste Management PEIS Records of Decision Affecting LANL

Waste Type	Preferred Action
TRU waste	DOE has decided to store and prepare TRU waste onsite prior to disposal at WIPP. LANL would also receive TRU waste from Sandia National Laboratory, which lacks the ability to prepare and store this waste prior to disposal.[a]
LLW	DOE has decided to treat LANL's LLW on site and continue onsite disposal.[b]
Mixed LLW	DOE has decided to regionalize treatment of mixed LLW at the Hanford Site, INEEL, ORR, and SRS. DOE has decided to ship LANL's mixed LLW to either the Hanford Site or NTS for disposal.[b]
Hazardous waste	DOE has decided to continue to use commercial facilities for treatment of most of LANL's non-wastewater hazardous waste.[c]

[a] From the ROD for TRU waste (63 FR 3629) and the ROD for the WIPP Disposal Phase SEIS (63 FR 3624).
[b] From the ROD for LLW and mixed LLW (65 FR 10061).
[c] From the ROD for hazardous waste (63 FR 41810).

DOE's decisions on the various waste types were announced in a series of RODs based on the Waste Management PEIS (DOE 1997a). The Hazardous Waste ROD (63 FR 41810; August 5, 1998) states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with the Oak Ridge Reservation (ORR) and SRS continuing to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically feasible. The LLW and Mixed LLW ROD (65 FR 10061; February 25, 2000) states that minimal LLW treatment will be performed at all sites, and LLW disposal will continue, to the extent practicable, onsite at Idaho National Engineering and Environmental Laboratory (INEEL), LANL, ORR, and SRS. In addition, Hanford and NTS will be available to all DOE sites for LLW disposal. Mixed LLW will be treated at Hanford, INEEL, ORR, and SRS and disposed of at Hanford and NTS.

The TRU Waste ROD (63 FR 3624; January 23, 1998) states that each DOE site that has or will generate TRU waste will prepare and store its TRU waste onsite, except the Sandia National Laboratory will transfer its TRU waste to LANL. DOE amended this ROD on December 29, 2000 (65 FR 82985), to establish the capability at WIPP to prepare for disposal up to 1,250 m^3 (44,144 ft^3) of contact-handled TRU waste out of about 7,000 m^3 (247,205 ft^3) expected to be received annually. DOE also decided to increase the time that waste may be stored aboveground at WIPP up to one year and to expand the storage capacity at WIPP by 25 percent. In a second amendment published on July 25, 2001 (66 FR 38646), DOE decided to transfer approximately 300 m^3 (13,843 ft^3) of contact-handled TRU waste from the Mound Plant to SRS for storage, characterization, and repackaging prior to disposal at WIPP.

4.3 NEVADA TEST SITE

The following sections describe the affected environment at NTS for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, and socioeconomics. In addition, radiation and hazardous chemical environment, transportation, and waste management are described.

4.3.1 Land Use and Visual Resources

4.3.1.1 Land Use

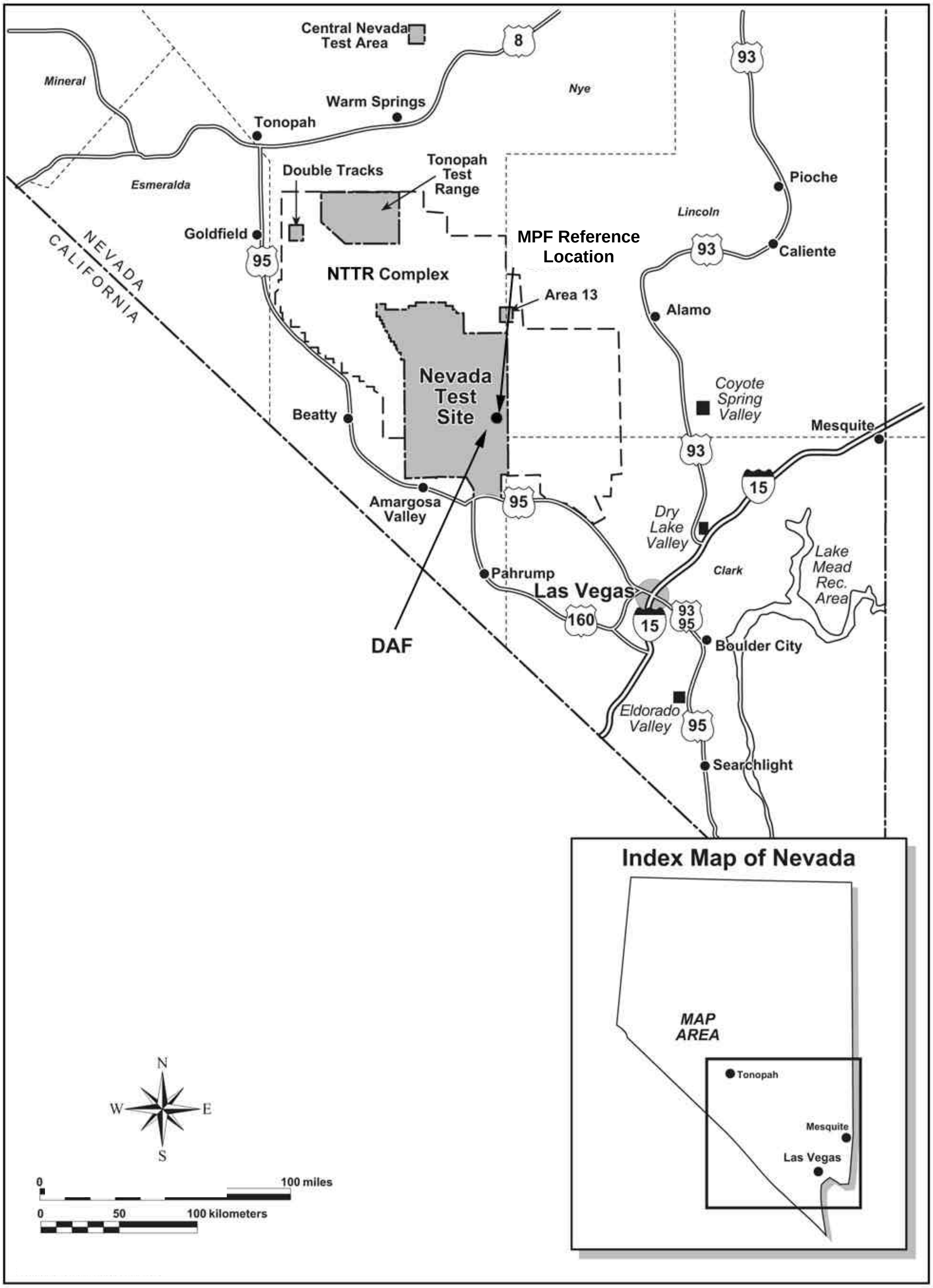
NTS is located on approximately 356,100 ha (879,990 ac) in southern Nye County, Nevada. The site is located 105 km (65 mi) to the northwest of Las Vegas and 16 km (10 mi) northeast of the California state line (see Figure 4.3.1.1–1). All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE's NNSA.

Federal lands surround NTS, with the Nevada Test and Training Range located on the north, east, and west, and BLM lands on the south and southwest. This area provides a buffer zone varying from 24-105 km (15-65 mi) between the NTS and public lands. Beyond the Federal lands surrounding NTS, principal land uses in Nye County in the vicinity of the site include mining, grazing, agriculture, and recreation. Of the total land area within the county, only a small number of isolated areas are under private ownership and, therefore, are subject to general planning guidelines.

Clark County, Nevada, lies immediately to the east of NTS. The Federal Government owns 95 percent of this county. Primary land uses on these Federal lands include open grazing, mining, and recreation. Rural communities located within the vicinity of NTS include Alamo, 69 km (43 mi) to the northeast; Pahrump, 42 km (26 mi) to the south; Beatty, 26 km (16 mi) to the west; and Amargosa Valley, 5 km (3 mi) to the south.

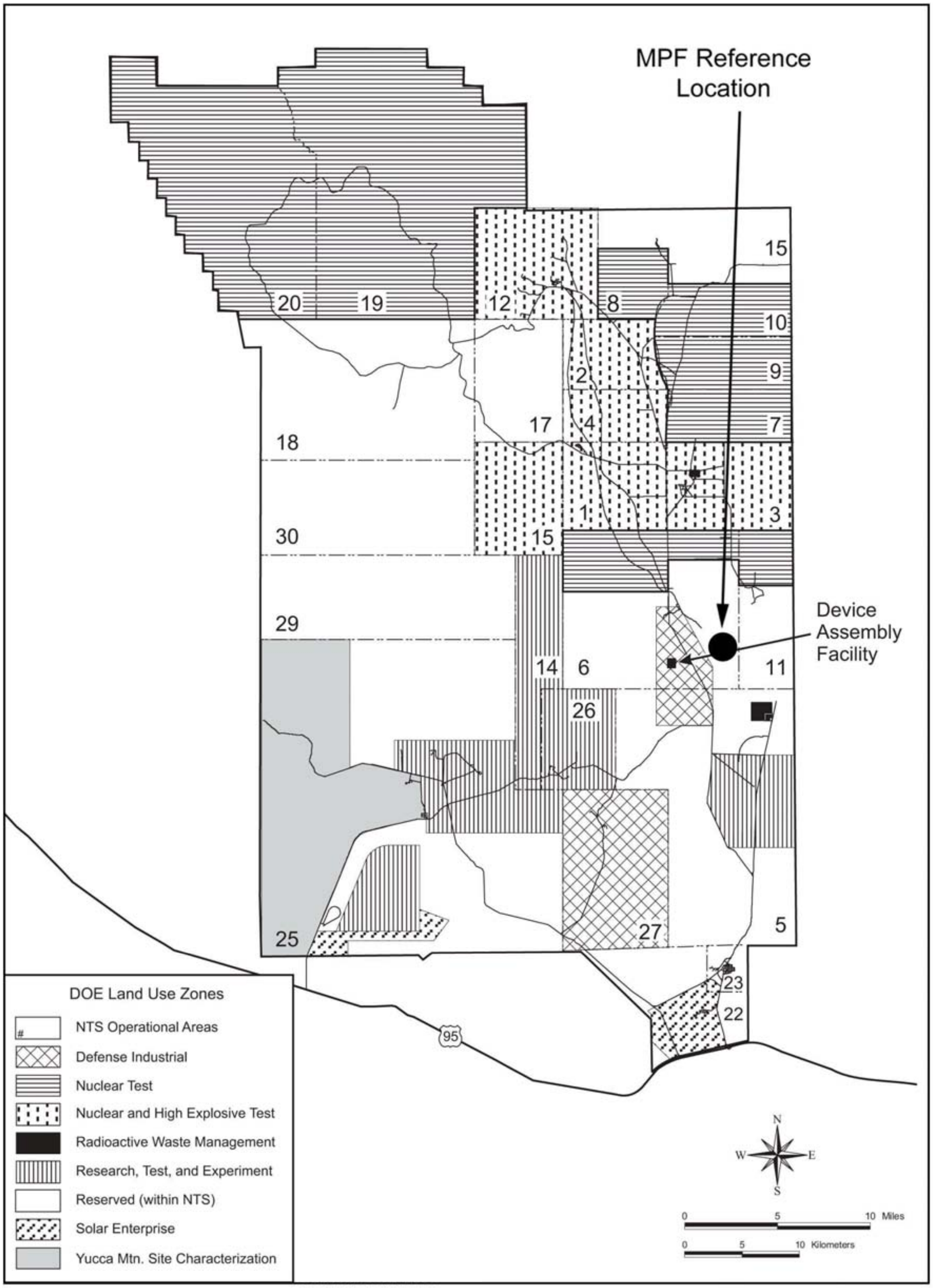
Land use zone categories at NTS include the Nuclear Test Zone, Nuclear and High Explosives Test Zone, Research Test and Experiment Zone, Radioactive Waste Management Zone, Solar Enterprise Zone, Defense Industrial Zone, and Reserved Zone (see Figure 4.3.1.1–2). In most cases, an area is assigned to a land use category based on the environmental characteristics it exhibits. Environmental characteristics, especially geography and geology, generally determine how suitable an area is for a particular use. Technical and experimental areas cluster in those sectors of NTS where geography and geology are most favorable to testing (DOE 1998a) (see Figure 4.3.1.1–3).

Approximately 45 percent of NTS is currently unused or provides buffer zones for ongoing programs or projects, while about 7-10 percent (24,281-35,006 ha [60,000-86,500 ac]) of the site has been disturbed.



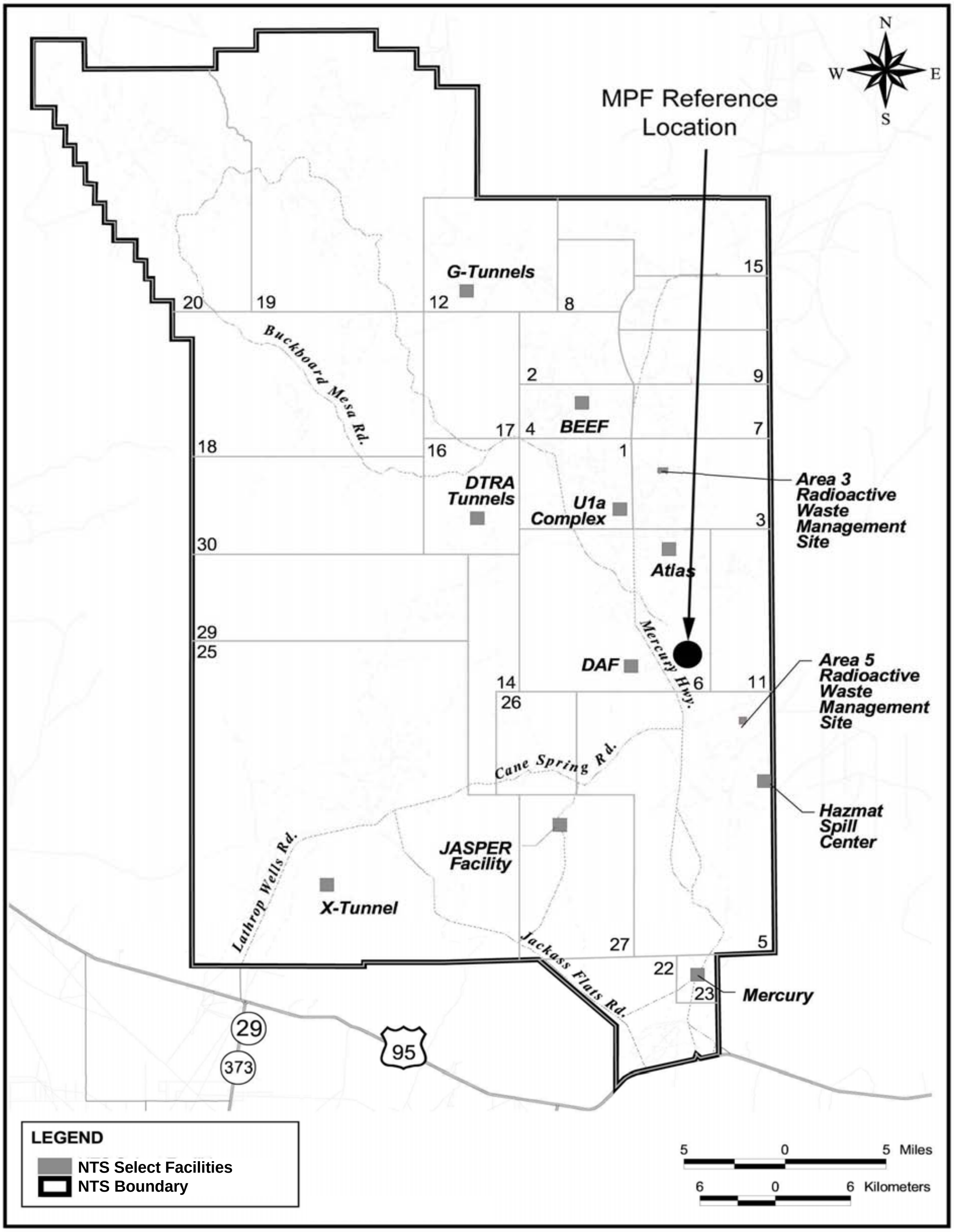
Source: DOE 2002k.

Figure 4.3.1.1–1. Location of the Nevada Test Site



Source: DOE 2002k.

Figure 4.3.1.1–2. Land Use at the Nevada Test Site



Source: DOE 2002k.

Figure 4.3.1.1–3. Technical and Experimental Area Clusters at the Nevada Test Site

The MPF reference location is within Area 6. Area 6 covers approximately 21,200 ha (52,385 ac) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. Three land use zones occur in Area 6 (Figure 4.3.1.1–2). The northern quarter of the area is designated as the Nuclear Test Zone, the south central portion is categorized as the Defense Industrial Zone, and the remaining area is designated as the Reserved Zone. More specifically, the MPF reference location lies near the borders between the Defense Industrial and Reserved Zones, just inside of the Defense Industrial Zone boundary. The Defense Industrial Zone is characterized as an area designated for stockpile management of weapons, including production, assembly, disassembly or modification, staging, repair, retrofit, and surveillance. Permanent facilities for stockpile stewardship operations are also included in this zone. The Reserved Zone is characterized by land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The Reserved Zone is also used for short-duration exercises and training such as nuclear emergency response, Federal Radiological Monitoring and Assessment Center training, and Department of Defense land navigation exercises and training.

NTS is part of the National Environmental Research Park network, although certain areas of the site are excluded from this designation because of operations or other activities related to the primary mission of the site. The National Environmental Research Park designation provides for research into biological diversity, plant and community development in disturbed and undisturbed landscapes, regional climate trends, soil formation differences, and other factors that control environmental conditions. Additionally, the compatibility of the environment with energy technology options can be studied (DOE 1998a).

Land use planning does not occur at the state level in Nevada; however, counties and other municipalities may plan if they choose. The Nye County Comprehensive Plan (NCBC 1994), adopted in 1994, is the most current county-level policy document permitting the county to establish zoning ordinances and land use planning. The Plan is based on five issues pertinent to the county; rapid population growth and/or declines, potential changes in management of public lands, the Yucca Mountain repository project, the withdrawal of public lands from multiple use and other public land planning activities, and the protection of water resources. Pahrump is the only municipality in Nye County to develop a plan. The Pahrump Regional Planning District Master Plan (PRPC 1999), adopted in 1999, was developed in order to address two main issues pertinent to the town, the relatively large growth in Pahrump's population and the protection of the region's water resources.

4.3.1.2 Visual Resources

NTS is located in a transition area between the Mojave Desert and the Great Basin. Vegetation characteristic of both deserts is found on the site. The topography of the site consists of a series of north-south oriented mountain ranges separated by broad, low-lying valleys and flats. Site topography is also characterized by the presence of numerous subsidence craters resulting from past nuclear testing. The southwestern Nevada volcanic field, which includes portions of NTS, is a nested, multi-caldera volcanic field. The facilities of NTS are widely distributed across this desert setting. Within Area 6, the reference location for the MPF, the developed areas are widespread and the undeveloped areas are predominately desert.

The area surrounding NTS ranges from unpopulated to sparsely populated desert and rural land. Access to areas that would have views of the site is controlled by NTS or the U.S. Air Force.

Therefore, few viewpoints are accessible to the general public. Public viewpoints of NTS along U.S. 95, the principal highway between Tonopah and Las Vegas, are limited to Mercury Valley due to the various mountain ranges surrounding the southern boundary of the site. The primary viewpoint in Mercury Valley is a roadside turnoff containing Nevada Historical Marker No. 165 of the Nevada State Park System, entitled “Nevada Test Site.” NTS facilities within 8 km (5 mi) are visible from this viewpoint. The main base camp at Mercury, located in Area 23, is well defined at night by facility lighting. Lands within NTS have a BLM Visual Resource Management rating of Class II or III (See Table 4.2.1.2–1 for definitions of each class.) Management activities within these classes may be seen, but should not dominate the view. Developed areas within the site are consistent with a Visual Resource Management Class IV rating in which management activities dominate the view and are the focus of viewer attention. The same BLM ratings apply to Area 6.

4.3.2 Site Infrastructure

An extensive network of existing infrastructure provides services to NTS activities and facilities as shown in Table 4.3.2–1. These services are discussed in detail in the following sections. Two categories of infrastructure—transportation access and utilities—are described below for NTS. Transportation access includes roads, railroads, and airports while utilities include electricity and fuel (e.g., natural gas, gasoline, and coal).

Table 4.3.2–1. NTS Site-wide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	1,127[a]	NA
Railroads (km)	0	NA
Electricity		
Energy consumption (MWh/yr)	101,377	176,844
Peak load (MWe)	27	45
Fuel		
Natural gas (m^3/yr)	0	NA
Liquid fuels (L/yr)	4,201,805	Not limited
Coal (t/yr)	0	NA

NA = not applicable.
[a] Includes paved and unpaved roads.
Source: DOE 2002k.

4.3.2.1 Transportation

There are 1,127 km (700 mi) of roads at NTS of which 644 km (400 mi) are paved. There is no railway connection service to NTS (DOE 2002k). NTS has two airstrips and is adjacent to the Nevada Test and Training Range Complex. NTS also benefits from ready access to several additional airports in the area, including McCarran International Airport and the onsite Desert Rock Airport with a runway capable of accepting jet aircraft.

4.3.2.2 Electrical Power

In the last several years, NTS has been provided power under contracts with Nevada Power Company and Western Area Power Administration. Nevada Power Company and Valley Electric Cooperative are dual transmission and station connections available at NTS. Nevada Power Company distributes power to NTS at the Mercury Switching Center in Area 22 by a primary 138-kV supply line. Another 138-kV Nevada Power Company transmission line connects the Mercury Switching Center to the Jackass Flats Substation in Area 25. Valley Electric Cooperative also has a transmission connection to the Jackass Flats Substation. Depending on contractual arrangements, NTS can receive service from either Nevada Power Company or Valley Electric Cooperative. A DOE-owned 138-kV loop extends primary power supply into NTS forward areas where smaller, lower voltage distribution lines feed power to individual facilities.

Table 4.3.2–1 shows that electrical capacity at NTS is approximately 177,000 million MWh/yr and peak load capacity, approximately 45 MWe. In 2000, NTS electrical usage was approximately 101,000 MWh/yr and peak load usage was 27 MWe (DOE 2002k).

4.3.2.3 Fuel

Only unleaded gasoline and diesel fuels are used at NTS. The fuel capacity is 45,424 L (12,000 gal) for unleaded gasoline and 37,853 L (10,000 gal) for diesel fuel. The fuel capacity at the fuel station in Area 6 is 75,706 L (20,000 gal) for both unleaded gasoline and diesel fuel. Bulk storage capacity in Area 6 is 158,983 L (42,000 gal) for unleaded gasoline and 397,457 L (105,000 gal) for diesel fuel (DOE 2002k).

4.3.3 Air Quality and Noise

4.3.3.1 Climate and Meteorology

The climate at NTS is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters, which are typical of other Great Basin areas. As elevation increases, precipitation increases and temperatures decrease.

Annual precipitation at higher NTS elevations is about 23 cm (9 in), including snow accumulations. The lower elevations receive approximately 15 cm (6 in) of precipitation annually, with occasional snow accumulations lasting only a few days. Precipitation in the summer falls in isolated showers, which cause large variations among local precipitation amounts. Summer precipitation occurs mainly in July and August, when intense heating of the ground beneath moist air masses triggers thunderstorm development and associated lightning. A tropical storm occasionally will move northeastward from the coast of Mexico, bringing heavy precipitation during September and October.

Elevation influences temperatures at NTS. At an elevation of 2,000 m (6,560 ft) on Pahute Mesa, the average daily maximum and minimum temperatures are 4°C to -2°C (40°F to 28°F) in January and 27°C to 17°C (80°F to 62°F) in July. In the Yucca Flat weapons test basin, at an elevation of 1,195 m (3,920 ft), the average daily maximum and minimum temperatures are 11°C to -6°C (51°F to 21°F) in January, and 36°C to 14°C (96°F to 57°F) in July. Elevation at

Mercury is 1,314 m (4,310 ft), and the extreme temperatures are 21°C to -11°C (69°F to 12 F) in January and 43°C to 15°C (109°F to 59°F) in July. The annual average temperature in the NTS area is 19°C (66°F). Monthly average temperatures range from 7°C (44°F) in January to 32°C (90°F) in July. Relative humidity readings (taken four times per day) range from 11 percent in June to 55 percent in January and December.

Average annual wind speeds and direction vary with location. At higher elevations on Pahute Mesa, the average annual wind speed is 4.5 m/s (10 mph). The prevailing wind direction during winter months is north-northeasterly, and during summer months winds are southerly. In the Yucca Flat weapons test basin, the average annual wind speed is 3 m/s (7 mph). The prevailing wind direction during winter months is north-northwesterly, and during summer months is south-southwesterly. At Mercury, the average annual wind speed is 4 m/s (8 mph) with northwesterly prevailing winds during winter months, and southwesterly prevailing winds during summer months. Wind speeds in excess of 27 m/s (60 mph), with gusts up to 48 m/s (107 mph), may be expected to occur once every 100 years.

Additional severe weather in the region includes occasional thunderstorms, lightning, tornadoes, and sandstorms. Severe thunderstorms may produce high precipitation that continues for approximately 1 hour and may create a potential for flash flooding. Few tornadoes have been observed in the region, and they are not considered a significant event. The estimated probability of a tornado striking a point at NTS is extremely low (3 in 10 million years).

4.3.3.2 Nonradiological Releases

NTS is located in the Nevada Intrastate AQCR. The region is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) under the NAAQS. The nearest non-attainment area is the Las Vegas area, located 105 km (65 mi) southeast of NTS. Las Vegas Valley Hydrographic Area 212, located in Clark County, is serious as moderate non-attainment for carbon monoxide and fugitive dust (PM_{10}). The remaining portion of Clark County is designated as unclassifiable/attainment for these pollutants (40 CFR 81.329).

The nearest Prevention of Significant Deterioration (PSD) Class I areas to NTS are the Grand Canyon National Park, 208 km (130 mi) to the southeast, and the Sequoia National Park, 169 km (105 mi) to the southwest. NTS has no sources subject to PSD requirements.

The criteria air pollutants emitted at NTS include particulates from construction, aggregate production, surface disturbances, and fugitive dust from vehicles traveling on unpaved roads; various pollutants from fuel-burning equipment, incineration, and open burning; and volatile organics from fuel storage facilities. Quantities of emissions from operations are calculated each year and submitted to the State of Nevada. A summary of 2002 emission estimates for sources at NTS is presented in Table 4.3.3.2–1.

Air quality monitoring for the criteria pollutants is not required for NTS. With the exception of the air permit for the Hazardous Materials Spill Center (HSC), the permits issued by the State of Nevada do require opacity and material throughput measurements. The HSC received a waiver by the state from adhering to opacity limits, due to the nature of its operations. Nonradiological monitoring is required by the HSC's air permit, and was conducted for four series of testing conducted at the HSC in 2000.

Table 4.3.3.2–1. NTS Source Emission Inventory in 2002

Source	PM_{10} (kg/hr)	NO_x (kg/hr)	CO (kg/hr)	SO_2 (kg/hr)	VOC (kg/hr)
Area 1 Aggregate Plant	1.63				
Area 1 Batch Plant	5.31				
Area 23 Boiler	0.041	0.41	0.10	0.14	0.01
Area 23 Incinerator	0.035	0.018	0.004	1.8×10^{-6}	9.0×10^{-3}

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
Source: Calman 2003.

The HSC was established in Frenchman Flat in Area 5 as a basic research tool for studying the dynamics of accidental releases of various hazardous materials and the effectiveness of mitigation procedures. In addition to State of Nevada air permit monitoring requirements, offsite monitoring of HSC tests may be required by EPA. Prior to each HSC test series, and, at other tests in the series depending on projected need, the documentation describing the tests are reviewed by EPA to determine whether appropriate air sampling equipment should be deployed downwind of the test at the NTS boundary to measure chemical concentration that may have reached the offsite area. During 2000, no monitoring was required.

Ambient air quality at NTS is not currently monitored for criteria pollutants or hazardous air pollutants, with the exception of radionuclides. Elevated levels of ozone or particulate matter may occasionally occur because of pollutants transported into the area or because of local sources of fugitive particulates. Ambient concentrations of other criteria pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) are probably low because there are no large sources of these pollutants nearby. The nearest area with air pollutant sources of concern is Las Vegas. Ambient air quality data for NTS is summarized in Table 4.3.3.2–2. These measurements were recorded from August 15 through September 15, 1990. Monitoring stations were located in Area 23 at Building 525; Area 6 at Building 170; and Area 12 at the sanitation department office trailer.

The existing ambient air concentrations attributed to sources at NTS are expected to represent a small percentage of the ambient air quality standards. No modeled concentrations are available showing the site contributions to ambient concentrations at the site boundary.

Table 4.3.3.2–2. NTS Nonradiological Ambient Air Monitoring Results

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Ambient Concentration [b] (micrograms per m^3)		
			Area 6	Area 12	Area 23
Carbon monoxide	8-hour (elevations < 5,000 ft. above msl)	10,000[b]	1,150	2,290	1,370
	8-hour (elevations ≥ 5,000 ft. above msl)	6,870[b]	Not applicable	Not applicable	Not applicable
	1-hour	40,000[c]	1,950	2,750	1,370
Nitrogen dioxide	Annual	100[c]	(d)	(d)	(d)

Table 4.3.3.2–2. NTS Nonradiological Ambient Air Monitoring Results (*continued*)

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Ambient Concentration [b] (micrograms per m^3)		
			Area 6	Area 12	Area 23
Sulfur dioxide	Annual	80[c]	(d)	(d)	(d)
	24-hour	365[c]	(d)	15.7	39.3
	3-hour	1,300[c]	(d)	52.4	65.4
PM_{10}	Annual	50[c]	(d)	(d)	(d)
	24-hour	150[c]	20.2	45.4	78.3
Lead	Quarterly	1.5[c]	(d)	(d)	(d)
Ozone	1-hour	235[c]	(d)	(d)	(d)

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] State standard.
[c] Federal standard (NAAQS).
[d] Not measured.
Source: DOE 1996d.

4.3.3.3 Radiological Releases

In 2000, an estimated 431 curies of tritium, 0.32 curies of plutonium-239/240, and 0.049 curies of americium-241 were released to the atmosphere at NTS. These releases were attributed to the diffusion of tritiated (tritium) water vapor from evaporation from tunnel and characterization well containment ponds; diffuse emissions calculated from the results of environmental surveillance activities; and the resuspension of plutonium and americium as measured with air sampling equipment or calculated by use of resuspension equations. The releases and their sources are presented in Table 4.3.3.3–1.

Table 4.3.3.3–1. NTS Radiological Airborne Releases to the Environment in 2000

Radionuclide	Source	Release (Curies)
Tritium (Hydrogen-3)	Area 6, CP-95A Laboratory	4.6×10^{-5}
	Area 6, DAF Laboratory	5.6
	Area 23, Building 650 Laboratory	3.0×10^{-4}
	Area 52, Building A-1, North Las Vegas	0.37
	Onsite	426
Plutonium-239/240	Areas 3 and 9	2.9×10^{-1}
	Other Areas	3.2×10^{-2}
Americium-241	Onsite	4.7×10^{-2}
	Near Offsite, NAFR	2.0×10^{-3}

Source: NTS 2001.

4.3.3.4 Noise

The major noise sources at NTS include equipment and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles), blasting and explosives testing, and aircraft operations. No NTS environmental noise survey data are available. At the NTS boundary, away from most facilities, noise from most sources is barely distinguishable above background noise levels.

The acoustic environment in areas adjacent to NTS can be classified as either uninhabited desert or small rural communities. In the uninhabited desert, the major sources of noise are natural physical phenomena such as wind, rain, and wildlife activities, and an occasional airplane. The wind is the predominant noise source. Desert noise levels as a function of wind have been measured at an upper limit of 22 dBA for a still desert and 38 dBA for a windy desert.

A background sound level of 30 dBA is a reasonable estimate. This is consistent with other estimates of sound levels for rural areas. The rural communities day-night average sound level has been estimated in the range of 35-50 dB (EPA 1974). A background sound level of 50 dB is a reasonable estimate for Mercury.

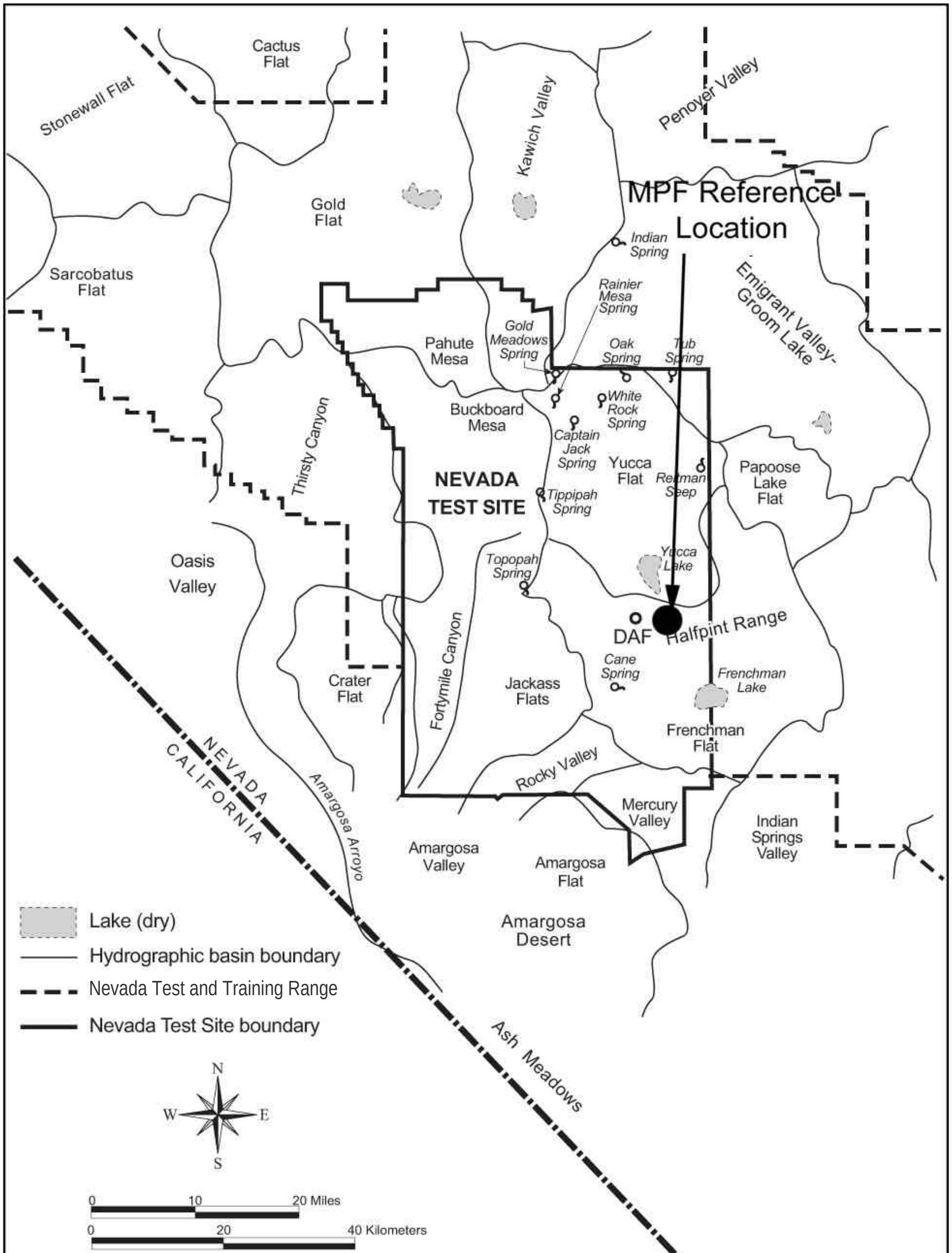
Except for the prohibition of nuisance noise, neither the State of Nevada nor local governments have established specific numerical environmental noise standards.

4.3.4 Water Resources

4.3.4.1 Surface Water

NTS is located within the Great Basin, a closed hydrographic basin from which no surface water leaves except by evaporation. The Great Basin includes much of Nevada. There are no perennial streams or other naturally occurring surface waterbodies at NTS. Streams (arroyos) in the region are ephemeral. Runoff results from snowmelt and from precipitation during storms that occur most commonly during winter and occasionally during fall and spring, as well as during localized thunderstorms that occur primarily in the summer. Much of the runoff quickly infiltrates rock fractures or the surface soils before being lost by evapotranspiration. Some runoff is carried down alluvial fans in arroyos, and some drains onto playas (dry, barren areas in the lowest part of an undrained desert basin that may be marked by an ephemeral lake) where it may stand for weeks as a lake. Runoff in the eastern half of the site ultimately collects in the playas Yucca and Frenchman Lakes of Yucca Flat and Frenchman Flat, respectively (Figure 4.3.4.1–1). In the northeastern portion, runoff drains off the site and onto the Nevada Test and Training Range Complex. In the western half and southernmost part of NTS, runoff is carried toward the Amargosa Desert (DOE 2002k). There are a number of springs on NTS, but seepage from springs travels only a short distance from the source before evaporating or infiltrating into the ground. In addition, there are a number of engineered waste disposal ponds and open reservoirs for industrial water on the site.

Intermittent streams for sheet flow and channelized flow through arroyos cause localized flooding throughout NTS. However, because of the size of NTS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains. Nevertheless, a rise in the surface elevation of any standing water on a playa creates a potential flood hazard. Playas in the Yucca Flat weapons test basin and Frenchman Flat in the northeastern and eastern part of NTS, respectively, collect and dissipate runoff from their respective hydrographic basins. Several arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing



Source DOE 2002k.

Figure 4.3.4.1–1. Nevada Test Site Surface Water Features

facilities, as do arroyos on Frenchman Flat. Ground-surface distance and craters associated with underground nuclear tests have rerouted parts of natural drainage paths in areas of nuclear testing. Some craters have captured nearby drainage, and headward erosion of drainage channels is occurring, however, this is considered to be negligible. In some areas of NTS, the natural drainage system has been all but obliterated by the craters. The western half and southmost parts of NTS have arroyos that carry runoff beyond NTS boundaries during intense storms. Fortymile Wash, the largest of these arroyos and prone to flooding, originates on Pahute Mesa and intersects the Amargosa River in the Amargosa Desert about 32 km (20 mi) southwest of NTS. The Amargosa River continues to Death Valley, California. Tonopah Wash, which runs southwesterly across Jackass Flats from Jackass Divide in the south-central part of NTS, is a major tributary of the Amargosa River (DOE 2002k).

There are no named streams within the Device Assembly Facility (DAF) area and no permanent, natural surface water features near the area. An evaporation/percolation basin is located near the facility. Runoff from the site is conveyed via the natural topography east and southeast toward Frenchman Lake. This playa only retains standing water during the winter months. A stormwater conveyance and diversion structure protects the facility and supporting structures from flooding and is designed for the probable maximum flood (DOE 2002k).

Surface Water Quality

There are no NPDES permits for the site because there are no wastewater discharges to onsite or offsite surface waters. However, the State of Nevada has issued sewage discharge permits for sewage lagoons and ponds for NTS facilities.

4.3.4.2 Groundwater

Groundwater beneath NTS exists within three groundwater subbasins of the Death Valley Basin flow system. This flow system encompasses about 41,000 km^2 (16,000 mi^2) of the Great Basin. In particular, the eastern half of NTS is located within the Ash Meadows Subbasin, and the western half of the site lies largely within the Alkali Flat Furnace Creek Ranch Subbasin. In addition, a small section of the north-west corner of the site is located within the Pahute Mesa Oasis Valley Subbasin (DOE 2002k). Hydrographic areas are mapped on the basis of topographic divides and are the geographic unit used by the State of Nevada for the purposes of water appropriation and management. NTS lies within at least part of 10 of these areas (i.e., Gold Flat, Buckboard Mesa, Kawich Valley, Emigrant Valley, Oasis Valley, Yucca Flat, Jackass Flats, Frenchman Flat, Rock Valley, and Mercury Valley) (DOE 2002k).

While the hydrogeology of the NTS region is complex, three principal hydrogeologic systems are recognized. The first is the valley fill alluvium that mostly consists of gravel, sand, silt, and clay alluvium and playa lake deposits of Quaternary to Late Tertiary age (i.e., recent to about 5 million years old). These deposits comprise the valley fill aquifer. Volcanic rocks including rhyolite lava flow and welded and nonwelded ash flow tuff deposits of mainly Middle to Late Tertiary age (i.e., about 5-24 million years old) characterize the second system. This system encompasses the lava flow and welded-tuff aquifers. The last major system consists of sedimentary rocks ranging in age from Permian/Pennsylvania to Cambrian (i.e., 245-570 million years old) that include the limestones and dolostones comprising the upper and lower carbonate aquifers. Within these systems, six major aquifers and four major aquitards in the region have been defined. Aquifers at NTS not affected by nuclear testing are generally acceptable for drinking water and industrial and agricultural uses. All hydrologic units that supply drinking water to NTS are classified as Class II groundwater (i.e., those that are currently used or are potentially available for drinking water or other beneficial uses) (DOE 2002k). The lower carbonate aquifer primarily represents the regional aquifer and is composed of 4,000-5,000 m (13,120-16,400 ft) of relatively thick, permeable limestones and dolostones with thinner, less permeable siltstones, shales, and quartzites. However, the lower carbonate aquifer is not present in all areas, and rarely is the entire thickness of the unit present under NTS or adjacent areas. Generally, in the eastern half of the site, the water table occurs in the valley-fill alluvium and Tertiary volcanic rocks overlying the regional aquifer and predominantly in the volcanic aquifers across the western half of the site (DOE 2002k). Thinner sequences of these volcanic rocks overlie the upper carbonate aquifer and clastic confining units within some areas of the Yucca and Frenchman Flats (DOE 2002k).

Three principal groundwater subbasins have been identified within the NTS region: the Ash Meadows, Oasis Valley, and Alkali Flat-Furnace Creek Ranch subbasins. The depth to groundwater at NTS varies from about 79 m (260 ft) below land surface in the extreme northwest part of the site, and about 160 m (525 ft) below land surface in portions of Frenchman Flat and Yucca Flat weapons test basin, to more than 610 m (2,000 ft) under the upland portions of Pahute Mesa. Perched groundwater is known to occur in some parts of NTS, mainly in the volcanic rocks of the Pahute Mesa area. Groundwater flows generally south and southwest. The flow system extends from the water table to a depth that may exceed 1,494 m (4,900 ft). The rates of flow are quite variable, with average flow rates over broad areas estimated to range from 2-201 m (7-660 ft) per year.

Recharge for the Death Valley groundwater system is provided by the higher mountain ranges of central and southern Nevada. Groundwater at NTS is also derived from the underflow from basins upgradient of the area (NTS 2001).

Most of the natural discharge from the Death Valley flow system is via transpiration by plants or evaporation from soil and playas in the Amargosa Desert and Death Valley. These discharge locations are dictated by the presence of rocks of lower permeability and lower elevations. Two examples are the Ash Meadows and Alkali Flat discharge areas located south of NTS. The groundwater discharge from the Ash Meadows area is estimated at 21 million m^3 (27 million ft^3) per year. In contrast, groundwater discharge on NTS is more limited and occurs only as a few small springs from perched zones primarily located in the northern, upland areas of the site and from several wells (NTS 2001).

NTS receives its water from a water system divided into four service areas with 11 wells for potable water, 2 wells for nonpotable water, approximately 30 usable storage tanks, 13 usable construction water sumps, and 6 water transmission systems. Potable water is transported to support facilities not connected to the potable water supply system. The annual maximum production capacity of site potable supply wells is approximately 8 billion L/yr (2.1 billion gal/yr). Sustainable site capacity is estimated to be approximately 5.15 billion L/yr (1.36 billion gal/yr) (DOE 2002k).

Groundwater is the only local source of potable water on NTS. Drinking water at NTS is currently provided by the 11 potable wells and is supplemented by bottled water in remote areas. Construction and fire control water are supplied by two nonpotable wells in addition to the potable water supply wells. Springs and seeps are not used for water supply purposes. DOE's water withdrawals have lowered water levels in the vicinity of water supply wells and have resulted in localized changes in groundwater flow direction. In general, the effects of pumping NTS water supply wells are concentrated within a distance of a few thousand feet of the operating wells (NTS 2001).

All water used at DAF in Area 6 is groundwater from 4 (of the 11) potable supply wells (C, C1, 4, and 4a). Wells 4 and 4a withdraw from volcanic aquifers at a depth of about 387 m (1,270 ft), and wells C and C1 withdraw from the carbonate aquifers (upper and lower carbonate aquifers) from depths of 473 and 485 m (1,552 and 1,591 ft), respectively. The depth to groundwater near the margins of Frenchman Flat in the vicinity of DAF is approximately 360 m (1,180 ft) (DOE 2002k). The depth of the water table beneath DAF is approximately 280 m (920 ft) (NTS 2001). The flow is generally to the southwest, but is locally variable.

The State of Nevada strictly controls all surface and groundwater withdrawals. The Appropriation Doctrine governs the acquisition and use of water rights. NTS has been withdrawn from public use and thus possesses an unquantified water right sufficient to meet the purposes of NTS land withdrawal, subject to water rights that existed at the time land for NTS was withdrawn.

Groundwater Quality

The locations of 828 underground nuclear tests have been confirmed at NTS that correspond to areas of potential groundwater contamination. About one-third of these tests were at or below the water table and produced heavy metal contamination and wide range of radionuclide by-products. Detonations conducted near the water table have contaminated groundwater near underground nuclear test cavities with 43 residual radionuclides, with tritium being the most prevalent radionuclide. Radionuclides considered are residual and unburned fissile fuel and tracer material, such as uranium isotopes, plutonium isotopes, americium isotopes and curium-244; fission products such as cesium-137 and strontium-90; tritium, and activities induced by neutrons in device parts, in external hardware, and in the surrounding geologic medium (such as carbon-14, chlorine-16, and calcium-41). Not all of the radionuclides produced during a nuclear test are included in this figure. Many of the nuclides have half-lives so short (microseconds to hours), that they decay to undetectable levels soon after the test. Other nuclides are produced in such low initial abundance that they never exceed levels deemed unsafe or non-permissible by regulatory agencies. Therefore, criteria were developed to exclude such nuclides, thus permitting focus of attention on the nuclides of interest from the perspective of risk assessment (LANL 2001a).

To safeguard the public's health and safety and comply with applicable Federal, state, and local environmental protection regulations as well as DOE directives, groundwater on and near NTS is monitored for radioactivity. Twenty-eight wells and one spring were sampled during the period of May 8 to October 11, 2000. Tritium results from these wells indicated all analyses were well below the national drinking water standard. All of the wells contained gross beta concentrations below the national drinking water standard. Three wells had gross alpha concentrations that exceeded the national drinking water standard. A summary of the three highest monitoring results is listed in Table 4.3.4.2–1.

Table 4.3.4.2–1. Summary of Three Highest NTS Radioactive Constituent Monitoring Results in 2000

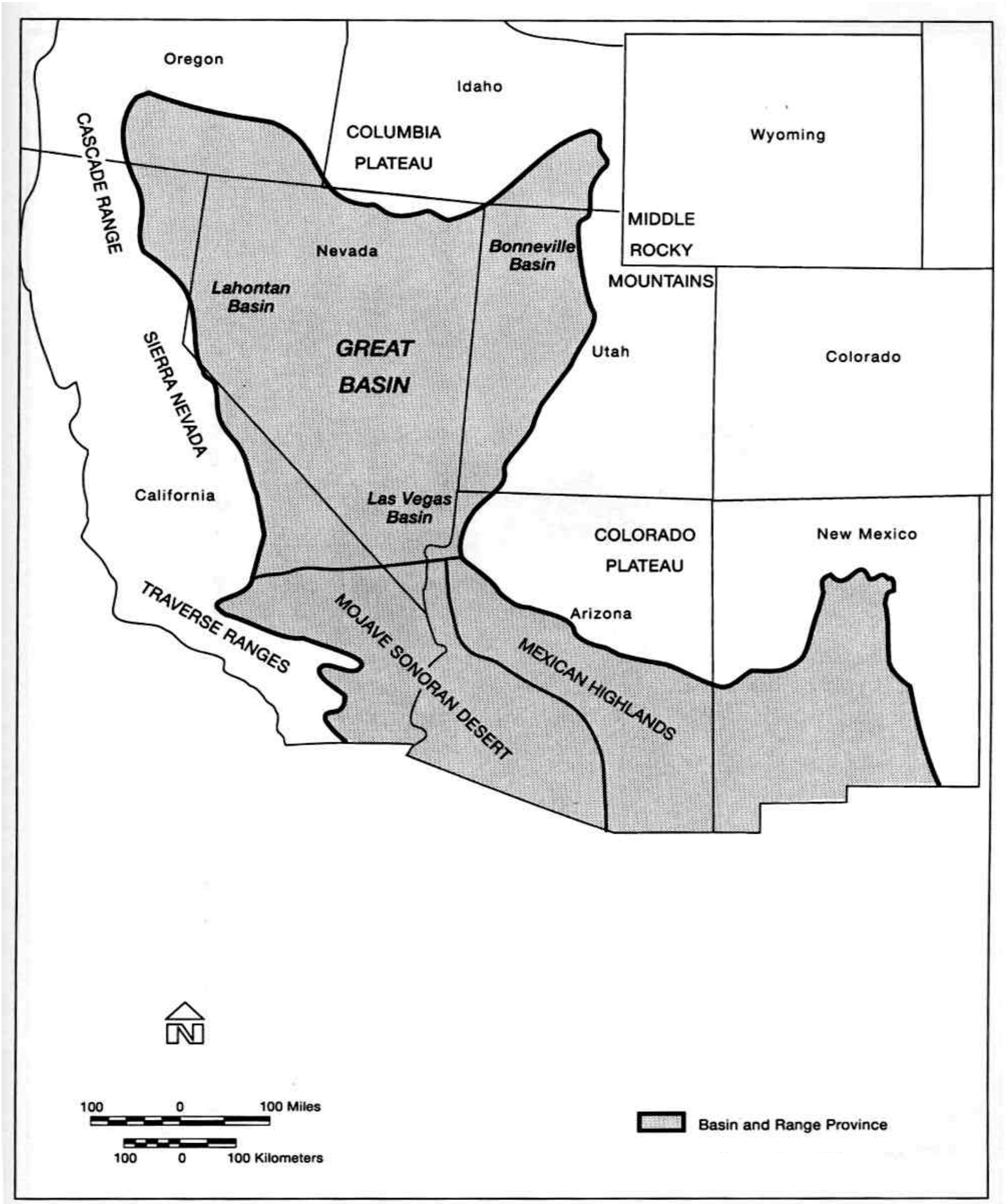
Radioactive Constituent and Area Location	Sample Date	Results (pCi/L)	DCG (pCi/L)
Tritium			
5 RNM #2S	May 17, 2000	195,000	20,000
5 RNM #2S	June 13, 2000	194,000	20,000
5 RNM #2S	June 29, 2000	178,000	20,000
Gross Alpha			
6 Water Well C-1	January 26, 2000	14.20	15
6 Water Well C-1	January 26, 2000	14.50	15
95 ER-OV-02	November 7, 2000	31.00	15
Gross Beta			
Beatty Water and Sewer	December 4, 2000	15.70	4 mrem/yr
95 ER-OV-02	November 7, 2000	17.00	4 mrem/yr
95 TW-5	May 8, 2000	20.00	4 mrem/yr
Radium-226			
UE-16d Eleana Water Well	January 26, 2000	1.45	3
22 Army #1 Water Well	October 24, 2000	2.00	3
95 Roger Bright Ranch	December 5, 2000	1.46	3
Plutonium-238			
95 Crystal Trailer Park	December 6, 2000	0.0467	40
ER-OV-02	November 7, 2000	0.0626	40
95 Tolicha Peak	November 21, 2000	0.0408	40
Plutonium-239 and Plutonium-240			
ER-OV-01	November 6, 2000	0.0160	30
95 Last Trail Ranch	December 5, 2000	0.0125	30
95 Revert Spring	November 7, 2000	0.0151	30
Strontium-90			
5 RNM #5	June 28, 2000	5.80	1,000
95 Fire Hall #2 Well	December 5, 2000	0.593	1,000
95 Last Trail Ranch	December 5, 2000	0.557	1,000

pCi/L = picocuries/Liter.
DCG = DOE Derived Concentration Guidelines.
Source: NTS 2001.

4.3.5 Geology and Soils

4.3.5.1 Geology

NTS is located about 105 km (65 mi) northwest of Las Vegas, Nevada, and lies within the southern part of the Great Basin, the northern-most subprovince of the Basin and Range Physiographic Province (Figure 4.3.5.1–1). NTS is generally characterized by more or less



Source: DOE 1996b.

Figure 4.3.5.1–1. Basin and Range Physiographic Province at NTS

regularly spaced, generally north-south trending mountain ranges separated by alluvial basins that were formed by faulting. There are three primary valleys on NTS: Yucca Flat, Frenchman Flat, and Jackass Flats. The alluvium- and tuff-filled valleys are rimmed mainly by Precambrian and Paleozoic sedimentary rocks and Cenozoic volcanic rocks. The representative site being evaluated for the MPF is in the northern part of Frenchman Flat.

The site features desert and mountainous terrain. The relief of NTS ranges from less than 1,000 m (3,280 ft) above sea level in Frenchman Flat and Jackass Flats to about 2,339 m (7,675 ft) on Rainier Mesa and about 2,199 m (7,216 ft) on Pahute Mesa.

The geology of NTS consists of a thick section (more than 10,597 m [34,768 ft]) of Paleozoic and older sedimentary rocks, locally intrusive Cretaceous granitic rocks, a variable assemblage of Miocene volcanic rocks, and locally thick deposits of postvolcanic sands and gravels that fill the present day valleys (NTS 2001).

Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of the ground and infrastructure at NTS and includes potential volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

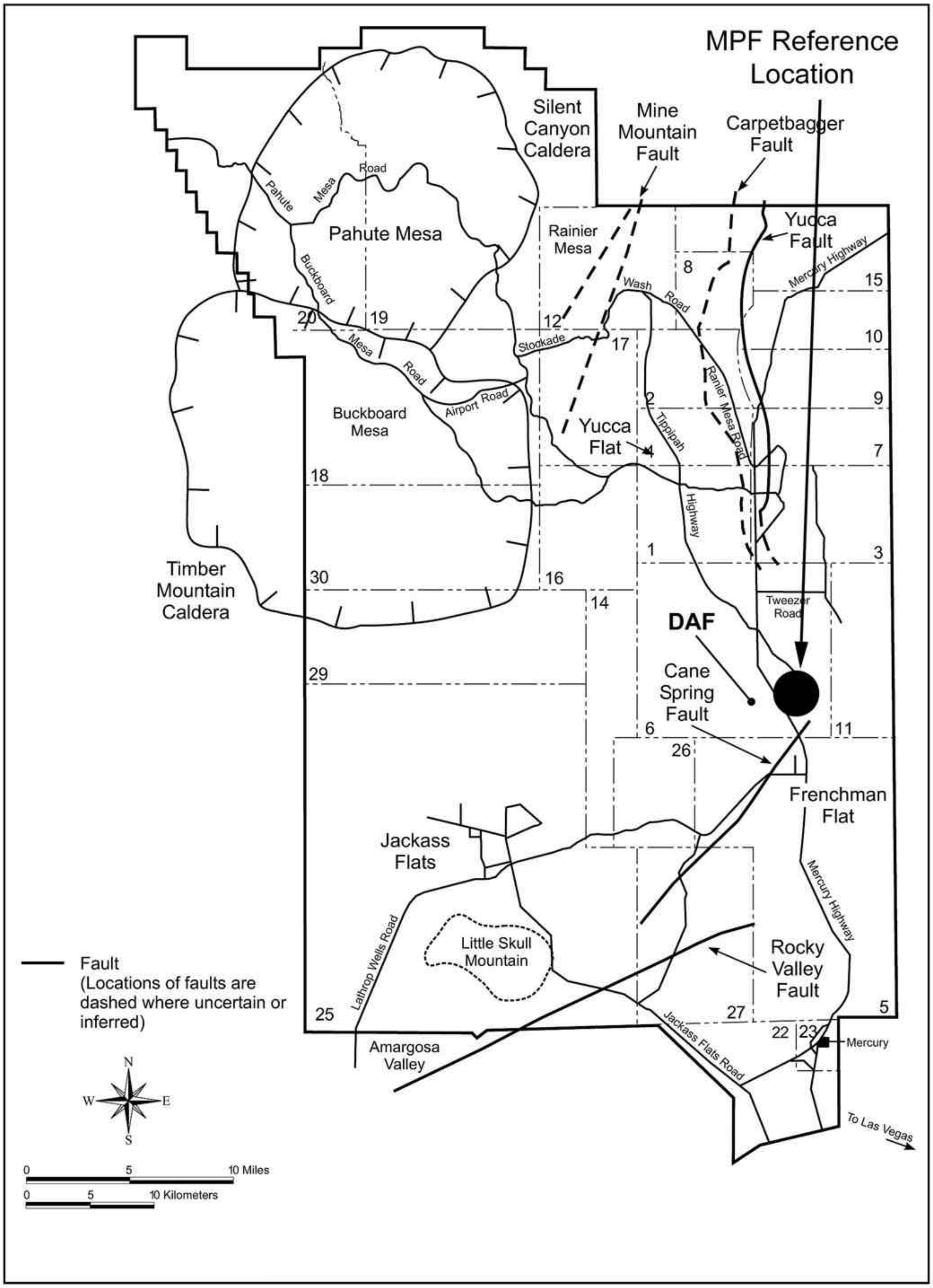
Volcanism

Eruptions of the southwest Nevada volcanic field occurred in the Middle Tertiary Period (NTS 2001). Several late Cenozoic, silicic caldera complexes occur in an eastward-trending belt. The Stonewall Caldera is the youngest (7.5×10^6 years) major silicic center in the area. Silicic volcanism is characterized by large-volume explosive eruptions.

A transition from predominantly silicic volcanism to predominantly basaltic volcanism, characterized by low-volume mild eruptions, was initiated approximately 1.0×10^8 years ago (NTS 2001). Since 7.5×10^6 years ago, only scattered, short-duration volcanic activity occurred in Nevada. The nearest examples of Quaternary volcanic cones and lava flows are located in Crater Flat, west of NTS (NTS 2001). Based on analysis of previous basaltic volcanism in the NTS region, there is no evidence of either an increase in the volcanic rate or the development of a large-volume volcanic field (NTS 2001).

Seismic Activity

The most prominent structures are related to basin-and-range extensional faulting that is younger than the volcanic rocks. In Frenchman Flat, structure strikes are mostly west-southwest. Three major fault zones in the region may be currently active: Mine Mountain, Cane Spring, and Rock Valley (Figure 4.3.5.1–2). Small earthquakes recently occurred at or near the Cane Spring Fault zone and the Rock Valley Fault zone, although no surface displacement was associated with either of these earthquakes (NTS 2001). A fault near Little Skull Mountain in the southwest part of NTS was the site of an earthquake with an approximate Richter magnitude of 5.6 in 1992 (see Table 4.2.5.1–2). This is the largest earthquake recorded within the boundaries of NTS and may have been associated with the approximate Richter magnitude 7.5 earthquake near Landers, California, which occurred less than 24 hours earlier. Although there was no surface rupture, the



Source: DOE 2002k.

Figure 4.3.5.1–2. Major Faults at NTS

Little Skull Mountain earthquake was the first to cause significant damage to facilities on NTS. These facilities, however, were built prior to the more stringent building codes presently followed on NTS (NTS 2001).

Additionally, the Yucca Fault in the Yucca Flat weapons test basin has been active in the recent geologic past (NTS 2001). This fault displaces surface alluvium by as much as 18 m (60 ft). Displacement of this young surface alluvium indicates that movement on Yucca Fault has occurred within the last few thousand to tens of thousands of years; subsurface displacement along this fault is 213 m (700 ft). The Carpetbagger Fault lies west of the Yucca Fault within the Yucca Flat weapons test basin (Figure 4.3.5.1–2). In the subsurface, this fault shows about 610 m (2,000 ft) of displacement in the past 7.5×10^6 years (NTS 2001).

Naturally occurring seismic events are associated with extensional tectonic activity characteristic of the province (NTS 2001). Human-induced historic seismic events recorded since 1868 include those resulting from (1) filling Lake Mead, (2) high-explosive tests, (3) underground nuclear-explosive tests, (4) postnuclear explosion cavity collapses, or (5) after shocks from nuclear explosions (NTS 2001). Parts of both the Yucca Fault and the Carpetbagger Fault have been reactivated from nearby testing of nuclear devices (NTS 2001).

Slope Stability, Subsidence, and Soil Liquefaction

Within the region, no natural factors have been reported as affecting engineering aspects of slope stability. External factors that have or could affect slope stability in the region include load and fracturing and ground motion associated with nuclear explosions. Although not reported as problematic, caution is warranted for certain activities (e.g., construction and drilling) on or near slopes in or near areas of previous nuclear testing. On NTS, particular caution is warranted on or near slopes that have been tunneled for nuclear testing.

Although not reported as problematic in the region, soils in arid environments can be conducive to swelling or contraction as water is added or removed. Site-specific evaluation for expandable clay would be necessary for specific activities because soils in the region have not been mapped extensively.

Certain areas where nuclear devices have been tested may be less stable than other areas. Such areas are not appropriate for other types of use because of their instability; these areas are fenced and controlled.

4.3.5.2 Soils

In general, the soils of NTS are similar to those of surrounding areas and include aridisols and entisols. The degree of soils development reflects their age, and the soils types and textures reflect their origin. Entisols generally form on steep mountain slopes where erosion is active. The aridisols are older and form on more stable fans and terraces.

The soils of the southern NTS reflect the mixed alluvial sediments upon which they form (NTS 2001). These soils are generally young in profile development and show only weak evidence of leaching. In general, soils texture is gradational from coarse-grained soils near the mountain fronts to fine-grained soils in the playa areas of the Yucca Flat weapons test basin and Frenchman Flat. Most soils are underlain by a hardpan of caliche. Soil salinity generally increases dramatically in the direction of the playa areas, with the highest level of soluble salts having accumulated in the deeper soil profile horizons in Frenchman Flat. None of the series in southwestern Nye County identified, including the region south and west of NTS, are considered prime farmland (EBS 1999).

Soil Erosion

Soil loss through wind and water erosion is a common occurrence throughout NTS and surrounding areas. Portions of some watersheds probably exhibit higher erosion rates, but the erosion conditions and susceptibility of soils on NTS have not been defined.

Mineral Resources

Important mineral commodities in the NTS region include gold, silver, copper, lead, zinc, tungsten, and uranium (NTS 2001). NTS has been closed to commercial mineral development since the 1940s (NTS 2001). Reactivation of many other gold districts in the region, in response to current gold prices and modern extraction technologies, suggests that the potential for precious metal deposits in the NTS region should be considered moderate to high (NTS 2001).

No occurrences of oil and gas, coal, tar sand, or oil shale in the region have been reported. Hot springs are common in the province (NTS 2001). However, if water temperatures near Yucca Mountain are representative (50-60°C [120-140°F]), water temperatures in the region may be insufficient for commercial power development.

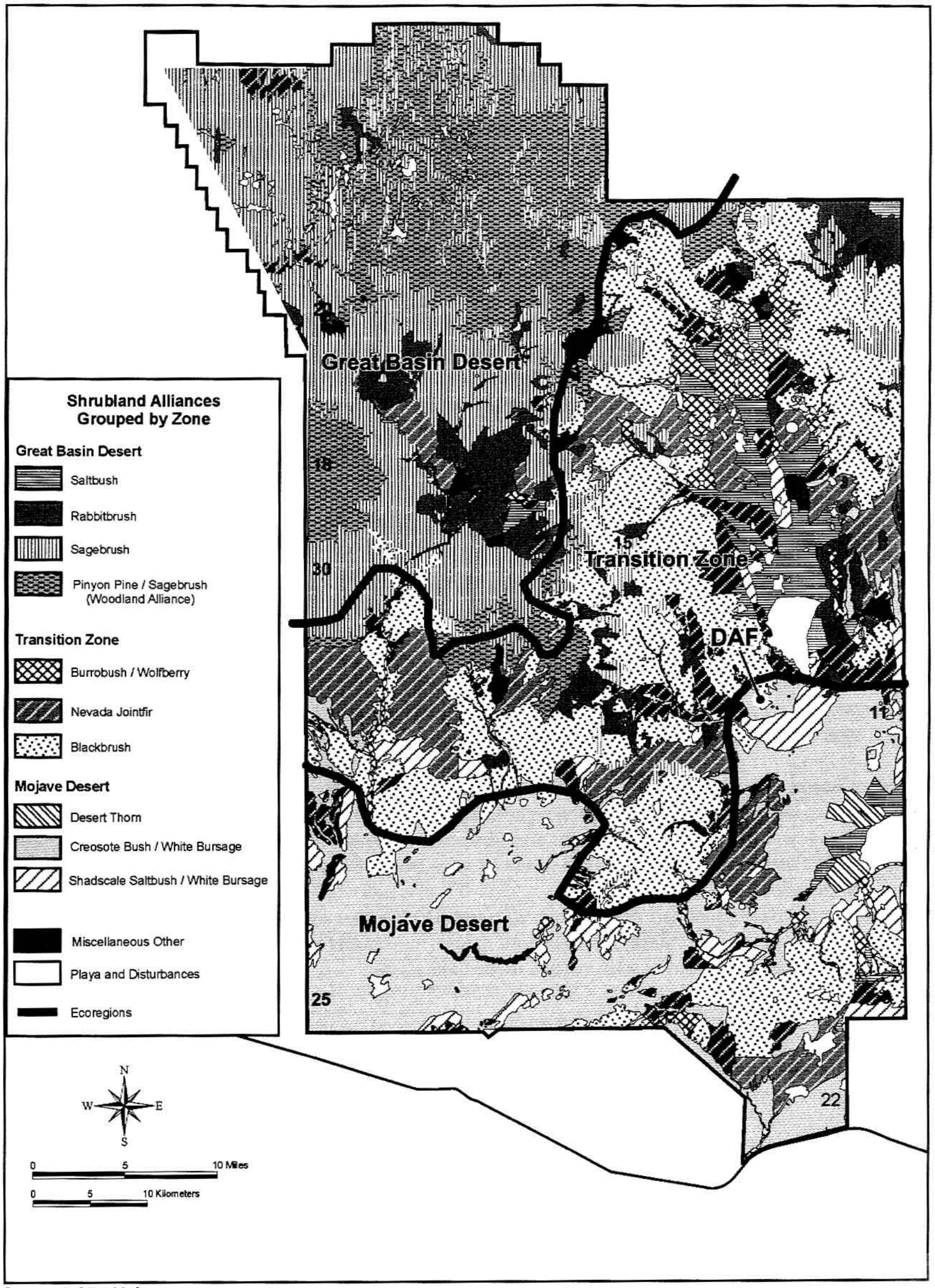
Most of the alluvial valleys in the region have aggregate resources at least along the flanks of adjacent mountains. The quantity and quality of these resources are likely sufficient to meet future demand. These resources do not have any unique value over aggregate occurring in other areas throughout southern Nevada.

4.3.6 Biological Resources

4.3.6.1 Terrestrial Resources

NTS is located along the transition zone between the Mojave Desert and Great Basin Desert. As a result, it has a diverse and complex mosaic of plant and animal communities representative of both deserts, as well as some communities common only in the transition zone between these deserts (Figure 4.3.6.1–1). This transition zone extends to the east and west far beyond the boundaries of NTS. Thus, the range of almost all species found onsite also extends beyond the site, and there are few rare or endemic species present.

Mojave Desert plant communities are found at elevations below approximately 1,219 m (4,000 ft) in Jackass Flats, Rock and Mercury Valleys, and Frenchman Flat. Creosote bush (*Larrea tridentata*) is the visually dominant shrub and is associated with a variety of other shrubs, including white bursage (*Ambrosia dumosa*) at the proposed project site, depending on soil type and elevation. Two plant communities are unique to the transition zone. The first, which occurs at elevations from 1,219-1,524 m (4,000-5,000 ft), is dominated by blackbrush (*Coleogyne ramosissima*). The second occurs in the bottom of enclosed Frenchman and Yucca Flat weapons test basins, where trapped winter air is too cold for typical Mojave Desert plants. The most abundant shrubs in these areas include three species of wolfberry (*Lycium* spp.) Little



Source: DOE 2002k.

Figure 4.3.6.1–1. Vegetation Association at Nevada Test Site

or no vegetation grows on the playas in these basins. Plant communities typical of the Great Basin Desert occur at elevations generally above 1,524 m (5,000 ft). Communities dominated by saltbush (*Atriplex* spp.), rabbitbrush (*Chrysothamnus* spp.), sagebrush (*Artemisia* spp.), and pinion pine (*Pinus pinea*)/sagebrush occur with increasing elevation. Over 700 plant taxa have been found at NTS.

Two hundred seventy-nine species of terrestrial vertebrates have been recorded at NTS, including 54 species of mammals, 190 species of birds, and 33 species of reptiles. Typical Mojave Desert species found at the site include kit fox (*Vulpes velox*), Merriam's kangaroo rat (*Dipodomys merriami*), desert tortoise (*Gopherus agassizii*), chuckwalla (*Sauromalus obesus*), western shovelnose snake (*Chionactis occipitalis)*, and sidewinder snake (*Crotalus cerastes)*. Typical Great Basin Desert species include cliff chipmunk (*Eutamias dorsalis)*, Great Basin pocket mouse (*Perognathus parvus*), mule deer (*Odocoileus hemionus*), northern flicker (*Colaptes auratus*), scrub jay (*Aphelocoma coerulescens)*, Brewer's sparrow (*Spizella breweri)*, western fence lizard (*Sceloporus occidentalis)*, and striped whipsnake (*Masticophis taeniatus)*. About 60 wild horses (*Equus caballus*) live on the northern part of NTS. Water holes, both natural and manmade, are important to many species of wildlife, including game animals such as pronghorn (*Antilocapra americana*) and mule deer. Hunting is not permitted anywhere on NTS.

Raptors such as the turkey vulture (*Cathartes aura*) and rough-legged hawk (*Buteo lagopus*), and carnivores such as the long-tailed weasel (*Mustela frenata*) and bobcat (*Lynx rufus*) are two ecologically important groups on the site. A variety of migratory birds have been found at NTS (DOE 2002k).

Vegetative communities that are found within Area 6 include those of both the Mojave Desert and transition zone. The DAF is located within habitat most like that of the Mojave Desert. Gentle slopes cut by shallow arroyos 1-3 m (3-10 ft) deep with shallow soils characterize the area. Facilities associated within the DAF include a paved access road, a water storage tank, a diversion ditch uphill of the buildings, and sewage evaporation ponds. Whereas cleared areas have removed habitat for most animals of the site, the sewage evaporation ponds have provided unlimited water to birds of the region. Baseline biological studies associated with the DAF facility, conducted in 1993 and 1994, identified 117 species of plants, 11 mammals, 71 birds, and 16 reptiles in the vicinity of the DAF (DOE 2002k). Dominant plants were the Joshua tree (*Yucca brevifolia*) and creosote bush. Common animals included the Merriam's kangaroo rat, long-tailed pocket mouse (*Chaetodipus formosus)*, mourning dove (*Zenaida macroura*), house finch (*Carpodacus mexicanus*), black-throated sparrow (*Amphispiza bilineata*), zebra-tailed lizard (*Callisaurus draconoides*), and side-blotched lizard (*Uta stansburiana*).

4.3.6.2 Wetlands

There are 24 springs and seeps found at NTS, most of which support wetland vegetation such as cattail (*Typha latifolia*), sedges (*Carex* spp.), and rushes (*Juncus* spp.). It is likely that these would constitute wetlands as defined under Section 404 of the *Clean Water Act* (CWA). One newly identified wetland, a historic borrow pit that catches water in large enough quantities and for long enough periods of time to sustain wetland vegetation, has been identified (DOE 2002k).

There is one natural waterbody, Yucca Lake, found within Area 6. It is located about 6.5 km (4 m) north of DAF. However, the reference location for the MPF is in the Frenchman Lake drainage area, which is located in Area 5. There are no wetlands located within the vicinity of DAF.

4.3.6.3 Aquatic Resources

Known natural water sources on NTS consist of 24 springs and seeps, 4 tanks (natural rock depressions that catch and hold surface runoff), and 1 intermittent playa pond. Man-made impoundments on NTS, that are scattered throughout the eastern half of the site, support three introduced species of fish: bluegill (*Lepomis macrochirus*), goldfish (*Carassius auratus*), and golden shiners (*Notemigonus crysoleucas*). Eighty-one species of plants and 138 species of animals (not all of which are aquatic species) have been documented at or near aquatic sites on NTS (DOE 2002k).

The surface hydrologic connection is between the reference site and Frenchman Lake in Area 5. There is one natural waterbody, Yucca Lake, located in Area 6 (see Figure 4.3.4.1–1) and several sewage evaporation ponds located at the DAF site. As noted above, these ponds are important to birds of the region.

4.3.6.4 Threatened and Endangered Species

The only federally-threatened species found at NTS is the Mojave Desert population of the desert tortoise (Table 4.3.6.4–1). Desert tortoises are found throughout the southern half of the site. The abundance of tortoises at NTS is low to very low compared to other areas within the range of this species. NTS contains less than 1 percent of the total desert tortoise habitat of the Mojave Desert population (DOE 2002k).

Area 6 is located within that part of the Mojave Desert that makes up the northern-most territory for the desert tortoise. No other threatened or endangered species have been found in the area around the DAF. In addition, no critical habitat has been identified in the area.

4.3.7 Cultural and Paleontological Resources

4.3.7.1 Cultural Resources

All undertakings at NTS are conducted in compliance with relevant cultural resource Federal legislation, particularly Sections 110 and 106 of the NHPA, and DOE orders and policies that address cultural resource protection and management. DOE entered into a Programmatic Agreement in 1990 with the Nevada SHPO and the Advisory Council on Historic Preservation. In addition, cultural resource compliance at NTS follows the policies presented in the *Cultural Resources Management Plan for the Nevada Test Site* (DOE 1999d). The ROI for cultural resources is the entire NTS site.

There have been 443 cultural resource investigations at NTS, covering approximately 5.5 percent of the land (DOE 2002i). Most of these investigations have been 100-percent-coverage pedestrian surveys, with some data recovery excavation and Native American ethnographic consultation. A total of 2,960 cultural resources has been recorded. National Register eligibility for these resources is as follows: 1,512 resources are not eligible, 1,075 resources are eligible or

Table 4.3.6.4–1. Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at NTS

Species	Federal Classification	State Classification	Occurrence at NTS
Mammals			
Fringed-myotis *Myotis thysanodes*	Special Concern	Unlisted	Occasional
Long-eared myotis *Myotis evotis*	Special Concern	Unlisted	Occasional
Long-legged myotis *Myotis volans*	Special Concern	Unlisted	Occasional
Pale Townsend's big-eared bat *Plecotus townsendii pallescens*	Special Concern	Unlisted	Occasional
Pygmy rabbit *Brachylagus idohoensis*	Special Concern	Unlisted	Potential habitat
Small-footed myotis *Myotis ciliolabrum*	Special Concern	Special Concern	Potential habitat
Spotted bat *Euderma maculatum*	Special Concern	Protected by State of Nevada	Occasional
Birds			
American peregrine falcon *Falco peregrinus aratum*	Special Concern	Unlisted	Occasional
Black tern *Chilidonias niger*	Special Concern	Special Concern	Potential habitat
Ferruginous hawk *Buteo regalis*	Special Concern	Unlisted	Rare Transient
Gray flycatcher *Empidonax wrightii*	Special Concern	Unlisted	Potential habitat
Least bittern *Ixobrychus exilis hesperis*	Special Concern	Special Concern	Potential habitat
Lucy's warbler *Vermivora lucine*	Special Concern	Unlisted	Potential habitat
Phainopepla *Phainopepla nitens*	Special Concern	Special Concern	Potential habitat
Western burrowing owl *Athene cunicularia hypugea*	Special Concern	Protected by State of Nevada	Resident
White-faced ibis *Plegadis chihi*	Special Concern	Protected by State of Nevada	Migrant
Reptiles			
Bandelier Gila monster *Heloderma suspectum cinctum*	Special Concern	Special Concern	Potential habitat
Chuckwalla *Sauromalus obesus*	Special Concern	Unlisted	Resident
Desert tortoise *Gopherus agassizii*	Threatened	Protected by State of Nevada	Resident
Plants			
Beatley milk vetch *Astragalus beatleyae*	Special Concern	Endangered	Potential habitat
Beatley phacelia *Phacelia beatleyae*	Special Concern	Unlisted	Potential habitat
Black woolypod *Astragalus funereus*	Special Concern	Unlisted	Potential habitat
Cane Spring evening primrose *Camissonia megalanatha*	Special Concern	Unlisted	Potential habitat

Table 4.3.6.4–1. Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at NTS *(continued)*

Species	Federal Classification	State Classification	Occurrence at NTS
Plants *(continued)*			
Clokey's egg-vetch *Astragalus oopherus var. clokeyanus*	Special Concern	Unlisted	Potential habitat
Death Valley beard tongue *Penstemon fruticiformis var. amargosae*	Special Concern	Unlisted	Potential habitat
Delicate rock daisy *Perityle megaloceplala var. intricata*	Special Concern	Special Concern	Potential habitat
Eastwood milkweed *Aschepias eastwoodiana*	Special Concern	Special Concern	Potential habitat
Kingston bedstraw *Galium hilendiae ssp. Kingstonense*	Special Concern	Unlisted	Potential habitat
Pahute Mesa beardtongue *Penstemon pahutensis*	Special Concern	Unlisted	Potential habitat
Pahute Mesa green gentian *Frasera pahutensis*	Special Concern	Unlisted	Potential habitat
Parish's phacelia *Phacelia parishii*	Special Concern	Unlisted	Potential habitat
Sanicle biscuitroot *Cymopterus ripleyi var. saniculoides*	Special Concern	Unlisted	Potential habitat
White bearpoppy *Arctomecon merriami*	Special Concern	Unlisted	Potential habitat
White-margined beardtongue *Penstemon albomarginatus*	Special Concern	Unlisted	Potential habitat

Source: DOE 2002k.

potentially eligible, and 373 resources are undetermined. Ninety-six percent of the resources are prehistoric, with the remainder either historic, recent significant, multicomponent, or unknown (DOE 2002i).

Prehistoric Resources

Prehistoric sites found on NTS include habitation sites with wood and brush structures, wind breaks, rock rings, rock shelters, rock art, hunting blinds, rock alignments, quarries, temporary camps, milling stations, roasting pits, water caches, and limited activity locations (DOE 2002k).

Areas of NTS that appear to have the highest prehistoric site density are the northwest part, on and around Pahute and Rainier Mesas, and in the southwest part, on and around Jackass Flats, Yucca Mountain, and Shoshone Mountain. However, the distribution information is preliminary. The high number of cultural resources in these areas is somewhat related to the numerous NTS activities that have taken place there, as most cultural resource investigations are conducted in response to planned NTS activities (DOE 2002i).

Historic Resources

Historic sites found include mines and prospects, trash dumps, settlements, campsites, ranches and homesteads, developed springs, roads, trails, and nuclear weapon development sites. At least 600 buildings, structures, and objects dating to the Cold War era have been identified at NTS, but these have not been systematically recorded or evaluated for significance. Frenchman Flat and Yucca Flat are rich in significant resources pertaining to the Cold War era (DOE 2002k).

Native American Resources

DOE has an extensive record of consultation with interested tribes concerning new, existing, and proposed activities at NTS. The Nevada Site Office has been consulting with Native Americans since 1988. These consultations have led to the establishment of the Consolidated Group of Tribes and Organizations (CGTO), which includes members from 16 tribes and 2 pan-tribal organizations, representing 3 ethnic groups which were found to have prehistoric and historic ties to NTS: Western Shoshone, Southern Paiute, and Owens Valley Paiute. Consultations with the CGTO and other affiliated tribes are ongoing and follow the policies set forth by DOE and the current executive orders (DOE 2002i).

The CGTO has identified several sites at NTS that are important to Native American people, including storied rocks, rock shelters, wooden lodges, rock rings, springs, and certain archaeological sites. In addition, 107 plant and more than 20 animal species resident on NTS have been identified by Native American elders as part of their traditional resources (DOE 2002k).

Cultural Resources on the Reference Location

The reference location for the MPF at NTS is located in the southern portion of Area 6, which is located within the Frenchman Flat basin and east of the DAF. As of 2000, approximately 2,426 ha (5,995 ac) of the basin had been inventoried for cultural resources, with one survey in Area 6 encompassing 1,089 ha (2,690 ac) surrounding the DAF. A total of 101 prehistoric sites has been recorded in the basin, and the survey in Area 6 located only 6 prehistoric sites (DOE 2002k; DOE 2000a). Four historic resources have been identified in the Frenchman Flat basin; two are unspecified and two are related to nuclear testing and research. The above-mentioned survey in Area 6 did not identify any historic resources. However, Frenchman Flat has been noted as an area rich in Cold War-era resources (DOE 2002k). The CGTO has stated that Frenchman Flat contains a wide variety of plants, animals, and archaeological sites of cultural importance to Native American people. A total of 20 plant species was identified at 2 plant study locations within the west-central portion of the basin (DOE 2002k).

4.3.7.2 Paleontological Resources

Alluvium-filled valleys surrounded by ranges composed of Precambrian and Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas characterize the surface geology of NTS. Although the Precambrian deposits contain only a few poorly preserved fossils, the Paleozoic marine limestones are moderately to abundantly fossiliferous, and can contain trilobites, conodonts, ostracods, corals, brachiopods, cephalopods, algae, gastropods, and archaic fish. These fossils are relatively common and have low research potential. The Tertiary volcanic deposits were not conducive to preservation when deposited and thus are not expected to contain fossils.

Late Pleistocene terrestrial vertebrate fossils could be expected in the Quaternary alluvial deposits. Discovery of mammoth, horse, camel, and bison remains could be expected since these types of remains have been found near NTS. Although no known fossil localities have been recorded on NTS, Quaternary deposits with paleontological materials may occur onsite (DOE 2002k, DOE 1996c).

4.3.8 Socioeconomics

Socioeconomic characteristics addressed at NTS include employment, income, population, housing, and community services. These characteristics are analyzed for a two-county ROI, Clark and Nye Counties in Nevada, where 97 percent of site employees reside, as shown in Table 4.3.8–1 (DOE 2002k).

Table 4.3.8–1. Two-County ROI Where NTS Employees Reside

County	Percent of Site Employment
Clark County	90
Nye County	7

Source: DOE 2002k.

4.3.8.1 Employment and Income

The service sector employs the greatest number of workers in the ROI, providing more than 44 percent of employment in the ROI. Other important sectors of employment include retail trade (16.4 percent); finance, insurance, and real estate (9.4 percent); and government (9.2 percent) (BEA 2002).

The labor force in the ROI increased 74.2 percent between 1990 and 2001, an average of 6.7 percent each year. This increase was over 20 percent greater than the labor force increase for the State of Nevada, which only increased a total of 53.9 percent over the same time period. Total employment in the ROI increased at a slightly slower pace than the labor force. ROI unemployment increased from 4.7 percent in 1990 to 5.5 percent in 2001. The state-wide average unemployment increased from 4.9 in 1990 to 5.3 in 2001 (BLS 2002a).

Per capita income in the ROI ranged from a high of $28,690 in Clark County to a low of $23,479 in Nye County in 2000. The average per capita income in the ROI was $28,570, compared to the State of Nevada average of $29,506 (BEA 2002).

4.3.8.2 Population and Housing

Between 1990 and 2000, the ROI population grew from 759,149 to 1,408,250, an increase of 85 percent. This increase was greater than for the State of Nevada, which grew at a rate of 66.3 percent during the same time period. Clark County had the highest rate of growth at 85.6 percent, while Nye County had the lowest rate of growth at 82.7 percent (Census 2002).

The number of housing units in the ROI was 575,733 in 2000, with 525,562 units occupied. Of these occupied units, 313,001 were owner-occupied and 212,561 were occupied rental units. In

2000, the homeowner vacancy rate in the ROI ranged from 2.6 percent in Clark County to 3.4 percent in Nye County, while the rental vacancy rate ranged from 9.7 percent in Clark County to 17.9 percent in Nye County. This is comparable to the State of Nevada rates of 2.6 percent homeowner vacancy and 9.7 percent rental vacancy. The greatest number of housing units in the ROI is in Clark County with more than 97 percent of the total housing units.

4.3.8.3 Community Services

There are two school districts in the ROI serving 236,945 students. The student-to-teacher ratio in these districts ranges from 15.5 in Nye County to 19.7 in Clark County. The average student to teacher ratio in the ROI is 19.6. The Clark County school district has 259 schools to serve 231,655 students. The Nye County school district has 16 schools to serve its 5,290 students.

The ROI is served by 13 hospitals with a capacity of over 2,400 beds. Most of these hospitals are located in Clark County in the Las Vegas area (AHA 1995). There are over 1,400 doctors in the ROI. Almost all are located in Clark County.

4.3.9 Radiation and Hazardous Chemical Environment

4.3.9.1 Radiation Exposure and Risk

An individual's radiation exposure in the vicinity of NTS amounts to approximately 379 mrem/yr as shown in Table 4.3.9.1–1 and is comprised of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; weapons test fallout; consumer and industrial products; and nuclear facilities. All radiation doses mentioned in this EIS are effective dose equivalents. Effective dose equivalents include the dose from internal deposition of radionuclides and the dose attributable to sources external to the body.

Table 4.3.9.1–1. Sources of Radiation Exposure to Individuals in the NTS Vicinity Unrelated to NTS Operations

Source	Radiation Dose (mrem/yr)
Natural Background Radiation	
Total external (cosmic and terrestrial)	74
Internal terrestrial and global cosmogenic	40[a]
Radon in homes (inhaled)	200[a]
Other Background Radiation[a]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	**379**

[a] An average for the United States.
Source: Derived from data in NCRP 1987.

Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to NTS operations.

Releases of radionuclides to the environment from NTS operations provide another source of radiation exposure to individuals in the vicinity of NTS. Types and quantities of radionuclides released from NTS operations in 2000 are listed in *Nevada Test Site Annual Site Environmental Report for Calendar Year 2000* (NTS 2001). The doses to the public resulting from these releases are presented in Table 4.3.9.1–2. The radionuclide emissions contributing the majority of the dose to the offsite MEI were tritium, isotopes of plutonium, and americium-241 (NTS 2001). These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

Table 4.3.9.1–2. Radiation Doses to the Public from Normal NTS Operations in 2000 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Offsite MEI (mrem)	10	0.17	4	0	100	0.17
Population within 80 km (person-rem)	None	0.44	None	0	None	0.44

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-mrem/yr limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.

Source: NTS 2001.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the offsite MEI due to radiological releases from NTS operations is estimated to be 8.5×10^{-8}, or 8.5 cancer deaths in a population of 100 million. The estimated probability of this maximally exposed person dying of cancer at some point in the future from radiation exposure associated with 1 year of NTS operations is less than one in 1 million (it takes several to many years from the time of radiation exposure for a cancer to potentially manifest itself).

According to the same risk estimator, 2.2×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of NTS from normal NTS operations. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population of 20,294 living within 80 km (50 mi) of NTS was 41. This expected number of fatal cancers is much higher than 2.2×10^{-4} fatal cancers estimated from NTS operations in 2000.

External radiation doses have been measured in areas of NTS that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 2000 showed a median annual dose on NTS of 132 mrem (NTS 2001), or approximately 132 mrem.

NTS workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at NTS from operations in 2001 are presented in Table 4.3.9.1–3. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among NTS workers from normal operations in 2001 is 5.2×10^{-4}. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 4.3.9.1–3. Radiation Doses to Workers from Normal NTS Operations in 2001 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (mrem)	5,000[a]	41
Collective radiation worker dose[b] (person-rem)	None	1.3

[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 mrem/yr (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] There were 32 workers with measurable doses in 2001.
Source: DOE 2001f.

4.3.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NTS workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at NTS via inhalation of air containing hazardous chemicals released to the atmosphere by NTS operations. Risks to the public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Routine nonradiological air monitoring at NTS in 2000 was limited to the HSC and asbestos sampling in conjunction with asbestos removal and renovation projects. Onsite nonradiological monitoring of the HSC was conducted in 2000 for four series of tests at the HSC. This monitoring indicated no exceedances of air permit requirements (NTS 2001).

4.3.10 Traffic and Transportation

4.3.10.1 Regional Transportation Infrastructure

NTS is approximately 105 km (65 mi) northwest of Las Vegas, Nevada (Figure 4.3.10.1–1). The route to NTS from all locations of interest to this EIS goes through Las Vegas. I-15 passes through Las Vegas in a southwest to northeast direction. A beltway, I-215, is being constructed to encircle all but the east side of Las Vegas.

The mercury interchange on U.S. 95 provides the principal access to NTS. All MPF-related shipments would arrive in the region from the east on I-40 and route around Hoover Dam and the City of Las Vegas. Completion of a new bridge (planned for 2006) for U.S. 93 across the Colorado River, just south of Hoover Dam, and the new I-215 around Las Vegas could simplify the routing to and from NTS.

4.3.10.2 Local Traffic Conditions

Ninety-five percent of all commuters and shipments to NTS arrive from the Las Vegas area on U.S. 95, a four-lane highway from Las Vegas to the Mercury interchange. Traffic is light and free flowing. Commuters, however, can experience gridlock conditions within the beltway, especially at the interchanges of U.S. 93, U.S. 95, I-15, I-515, and I-215. Table 4.3.10.2–1 provides traffic information for U.S. 95 near NTS. Traffic conditions within Las Vegas are not provided since the NTS contribution to the heavy traffic congestion in Las Vegas is minimal.

Table 4.3.10.2–1. Traffic Conditions on the Access Road to NTS

Access Road	Average Annual Daily Traffic[a]	Peak Hourly Traffic[b]	Volume to Capacity Ratio[b]	Level of Service[b,c]
U.S. 95 near the Mercury interchange	3110	199	0.14	A

[a] NDOT 2001.
[b] Lawson 2002.
[c] Levels of Service:

A. Free flow of the traffic stream; users are unaffected by the presence of others.
B. Stable flow in which the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished.
C. Stable flow that marks the beginning of the range of flow in which the operation of individual users is significantly affected by interactions with the traffic stream.
D. High-density, stable flow in which speed and freedom to maneuver are severely restricted; small increases in traffic will generally cause operational problems.
E. Operating conditions at or near capacity level causing low but uniform speeds and extremely difficult maneuvering that is accomplished by forcing another vehicle to give way; small increases in flow or minor perturbations will cause breakdowns.
F. Defines forced or breakdown flow that occurs wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. This situation causes the formation of queues characterized by stop-and-go waves and extreme instability.

Figure 4.3.10.1–1. Highways in the Region of Nevada Test Site

4.3.11 Waste Management

This section describes the DOE waste generation baseline that will be used to gauge the relative impact of MPF construction and operations on the overall waste generation at NTS and on DOE's capability to manage such waste. NTS manages the following types of waste: TRU waste, including mixed TRU waste; LLW; mixed LLW; hazardous waste; and sanitary waste. Table 4.3.11–1 provides the routine waste generation rates at NTS. Table 4.3.11–2 summarizes the waste management capabilities at NTS.

Table 4.3.11–1. Annual Routine Waste Generation from NTS Operations (m^3)

Waste Type	1996	1997	1998	1999	2000	2001
Transuranic	0	0	0	0	0	0
Low-level	0	0	0	7.1	0.46	0
Mixed	0	0	0	0	0	0
Hazardous[a]	46	11	50.2	14	24.5	4.86
Sanitary[b]	4,550	2,280	6,460	7,460	5,080	4,550

[a] Includes state-regulated waste. Hazardous waste reported in metric tons.
[b] From DOE 2002o (1996 data) and DOE's Central Internet Database (available at http://cid.em.doe.gov/). Sanitary waste reported in metric tons.
Source: DOE 2002o.

4.3.11.1 Low-Level Radioactive Waste

LLW is disposed in engineered pits and trenches and in subsidence craters at two Radioactive Waste Management Sites (RWMSs) in Area 3 and Area 5 on NTS. The RWMS in Area 5 is a 37-ha (92-ac) facility consisting of trenches and pits for burying LLW and aboveground storage for TRU waste awaiting transfer to the WIPP. The Area 5 RWMS includes Greater Confinement Disposal Units, which consist of 3 m (10 ft) in diameter partially cased shafts that are 36 m (120 ft) deep. These units were used for disposing of waste not suited for shallow land burial because of high exposure and potential for migration into biopathways. DOE is considering using different disposal configurations (other than boreholes) for Greater Confinement Disposal. In the Area 3 RWMS, DOE uses surface subsidence craters (that were formed by underground nuclear tests) for disposal of LLW in bulk form (such as debris collected from atmospheric nuclear test locations).

NTS is currently accepting LLW from offsite-approved DOE and Department of Defense generators. An approved generator must undergo an extensive approval process, which is detailed in *Nevada Test Site Waste Acceptance Criteria* (DOE 2002d). The process is designed to verify that the generator site has a program in place to ensure that waste shipped to the NTS meets acceptance criteria. NTS typically receives less than 28,300 m^3 (999,414 ft^3) of LLW per year for disposal. During FY2001, the RWMSs in Areas 3 and 5 received more than 900 shipments of LLW for a total of 34,800 m^3 (122,896 ft^3). Nearly all of this LLW came from 16 offsite generators, with about 1 m^3 (35.3 ft^3) coming from onsite generators (DOE 2002b).

Table 4.3.11–2. Waste Management Facilities at NTS

Facility/ Description	Capacity	Status	Applicable waste types				
			LLW	Mixed LLW	TRU waste	Hazardous waste	Nonhazardous waste
Treatment Facility							
Explosive Ordnance Disposal Unit (kg/hr)	45.4	Online				X	
Storage Facility (m^3)							
TRU waste storage pad	1,150	Online		X	X		
Hazardous waste storage unit	61.6	Online				X	
Disposal Facility (m^3)							
Areas 3 and 5 RWMS[a]	1,000,000	Online	X				
Area 5 Pit 3 MWDU	70,800[b]	Online		X			
Area 6 hydrocarbon disposal site	92,000	Online					X
Area 9 U-10c solid waste disposal site	660,000	Online					X
Area 23 solid waste disposal site	210,000	Online					X

[a] The Area 3 and Area 5 RWMSs are capable of disposing 3.8 million m^3 (134.2 million ft^3) of LLW, if DOE were to use all available disposal area. The capacity of 1 million m^3 (35.3 million ft^3) includes LLW already disposed plus that projected through 2011.
[b] Upon receipt of the RCRA permit, this capacity may be limited to 20,000 m^3 (706,300 ft^3). The NTS capacity could accommodate 71 percent of DOE-complex mixed waste estimated to be 99,000 m^3 (3.4 million ft^3).
Source: DOE 2002k, 2002i.

As of July 2002, a total of 654,000 m^3 (23,096,010 ft^3) of LLW and 8,500 m^3 (300,177 ft^3) of mixed LLW has been disposed at the NTS. Disposal volumes are anticipated to increase dramatically in the next few years as a result of accelerated clean-up initiatives across the DOE complex (DOE 2002l).

4.3.11.2 Mixed Low-Level Waste

DOE's ROD for the Waste Management PEIS (65 FR 10061, February 25, 2000) identified NTS as one of two national mixed LLW disposal sites for the DOE complex. One interim status disposal unit at Area 5 is currently being used to dispose of mixed LLW generated from NNSA/Nevada (NV) activities. NTS is not currently permitted to receive mixed LLW from offsite (excluding NNSA/NV) locations. On December 22, 2000, DOE submitted a RCRA permit application requesting that NTS be allowed to dispose of mixed LLW generated both onsite and offsite in the Pit 3 Mixed Waste Disposal Unit (MWDU) in Area 5. The proposed facility would have a disposal capacity of 20,000 m^3 (706,300 ft^3). The permit application for the MWDU is under review by the State of Nevada (DOE 2002c). DOE expects to receive the RCRA permit and start mixed LLW disposal operations at NTS in FY 2003 (DOE 2002l).

Mixed waste is stored on a pad in the Area 5 RWMS awaiting treatment and/or disposal. Most of mixed LLW generated at NTS is shipped offsite for treatment. In recent years, NTS has shipped mixed LLW to Waste Control Specialists and to a treatment facility at the Hanford Site. NTS' projected mixed LLW generation from 2000-2070 is negligible (<1 m^3 [<35.3 ft^3]) and is derived primarily from deactivation and decommissioning activities (DOE 2001c).

4.3.11.3 Transuranic and Alpha Waste

Most of the TRU waste currently stored at NTS was generated at the Lawrence Livermore National Laboratory. This legacy waste was shipped to NTS for temporary storage between 1974 and 1990. A small quantity of TRU waste was generated at NTS by environmental restoration activities on NTS and the Tonopah Test Range. These TRU wastes are stored at the TRU Waste Storage Building in the Area 5 RWMS pending shipment to WIPP. The Waste Examination Facility located just outside the Area 5 RWMS will be used to characterize and certify the NTS inventory of TRU waste in accordance with the WIPP waste acceptance criteria. DOE anticipates shipments to WIPP beginning in September 2003, with an initial shipping campaign of 215 m^3 (7,593 ft^3). The current volume projections and WIPP shipment schedule indicate that the TRU waste storage volume is sufficient to meet NTS's needs.

DOE has proposed to accelerate the disposition of legacy TRU waste stored at NTS. Nuclear safety authorization basis documents will be streamlined and mobile vendors will be used to characterize and certify TRU waste for disposal at WIPP. Beginning in 2004, DOE will investigate technologies for those NTS TRU wastes with no current path forward for disposition, including oversized, classified, and spherical TRU wastes. Under this strategic initiative, DOE would complete the disposition of all non-classified TRU waste stored at NTS by July 2007, two years ahead of existing Site Treatment Plan deadlines. If the proposed treatment for the NTS legacy TRU waste is unsuccessful, DOE would pursue an alternate path of transferring the waste to a western hub, such as the Hanford Site, under the Western Small Quantity Site Acceleration Program described in the *Transuranic Waste Performance Management Plan* (DOE 2002m). The western hub will have the capacity to process all of the NTS waste, if necessary (DOE 2002l).

4.3.11.4 Hazardous Waste

NTS stores hazardous waste onsite prior to shipping it to a permitted commercial facility for treatment/disposal. NTS received its final RCRA permit for storage in 1995 and renewed that permit in 2000. The permit limited storage to 61,600 L (16,300 gal) or 61.6 m^3 (2,175 ft^3) at one time. This storage capacity is adequate for projected waste volumes.

NTS is also permitted to treat certain explosive hazardous wastes. The projected volume of explosive waste to be treated is well under the limit set by the RCRA permit.

NTS also manages waste containing PCBs regulated under TSCA. Regulated PCB waste is not generated during operations, but could be generated during remediation and decommissioning activities. Currently, PCB-contaminated mixed and LLW are stored on the TRU Waste Storage Pad in a designated area outside of the TRU Pad Cover Building. PCB-contaminated hazardous waste can be stored in the Hazardous Waste Storage Unit. Treatment and disposal options for the PCB wastes are available; therefore, the wastes are shipped offsite when sufficient quantities have accumulated. During FY2001, DOE made one shipment of PCB-contaminated LLW (0.226 m^3 [8 ft^3]) from NTS to the TSCA incinerator in Oak Ridge, Tennessee.

4.3.11.5 Sanitary Waste

NTS has three landfills permitted for the disposal of non-hazardous waste in accordance with the classifications set forth in Nevada Annotated Code (NAC) 444.570-7499. The Hydrocarbon Disposal Site in Area 6 and the Area 9 U10c Disposal Site are permitted as Class III (industrial solid waste) landfills. Hydrocarbon-contaminated soils and sludge are disposed in the hydrocarbon landfill, and inert debris (such as construction and demolition debris) is disposed in the Area 9 landfill. The third landfill is a Class II (municipal solid waste) landfill in Area 23 that receives sanitary solid waste. Currently, only NTS and offsite Nevada locations under the control of NNSA/NV dispose of waste in these NTS landfills. However, DOE intends to use the Area 9 and Area 23 landfills for the disposal of construction and demolition debris and sanitary and industrial solid waste from the proposed Yucca Mountain repository, if a nonhazardous waste landfill is not sited at the repository.

Construction of a new Class I or II landfill at NTS with a capacity of approximately 420,000 m^3 (1,483,230 ft^3) was included under the Expanded Use Alternative of the 1996 *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996b). In a recent supplement analysis to that EIS (DOE 2002i), DOE concluded that the projected waste volumes through 2011 would consume less than 20 percent of the available sanitary waste disposal capacity at NTS.

4.3.11.6 Wastewater

Wastewater at NTS is disposed either by a septic system or a lagoon system. Sewage lagoon systems other than Area 23 Mercury and Area 25 Effluent Treatment System will be replaced by septic systems. Sludge removed from the systems is disposed in the Area 23 sanitary landfill or the Hydrocarbon Disposal Site, depending on hydrocarbon content. At areas not serviced by a permanent wastewater system, portable sanitary units are provided. Review of the historic flow records and design capacities by DOE did not indicate impacts to wastewater capacity beyond permit and design limitations (DOE 2002i).

4.3.11.7 Pollution Prevention

The total waste (routine waste as well as environmental restoration and D&D waste) generated by NTS was 13,400 m^3 (473,221 ft^3) in FY2001, accounting for 2 percent of DOE's overall waste generation. Implementing pollution prevention projects reduced the total amount of waste generated at NTS in 2001 by approximately 1,390 m^3 (49,088 ft^3). Examples of NTS pollution prevention projects completed in 2001 include the reduction of mixed LLW by 80 m^3 (2,825 ft^3) by segregating lead contaminated metal and ash from mixed LLW. The segregated lead materials were managed as mixed LLW and the remainder was found to be free of lead contamination and disposed of at NTS as LLW. NTS also reduced their hazardous waste by 1 metric ton (1.1 tons) and sanitary waste by 4 metric tons (4.4 tons) by identifying a reuse for chemicals, equipment, instrumentation, and supplies removed during the decommissioning of the Analytical Radiological Laboratory (DOE 2002g).

4.3.11.8 Waste Management PEIS Records of Decision

A discussion of DOE's hazardous waste, LLW, mixed LLW, and TRU waste decisions based on the Waste Management PEIS is provided in Section 4.2.11.8. The Waste Management PEIS RODs affecting NTS are shown in Table 4.3.11.8–1.

Table 4.3.11.8–1. Waste Management PEIS Records of Decision Affecting NTS

Waste Type	Preferred Action
TRU waste	DOE has decided to store and prepare TRU waste onsite prior to disposal at WIPP.[a]
LLW	DOE has decided to continue to treat and dispose of NTS LLW on site. In addition, NTS is available to all DOE sites for LLW disposal.[b]
Mixed LLW	NTS will continue to dispose of its own mixed LLW on site and will receive and dispose of mixed LLW generated and shipped by other sites, consistent with permit conditions and other applicable requirements.[b]
Hazardous waste	DOE has decided to continue to use commercial facilities for treatment of NTS nonwastewater hazardous waste.[c]

[a] From the ROD for TRU waste (63 FR 3629) and the ROD for the WIPP Disposal Phase SEIS (63 FR 3624).
[b] From the ROD for LLW and mixed LLW (65 FR 10061).
[c] From the ROD for hazardous waste (63 FR 41810).

4.4 PANTEX SITE

The following sections describe the affected environment at Pantex for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, and socioeconomics. In addition, radiation and hazardous chemical environment, transportation, and waste management are described.

4.4.1 Land Use and Visual Resources

4.4.1.1 Land Use

Pantex is a 6,111-ha (15,100-ac) facility approximately 27 km (17 mi) east-northeast of Amarillo, Texas, in Carson County (see Figure 4.4.1.1–1). DOE owns 60 percent of the land area or approximately 3,642 ha (9,000 ac). The remainder (approximately 2,428 ha [6,000 ac]) is owned by Texas Tech University and is leased to DOE. In addition, DOE owns the detached property around Pantex Lake, approximately 4 km (2.5 mi) northeast of the main plant. The 436 ha (1,077 ac) of undeveloped land around Pantex Lake is held by DOE to retain water rights.

Historically, Pantex was divided into functional areas referred to as zones. The only current functional areas that retain this designation are Zone 12, which contains fabrication, assembly/disassembly, technical areas, and administrative support areas; Zone 11, which contains the high explosives development area; Zone 10, which serves as an excess property storage site; and Zone 4, which includes the weapons/high explosives magazine and interim pit storage area (see Figure 4.4.1.1–2). Generalized land use categories at Pantex are depicted in Figure 4.4.1.1–3. These include industrial, rangeland, open space, agricultural, and playas.

Industrial operations at Pantex are currently limited to approximately 809 ha (2,000 ac) on the DOE-owned property (Figure 4.4.1.1–2). Within the industrialized area, facilities are provided for production, storage, administration, and supporting infrastructure. Outside of the industrial area, Pantex has a burning ground, firing sites, and other outlying areas occupying 198 ha (489 ac). Operations at Pantex are conducted for DOE/NNSA by a management and operating contractor, BWXT Pantex LLC and Sandia National Laboratories.

Texas Tech University owns the land south of and contiguous to the DOE-owned land and uses it for a variety of agricultural research programs, including dry-land farming and livestock grazing. Most of this property is considered prime farmland when irrigated. DOE uses this land as a safety and security buffer. Texas Tech also uses approximately 2,144 ha (5,300 ac) of DOE-owned land for agricultural purposes under a service agreement with DOE.

The reference location for the MPF at Pantex is a 36-ha (90-ac) tract of land just north of Zone 11 and south of Zone 4 West and Zone 4 East. The land was cultivated until 1993 and replanted with native grasses in 1996. This tract of land is surrounded on all sides by a similar land use—open space. It is now considered a non-industrial low maintenance area within the Protected Area boundaries. From the center of the 36-ha (90-ac) tract, the center of Playa #2 is approximately 1,585 m (5,200 ft) west, while the center of Playa #1 is approximately 1,176 m (3,860 ft) northeast.

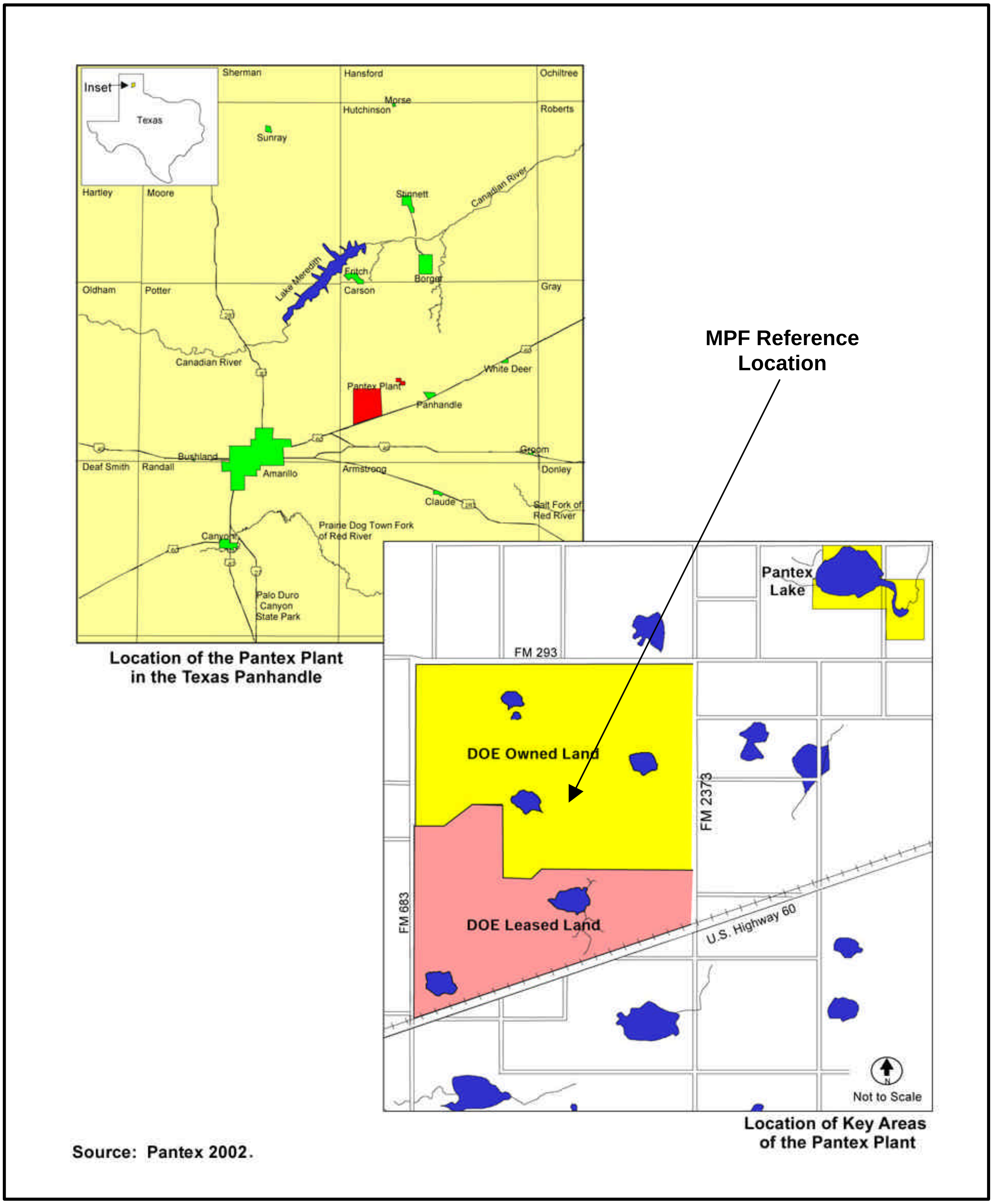
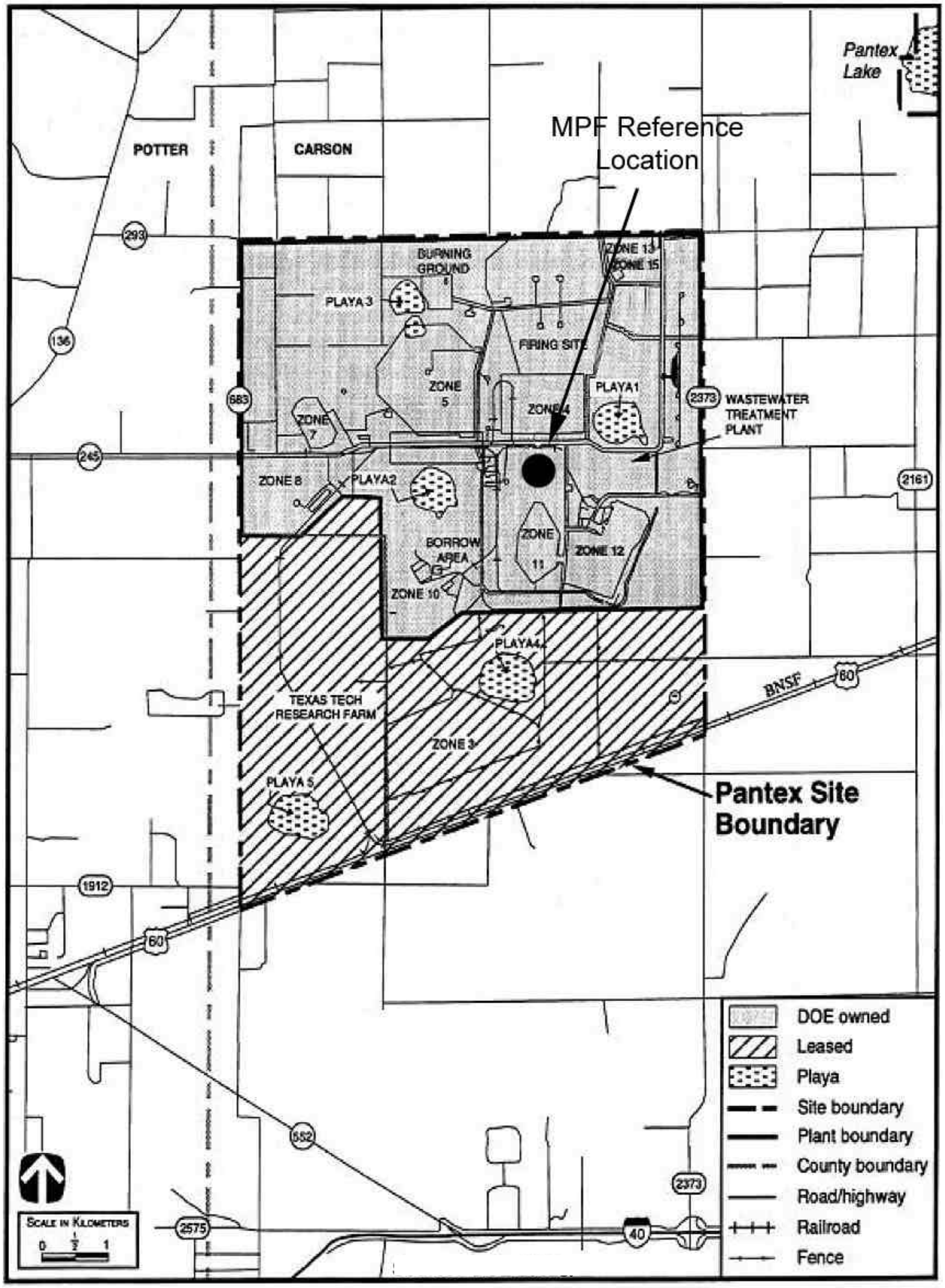


Figure 4.4.1.1–1. Location of the Pantex Site



Source: DOE 2002e.

Figure 4.4.1.1–2. Pantex Site

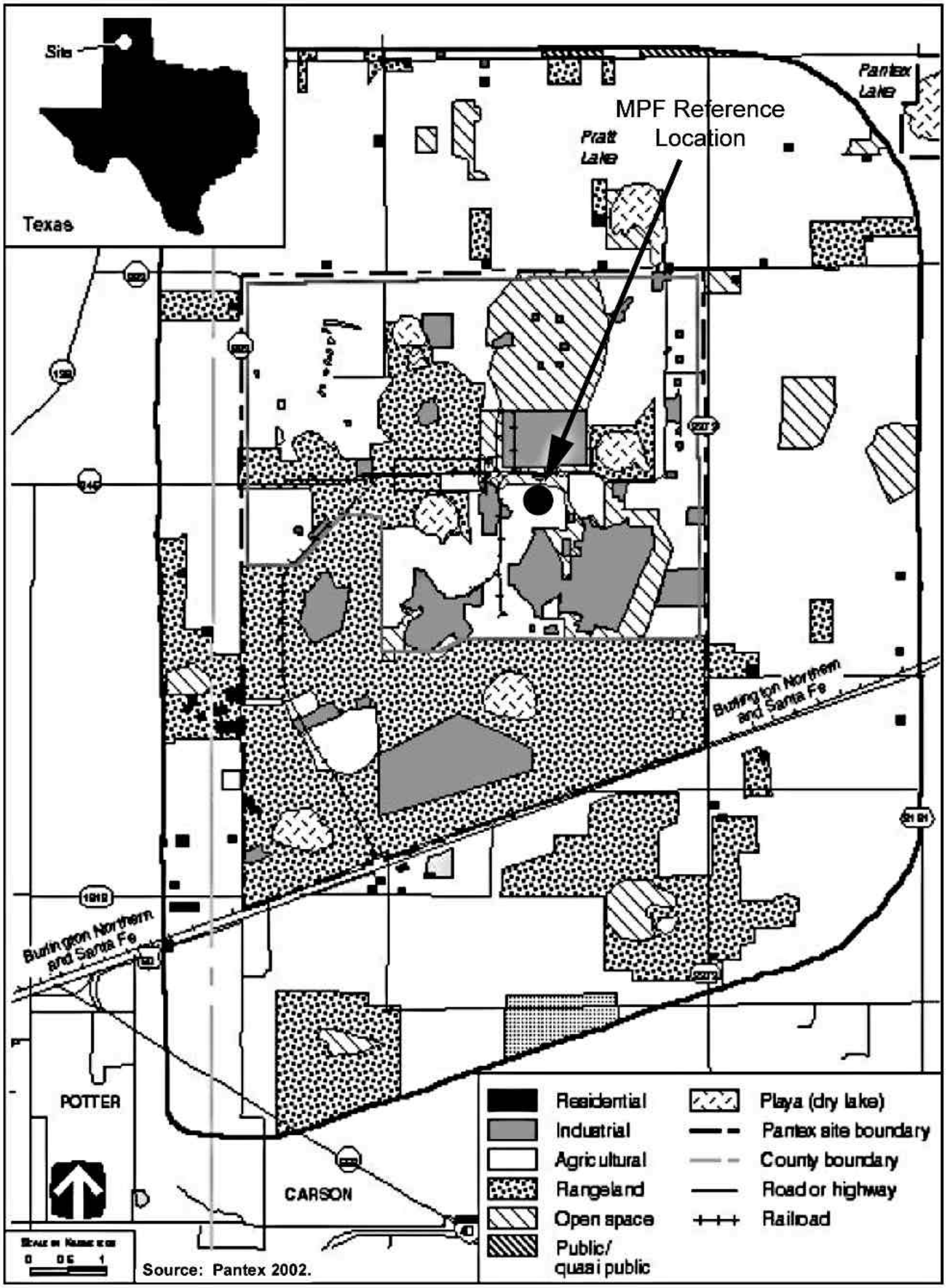


Figure 4.4.1.1–3. Generalized Land Use at Pantex Site

DOE will manage future land and facility use at Pantex through the *Pantex Plant FY2003 10-Year Comprehensive Site Plan* (Pantex 2002). Land resources are expected to remain constant with continued leasing of the Texas Tech land. The *Integrated Plan for Playa Management at Pantex Plant* (BWXT 2002b) provides land use guidelines for the playas and surrounding areas. This plan is being implemented as a best management plan to protect and manage cultural and natural resources.

In the area near Pantex, residences occur mostly in the small town of Panhandle, 18 km (11 mi) east of Pantex. Other concentrations of residences are at Highland Park Village, approximately 11 km (7 mi) southwest and Washburn 10 km (6.5 mi) south. The closest residences are approximately 30 m (100 ft) west and north of the plant boundary along Texas Farm-to-Market Road (FM) 683 and 293, and within 0.8 km (0.5 mi) east of the Plant Boundary along FM 2373. Most of the land surrounding the plant is prime farmland (when irrigated) with some rangeland to the northwest. The Iowa Beef Packers, Inc., packing plant is the only industrial facility within 3 km (2 mi).

Within the State of Texas, land-use planning occurs only at the municipal level. The *City of Amarillo Comprehensive Plan* (City of Amarillo 1989) includes land near Pantex in its East Planning Area. This area has been a slower-growing area because of some of the industrial facilities already in the area, including the airport. The Plan encourages growth in the East Planning Area to be compatible with the industrial nature of the current use.

4.4.1.2 Visual Resources

Pantex is in a treeless plain of a shortgrass prairie ecosystem. The plant consists of approximately 700 operational buildings. These industrial uses are surrounded by cropland and rangeland that blend into the offsite viewshed. As mentioned above, the reference location for the MPF was cultivated until 1993 and replanted with native grasses in 1996. It is surrounded on all sides by a similar land use—open space. There is a radio tower planned for construction near the eastern perimeter of this location.

The developed areas at Pantex are consistent with a Visual Resource Management Class IV designation, as defined by the BLM (DOI 2001). The remainder of Pantex is consistent with a Visual Resource Management rating of Class III or IV. (See Table 4.2.1.2–1 for descriptions of the Visual Resource Management Rating System). Plant facilities are visible from U.S. 60 and the local Farm-to-Market roads adjacent to Pantex's boundaries. At night, Pantex lights are visible from the aforementioned roads and I-40. However, the MPF reference location is in the midst of the industrial complex. With the possible exception of the 30-m (100-ft) HEPA filter exhaust stacks, no MPF facility structures would be visible from areas offsite because the existing buildings and infrastructure would obstruct the view.

4.4.2 Site Infrastructure

An extensive network of existing infrastructure provides services to Pantex activities and facilities as shown in Table 4.4.2–1. These services are discussed in detail in the following sections. Two categories of infrastructure—transportation access and utilities—are described below for Pantex. Transportation access includes roads, railroads, and airports while utilities include electricity and fuel (e.g., natural gas, gasoline, and coal).

Table 4.4.2–1. Pantex Site-Wide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	76	76
Railroads (km)	27	27
Electricity		
Energy consumption (MWh/yr)	81,850	201,480
Peak load (MWe)	13.6	47.5
Fuel		
Natural gas (m^3/yr)	12,910,000	289,000,000
Oil (L/yr)	59,960	Not limited[a]
Coal (t/yr)	0	0

NA = not applicable
[a] Low supplies can be replenished by truck or rail.
Source: King 1997; DOE 1999h; DOE 2002e.

4.4.2.1 Transportation

Access to the site is provided by the Texas Farm-to-Market roads bounding the site on the north, east, and west and by U.S. 60, 1.6 km (1 mi) to the south. I-40 and I-27 provide access to the interstate highway system. Additionally, 76 km (47 mi) of roads exist within Pantex boundaries.

Roads within Pantex are classified as primary, secondary, and tertiary roadways. Primary roads are the main distribution arteries for all onsite and offsite traffic. Secondary roads are collector roadways that supplement the primary roads. Primary and secondary roads are paved, two-lane roadways. Tertiary roads are generally single-lane roads, but some heavily traveled tertiary roads are two lanes (M&H 1996, DOE 1999h).

Pantex is connected to the Burlington Northern and Santa Fe railroad system via a spur that enters from the southwest. This spur provides access to the entire system as well as to other railroads (M&H 1996, DOE 1999h).

The Amarillo International Airport is located approximately 12 km (7.5 mi) southwest of Pantex. Pantex leases a small facility at the airport for its own transportation use (DOE 1996e).

4.4.2.2 Electrical Power

Electrical power is supplied by XCEL Energy to the nine-county region surrounding Pantex with the exception of Donley County, which is serviced by West Texas Utilities. Generation is primarily from coal, oil, and gas. Other sources include nuclear and hydroelectric. Pantex draws its power from the West Central Power Pool.

Current site electricity consumption and site capacity are approximately 81,850 MWh/yr and 201,480 MWh/yr, respectively. The peak load capacity for the entire site is 47.5 MWe with peak load usage at approximately 13.6 MWe.

4.4.2.3 Fuel

The Texas Panhandle is one of the major oil and gas producing regions in the country with considerable reserves. Oil is used as a backup for Building 16-13 steam boiler. Oil capacity is limited by number of deliveries and onsite storage capacity of 89,300 L (23,600 gal) (DOE 1999h).

Natural gas is supplied to Pantex by ATMOS Energy. The natural gas is delivered through a 25-cm (10-in) main supply line, which is capable of supplying 289 million m^3 (10.2 billion ft^3), sufficient capacity for all future plant requirements (DOE 1995a). Annual site availability of natural gas is about 289 million m^3/yr (10.2 billion ft^3/yr) with current usage about 12.9 million m^3/yr (456 million ft^3/yr) (King 1997, DOE 1999h, DOE 2002e).

4.4.3 Air Quality and Noise

4.4.3.1 Climate and Meteorology

The climate at Pantex and the surrounding region is characteristically that of middle latitude steppe. It is typified by large variations in temperature and precipitation from year to year, with summers that are hot and dry and winters that are mild. A high percentage of sunshine and a rather low humidity prevail over the region. The region is subject to rapid and large temperature changes, especially during the winter when cold fronts from the northern Rocky Mountains and Plains move across the region at speeds up to 64 km (40 mi) per hour. In the spring, moving low-pressure systems produce high winds, with March and April having the strongest. Severe local storms are infrequent, though a few thunderstorms, with damaging hail, lightning, and wind in very localized areas occur most years, usually in spring and summer. These storms are often accompanied by very heavy rain, which produces local flooding.

The average annual temperature in the Amarillo region is 13.8°C (56.9°F); temperatures range from an average daily minimum of -5.7°C (21.8°F) in January to an average daily maximum of 32.8°C (91.1°F) in July. The average annual precipitation is 49.8 cm (19.6 in). Seventy-five percent of the total annual precipitation falls between April and September. The average annual snowfall is 42.9 cm (16.9 in). The snow usually melts in a few days.

Average wind speeds at Amarillo are relatively high. The average annual windspeed is 6 m/s (13.5 mi/hr). Calms occur about 1 percent of the time. The wind blows predominantly from the south from May to September and from the southwest the remainder of the year.

Pantex is located in an area with a relatively high frequency of tornadoes. Fifty-three tornadoes were recorded in Carson County from 1950-1994. The estimated probability of a tornado striking a point at Pantex is 2.3×10^{-4} per year (DOE 1995a).

4.4.3.2 Nonradiological Releases

Pantex operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. Pantex is located within the Amarillo-Lubbock Intrastate AQCR. The Amarillo-Lubbock Intrastate AQCR is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and PM_{10}) (40 CFR 81.344).

In addition to the NAAQS established by the EPA, the State of Texas has established ambient air quality standards for total suspended particulate matter, inorganic fluoride compounds calculated as hydrogen fluoride, hydrogen sulfide, sulfuric acid, and beryllium.

The nearest PSD Class I areas to Pantex are the Salt Creek Wilderness in New Mexico, approximately 274 km (170 mi) to the southwest, and the Wichita Mountains Wilderness in Oklahoma, approximately 290 km (180 mi) to the east-southeast (40 CFR 81.421 and 81.424). Pantex has no sources subject to PSD requirements.

The primary emission sources of criteria pollutants at Pantex are the steam plant boilers, the explosives-burning operation, and emissions from onsite vehicles. Emission sources of hazardous or toxic air pollutants include the high-explosives synthesis facility, the explosives-burning operation, paint spray booths, miscellaneous laboratories, and other small operations. With the exception of thermal treatment of high explosives at the burning ground, most stationary sources of nonradioactive atmospheric releases are fume hoods and building exhaust systems, some of which have HEPA filters for control of particulate emissions.

Pantex air quality monitoring stations measure organic pollutants, PM_{10}, and hydrogen fluoride. Organic pollutants are measured as VOCs in parts per billion by volume (ppbv). A few samples have been analyzed for metals, but this is not done on a regular basis. At two sites, wind speed, wind direction, temperature, and relative humidity are measured. During 2000, ambient air monitoring was conducted for hydrogen fluoride, PM_{10}, and 39 species of VOCs. The results of the 2000 ambient air monitoring are summarized in Table 4.4.3.2–1.

Table 4.4.3.2–1. Nonradiological Ambient Air Monitoring Results, 2000

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Ambient Concentration (micrograms per m^3)
PM_{10}	Annual	50[b]	37.46
	24-hour	150[b]	118.32
Hydrogen fluoride	24-hour	2.18[c]	0.085
Benzene[d]	24-hour	4 (ppbv)[c]	2.500 (ppbv)

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period.
[b] Federal and state standard.
[c] TCEQ effects screening levels (ESL) are "tools" used by the Toxicology and Risk Assessment Staff to evaluate impacts of air pollutant emissions. They are not ambient air standards. If ambient levels of air contaminants exceed the screening levels, it does not necessarily indicate a problem, but would trigger an in-depth review. The levels were set where no adverse effect is expected.
[d] Thirty-nine VOC species were monitored. The largest measurement "normalized" to ESLs was that for a 2.500 ppbv measurement of Benzene which is 62.5% of the ESL for that substance.
Source: Pantex 2001b.

Table 4.4.3.2–2 presents the ambient air concentrations attributable to sources at Pantex, which are based on emissions for 1993. These emissions were modeled using meteorological data from 1988 and represent maximum output conditions. Actual annual emissions for some pollutants are somewhat less than these levels, and the estimated concentrations bound the actual Pantex contribution to ambient levels. Concentrations of nonradiological air pollutants shown in Table 4.4.3.2–2 are in compliance with applicable regulations or are below applicable health effects screening levels (the concentration of hazardous air pollutants determined by the TCEQ to have minimal effect on human health and the environment).

Table 4.4.3.2–2. Nonradiological Ambient Air Concentrations from Pantex Sources, 1993

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Ambient Concentration (micrograms per m^3)
Carbon monoxide	8-hour	10,000[b]	161
	1-hour	40,000[b]	924
Nitrogen dioxide	Annual	100[b]	0.90
Sulfur dioxide	Annual	80[b]	<0.01
	24-hour	365[b]	<0.01
	3-hour	1,300[b]	<0.01
	30-minute	1,048[c]	<0.01
Ozone	8-hour[e]	157[d]	[e]
	1-hour	235[b]	[e]
PM_{10}	Annual	50[b]	8.73
	24-hour	150[b]	88.5
$PM_{2.5}$	Annual	15[d]	[e]
	24-hour	65[d]	[e]
Total suspended particulates	3-hour	200[c]	[f]
	1-hour	400[c]	[f]
Hydrogen sulfide	30-minutes	112[c]	[g]
Benzene	24-hour	4 (ppbv)[h]	[f]
	1-hour	75 (ppbv)[h]	19.4 (ppbv)[i]
Ethylene glycol	24-hour	26 (ppbv)[h]	[f]
	1-hour	260 (ppbv)[h]	[f]

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in aerodynamic diameter.
[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period.
[b] Federal and state standard.
[c] State standard.
[d] The 8-hour ozone and the $PM_{2.5}$ standards are undergoing judicial review.
[e] No data is available for assessment of ambient concentrations.
[f] No site boundary concentrations from Pantex facilities are available.
[g] No sources identified at site.
[h] TCEQ effects screening levels are "tools" used by the Toxicology and Risk Assessment Staff to evaluate impacts of air pollutant emissions. They are not ambient air standards. If ambient levels of air contaminants exceed the screening levels, it does not necessarily indicate a problem, but would trigger an in-depth review. The levels were set where no adverse effect is expected.
[i] Concentration reported as a 30-minute average. No 24-hour concentration reported.
Source: DOE 1996d.

4.4.3.3 Radiological Releases

In normal operating situations, little potential exists for exposure of Pantex personnel, the public, or the environment from release of radioactive materials. Small amounts of tritium escape as a gas or vapor during normal operations, and some tritium residual is present onsite as a result of an accidental release in 1989 that occurred during a routine disassembly operation in Cell 1, Zone 12. The accidental release of tritium was conservatively estimated as 40,000 curies (Ci) (DOE 1996d). Radionuclide releases to the environment during 2000 are summarized in Table 4.4.3.3–1. These releases represent the maximum possible release from a point (stack or vent) and/or area source. The source term for releases to air was estimated based upon process knowledge, the number of operations conducted during the year and other modifying factors. The actual releases are much smaller than the estimates presented in Table 4.3.3.3–1.

Table 4.4.3.3–1. Radiological Airborne Releases at Pantex in 2000

Radionuclide	Release (Curies)
Tritium (Hydrogen-3)	2.714
Thorium-232	2.76×10^{-7}
Uranium-234	6.47×10^{-11}
Uranium-238	6.73×10^{-7}
All other	3.28×10^{-6}

Source: Pantex 2001b.

4.4.3.4 Noise

The major noise sources at Pantex include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, construction and materials-handling equipment, vehicles), as well as small arms firing, alarms, and explosives detonation. Most Pantex industrial facilities are far enough from the site boundary that noise levels from these sources at the boundary are barely distinguishable from background noise. However, some noise from explosives detonation can be heard at residences north of the site, and small arms weapons firing can be heard at residences to the west (DOE 1996d).

The acoustic environment along the Pantex boundary and at nearby residences away from traffic noise is typical of a rural location. The day-night average sound levels are in the range of 35 to 50 dBA. Noise survey results in areas adjacent to Pantex indicate that ambient sound levels are generally low, with natural sounds and distant traffic being the primary sources. Traffic is the primary source of noise at the site boundary and at residences near roads.

Traffic noise is expected to dominate sound levels along major roads in the area, such as U.S. 60. The residents most likely to be affected by noise from plant traffic along Pantex access routes are those living along FM 2373 and FM 683. Measurements of equivalent sound levels for traffic noise and other sources along the roads bounding Pantex are 53 to 62 dBA for FM 2373 at about 400 m (1,300 ft) from the road; 51 to 58 dBA for FM 293 at about 70 m (230 ft); 44 to 65 dBA for FM 683 at about 40 m (130 ft); and 51 dBA for U.S. 60 at about 225 m (740 ft). These levels are based on a limited number of 30-minute samples taken during peak and off-peak traffic periods, mostly at locations within the site boundary. The levels represent the range of daytime traffic noise levels at residences near the site. Other sources of noise include aircraft, wind, insect activity, and agricultural activity (DOE 1996d).

Except for the prohibition of nuisance noise, neither the State of Texas nor local governments have established any regulations that specify acceptable community noise levels applicable to Pantex (DOE 1996d). The EPA guidelines for environmental noise protection recommend an average day-night 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). It is expected that for most residences near Pantex, the day-night average sound level is less than 65 dBA and is compatible with the residential land use (DOE 1999h).

4.4.4 Water Resources

4.4.4.1 Surface Water

Pantex is situated on a flat portion of the Southern High Plains of Texas. No streams or rivers flow through Pantex. Major surface water in the vicinity includes the Canadian River, 27 km (17 mi) to the north, Sweetwater Creek and the Salt Fork of the Red River, respectively 80 km (50 mi) and 32 km (20 mi) to the east, and the Prairie Dog Fork of the Red River, 56 km (35 mi) to the south. The Canadian River flows north into Lake Meredith, about 40 km (25 mi). Water from Lake Meredith is mixed with water pumped from the Ogallala Aquifer for use as drinking water for several Southern High Plains cities. No hydrologic connections exist to transport contaminants from Pantex into either the Canadian River or Lake Meredith (DOE 1999h).

The only naturally occurring waterbodies on or adjacent to the site are six playas and very small, unnamed, intermittent channels and ditches that may feed stormwater into them. There are three playas (Playas 1, 2, and 3) on Pantex property, two (Playas 4 and 5) on the Texas Tech University property, several playas adjacent to Pantex, and one, called Pantex Lake, on DOE-owned property about 4 km (2.5 mi) northeast of the main portion of Pantex. Pantex Lake received discharges from the old sewage treatment facility from 1942 until the early 1970s. Playa 1 has received continuous discharges from Pantex Wastewater Treatment Facility (WWTF), with the only continuous flow occurring in the associated discharge outfall ditch. Playa 1 has also received wastewater effluent and stormwater via discharge points originating from plant operations. Playa 3 receives stormwater runoff from the Burning Ground. Currently, only Playa 1 receives treated wastewater discharges (BWXT 2002a). All of the playas receive stormwater runoff from precipitation events.

Studies have suggested that most of the recharge of the underlying Ogallala Aquifer within the Southern High Plains originates from water stored in the playas. However, the playas are frequently dry because of the high, naturally occurring evaporation rate combined with a rate of infiltration that normally exceeds the rate of inflow. Playas in the area of the plant may be as large as 1,220 m (4,000 ft) in diameter and more than 9 m (30 ft) deep. Most of the playas are floored with a clay accumulation at the bottom that is lens shaped, being thickest in the middle and thinning out toward the edges. These clay floors may contain desiccation cracks up to 1.8 m (6 ft) deep when the floor is dry (Pantex 2001b).

The only surface water that flows throughout the year is the one that receives flow from the WWTF and discharges into Playa 1. The WWTF consists of a facultative lagoon and an irrigated storage pond. The facultative lagoon has a compacted clay liner and the storage pond has a synthetic liner. The facultative lagoon is 9.7 ha (3.9 ac) and has a capacity of (41.6 million L) (11.0 million gal). The irrigation storage pond is the same size and capacity. Facultative treatment involves bacteria that live in normal-oxygen and reduced-oxygen environments. Total detention time is 35 days. In 2002, sampling was conducted at both the incoming weir of the lagoon (before treatment) and at the permitted discharge point (after treatment) to evaluate the lagoon’s efficiency.

Domestic and treated industrial effluent discharges are authorized by Texas Commission on Environmental Quality (TCEQ) permit. In September 1998, EPA issued an Administrative

Order to Mason & Hanger Corporation requiring certain changes and corrective actions for violations of its NPDES permit limitations at Playa 1. In September 2001, the TCEQ and NPDES permits were combined into a single permit. This combined permit resulted from the State of Texas assuming permitting authority from the EPA in September 1998. The new permit authorizes discharge of treated domestic and industrial effluent to the environment through only one outfall from the permit. Industrial stormwater discharges are regulated by the Texas Pollutant Discharge Elimination System (TPDES) Multi-Sector General Permit (MSGP). Pantex filed for coverage under the TPDES MSGP in November 2001.

In January 2001, the U.S. Supreme Court issued a decision that significantly limited the scope of the CWA as it applied to Pantex. The Supreme Court held that isolated waterbodies like the Playa Lakes into which Pantex effluent and stormwater discharges flow are not under the jurisdiction of the CWA. As a result, these discharges are regulated only if the State of Texas has applicable regulations. Stormwater discharges involving construction activities are regulated by the TCEQ. The TCEQ issued Pantex a new general permit for construction stormwater discharges in 2003. Pantex adheres to the standards set forth in this permit during construction activities.

Surface Water Quality

In 2001, surface water was monitored for radioactive and nonradioactive parameters at 20 locations. Sampling at the WWTF was conducted in 2001 in accordance with Pantex's NPDES permit. Nonradiological sampling includes metals, organics, explosives, pesticides, and PCBs. Radiological sampling at the playas includes gross alpha/beta and tritium. Metals were below state Inland Water Quality Parameters and consistent with historical values. Due to an extremely dry year, Playas 2 and 4 were predominantly dry throughout 2001. The playas never contained enough water to collect a representative sample. A VOC, acetone, was detected at Playas 1 and 3. The explosive HMX and RDX were detected in Playas 1 and 3. The Playa 1 February 2001 sample results were below the Practical Quantitation Limit (PQL) of 0.002 mg/L, while the October 2001 results were slightly above PQLs with HMX at 0.0013 mg/L and RDX at 0.0018 mg/L. The Playa 3 sample results were below PQLs for HMX and RDX (Pantex 2001b). Table 4.4.4.1–1 summarizes the constituents that were above the PQL except for the gross alpha measurement, which is defined as the Maximum Contaminant Level (MCL). A PQL is the lowest level that can be accurately and reproducibly quantified (DOE 1999h).

In 2002, construction of the new wastewater treatment facility was completed. Construction of the new system was designed to allow Pantex to use treated effluent for irrigation purposes. In 2001, an application for a Texas Land Application Permit was filed with the TCEQ. This application has not been approved, thus Pantex continues to discharge to Playa 1. If the pending application is approved, Pantex will design and build an irrigation system to allow beneficial use of the treated effluent.

Water rights in Texas fall under the Doctrine of Prior Appropriations. However, since Pantex does not use any surface water, it exerts no surface water rights. Figure 4.4.4.1–1 shows the surface water drainage basins for each of the playas (DOE 1999h). Stormwater runoff from the industrialized areas of Pantex collects within the playas and does not flow offsite. During heavy precipitation events in 2000, Playa 1 also received flow, via a pump, from the tailwater pit near the old Sewage Treatment Plant at the northeast corner of Pantex (Pantex 2001b). Flooding of some low-lying portions of Pantex could occur as a result of runoff associated with precipitation and the subsequent filling of the playas. There has been no major flooding at the Pantex site (DOE 1999h).

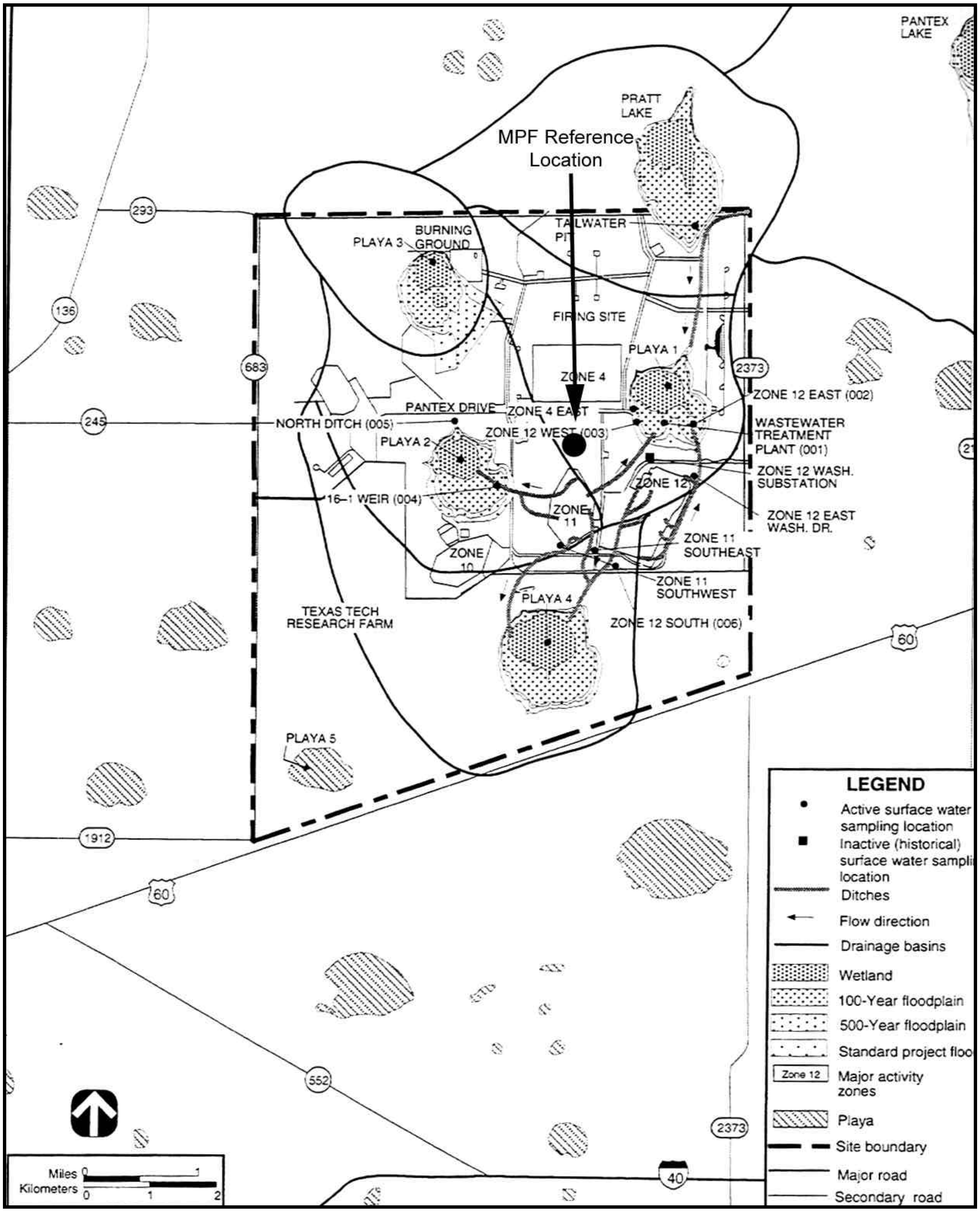
Table 4.4.4.1-1. Summary of Constituents Sampling Results above Practical Quantitation Limit for Pantex Plant Surface Water

Location and Constituent	Date	Sample Result (mg/L)	PQL (mg/L)
Playa 1 Basin			
HMX	October 2001	0.0013	0.002
RDX	October 2001	0.0018	0.002
Wastewater Treatment Facility			
Chlorine	October 2001 and December 2001	4.3, 4.1 respectively	4.0
Oil and Grease	May, August, December	26.0, 16.0, 23.0 respectively	15.0
Ammonia	February 2001, March 2001, April 2001	5.05, 5.22, 5.38 respectively	5.0
Playa 2 Basin			
Playa 2 never contained enough water to collect samples in 2001			
Playa 3 Basin			
Gross alpha	February 2001	93 pCi/L	15.0 pCi/L*
Gross beta	February 2001	160 pCi/L	50 pCi/L*
Playa 4 Basin			
Playa 4 never contained enough water to collect samples in 2001			
Pantex Lake			
Pantex Lake never contained enough water to collect samples in 2001			

* denotes MCL standard
Source: Pantex 2001b.

Floodplains at Pantex were delineated by the U.S. Army Corps of Engineers (USACE) in accordance with Executive Order 11988 (E.O. 11988). This assessment also addressed DOE's environmental review requirement under *Compliance with Floodplain/Wetlands Environmental Review Requirements* (10 CFR 1022). The USACE delineated floodplain boundaries for Playas 1 though 4, Pantex Lake, and Pratt Lake, located north of the site, using criteria for 100-year, 500-year, and Standard Project Flood boundaries (see Figure 4.4.4.1–1). The reference location is not within any of these flood boundaries.

Except for Playa 3, the floodplains are within the drainage boundary for each playa. The 500-year and Standard Project Flood runoff into Playa 3 will overflow out of the drainage basin creating shallow (less than 30 cm [1 ft]) flooding of the drainage basins for Playas 1 and 2 (DOE 1999h).



Source: DOE 1996e.

Figure 4.4.4.1–1. Locations of Primary Outfalls and Floodplains at Pantex

4.4.4.2 Groundwater

The three primary hydrostratigraphic units (i.e., separate layers of water) in the vicinity of Pantex are the Blackwater Draw Formation, the Ogallala Formation, and the Triassic Dockum Group. The units as a whole constitute an upper vadose (unsaturated) zone, a saturated perched aquifer zone, the lower vadose zone above the Ogallala Aquifer, and the Ogallala Aquifer.

The Blackwater Draw Formation has been identified as the most widespread post-Ogallala unit throughout the Southern High Plains. It consists of modified eolian sands and silts interbedded with numerous caliches composed of variably cemented carbonate layers and nodules. The thickness of the Blackwater Draw Formation at Pantex is variable, ranging from 15-24 m (50-80 ft) (DOE 1999h).

The lower part of the Ogallala Formation is saturated and commonly referred to as the Ogallala Aquifer. Perched groundwater also occurs beneath parts of Pantex, and overlies the Ogallala Aquifer. Recharge occurs from precipitation and subsequent infiltration of surface water either through surface soils or through focused recharge from the numerous playas that occur across the area. Direct recharge of the aquifer can occur in those limited areas where the aquifer formation is at the surface, but no outcrops exist at Pantex. Recent evidence supports significant recharge of the aquifer below the playas in the Southern High Plains; however, evidence of such recharge has not been determined for the Ogallala Aquifer at Pantex (DOE 1999h).

The Ogallala Aquifer is the principal aquifer and major source of water in the vicinity of Pantex and the surrounding region. The Ogallala Aquifer can yield 2,650-4,542 L (700-1,200 gal) per minute of high quality waters to the wells in the area. Depths to the Ogallala Aquifer generally run parallel to the regional land surface, which dips gently from northwest to southeast and varies at Pantex from about 105 m (344 ft) at the southern boundary to 151 m (496 ft) at the northern boundary (DOE 2002e). This south-to-north groundwater flow contrasts with the regional northwest-to-southeast trend of the remaining portion of the Southern High Plains. The current data reflect a decline in the Ogallala water table elevation of up to 9 m (30 ft) beneath portions of Pantex. This is due to the drawdown and attests to the continued regional state of overdraft (DOE 2002e).

The Triassic Dockum Group underlying the Ogallala Formation is believed to be as thick as 30 m (100 ft) under Pantex (DOE 1999h). Limited data from regional hydrogeologic studies of the Triassic Dockum Group divide it into an upper and a lower section, with only the Lower Dockum Group inferred to exist beneath portions of Carson County, including the southwest portion where Pantex is located. The Lower Dockum Group consists predominantly of fine- to coarse-grained sandstones and granular and pebble conglomerate along with mudstone sequences of alluvial, deltaic, and lacustrine origin. It has a thickness of less than 61 m (200 ft) beneath southwestern Carson County (DOE 1999h). The water-bearing stratum of the Lower Dockum Group is the Lower Dockum Aquifer. Regionally, the surface of the aquifer lies 91-213 m (300-700 ft) below the base of the Ogallala Formation (DOE 1999h).

The two main water-bearing units beneath Pantex are the Tertiary Ogallala Formation and the Triassic Dockum Group. Two water-bearing zones in the Ogallala Formation are present beneath Pantex. The first is a perched water zone above the main zone of saturation. One of these is present beneath Playa 1. The perched water zone consists of discontinuous perched water lenses, the lateral extent of which has not been fully determined. Extensive hydrogeological studies of the perched groundwater have been conducted by the University of Texas at Austin, Bureau of Economic Geology, the USACE, Battelle Memorial Institute, and the Texas Higher Education Consortium. As it is currently understood, the perched aquifers underlying Pantex are believed to be the result of operational and industrial discharges from the site (Pantex 2001b). Runoff from buildings, streets, parking lots, and fields at Pantex flows through unlined ditches and accumulates in playas, mainly in Playa 1. All industrial discharges that historically flowed through these ditches have been plumbed to the sanitary sewer. However, the WWTF continues to discharge to an open ditch before entering Playa 1. Water from the ditches and playas that are not lost to evaporation infiltrates to the perched aquifers. The contamination in the perched aquifer is believed to be the result of Pantex operations conducted between the early 1950s through the early 1980s. At Pantex, perched groundwater is not used for industrial activities or for human consumption (Pantex 2001b).

Four production wells in the northeast corner of Pantex provide water for the site's needs. In 2001, Pantex used approximately 492 million L (130 million gal) of water. The city of Amarillo produced approximately 98 billion L (26 billion gal) of water from the Ogallala Aquifer via the Amarillo-Carson County wellfield.

Groundwater is controlled by individual landowners in Texas through the Doctrine of Prior Appropriations. TCEQ and the Texas Water Development Board are the two state agencies with major involvement in groundwater fact finding, data gathering, and analysis. Groundwater management is the responsibility of local jurisdictions through Groundwater Management Districts. Pantex is in the Panhandle Groundwater Conservation District, which has the authority to require permits and limit the quantity of water pumped. Historically, the Panhandle Groundwater Conservation District has not limited the quantity of water pumped.

However, for wells drilled after July 19, 1995, that produce more than 1.3 million L/yr (350,000 gal/yr) per acre owned, landowners are required to obtain a High Production Permit from the Panhandle Groundwater Conservation District (DOE 1999h). The DOE-owned portion of Pantex is approximately 4,100 ha (10,131 ac) in area. Therefore, a High Production Permit would be required if DOE were to exceed approximately 13 billion L/yr (3.4 billion gal/yr) of groundwater withdrawals. In 2001, water usage at Pantex was approximately 492 million L/yr (130 million gal/yr), with a system capacity of approximately 3.8 billion L/yr (1 billion gal/yr) (DOE 2002e).

Groundwater Quality

Monitoring of the groundwater to identify impacts, both past and present, of Pantex operations is performed according to DOE Order 450.1, Environmental Protection Program, and the requirements of TCEQ Hazardous Waste Permit, HW-50284. The groundwater monitoring network at Pantex is composed of 125 wells. Ninety-one wells are completed into the perched aquifer. Seventy-eight wells are onsite; and the remainders are offsite, on the Texas Tech University Property (nine) or on various private properties (four). Ten wells are dry; however, they are checked on a regular basis for the presence of groundwater.

Thirty-four wells were completed in the Ogallala Aquifer. Twenty-six wells are located onsite; the remainder are offsite on the Texas Tech University Property (two), on various private properties (five) and a single (one) control well located at the United States Department of Agriculture's Agricultural Research Service Conservation and Production Research Laboratory near Bushland, Texas.

Twenty-nine wells are used for investigative purposes and five are permitted monitoring wells. One monitor well and two investigation wells were plugged and abandoned in 2001. Ten investigation wells (nine perched and one Ogallala) have been parked (dropped from the sampling plan at this time) in agreement with the TCEQ. The parked wells are not sampled, but are in close proximity to wells that are sampled.

The Risk Reduction Rule Guidance for Pantex Plant is a guide used to identify the quantifiable detection limit for sampled constituents. The detection limit is defined as the PQL (lowest level that can be accurately and reproducibly quantified) for all constituents except hexavalent chromium (CR-6). The limit for CR-6 is defined as the MCL. Groundwater investigation wells were sampled quarterly, semiannually, or annually, depending on the analyte for which the sampling was performed. Pantex Production wells are also monitored on a quarterly and annual basis, depending upon the analyte being sampled.

The control well location near Bushland, Texas, was sampled quarterly in 2001. Sampling at the Bushland location allows Pantex technicians to obtain comparative data for the Ogallala in a cross- gradient location. It is unaffected by Pantex Plant operations.

In 2002, 196 samples were collected from the Ogallala and 92 samples from the perched aquifers. The results of the sampling efforts are discussed below.

Perched Aquifer Groundwater Investigation/Monitor Wells

Analytical results for compounds detected in 2002 in all perched investigation and monitor wells are summarized in Table 4.4.4.2-1. The calculated means included in the tables are not inclusive of sample results that were below the PQLs.

Metals Results. Of the 24 metals analyzed for in the perched aquifer, 18 were detected at or above their respective PQLs at least once during 2002. Metals, with the exception of hexavalent chromium, are naturally occurring in the soils and sediments at the Pantex Plant.

Metals concentrations can be attributed to the fact that they have been detected in perched groundwater at Pantex, due to heavy sediment loads that often occur in perched groundwater samples. In addition to this, impacts from historic plant operations are also contributing factors to some of the detected metals results in the perched aquifer. All but seven of the metals (antimony, molybdenum, calcium, iron, magnesium, potassium, and selenium) detected in the perched aquifer during 2002 have been previously identified as contaminants of potential concern in the perched aquifer.

High Explosives Results. Of the 15 high explosives that were analyzed for in the perched, 13 were detected at or above their respective PQLs at least once during 2002. These detections are indicative of impacts from historic plant operations. The majority of the explosives detected in the perched during 2002 have been previously identified as contaminants of potential concern in the perched aquifer; 2-nitrotoluene and 4-nitrotoluene have been sporadically detected in perched groundwater across Pantex, but contamination has never been confirmed based on trending and validation results.

Pesticides Results. The analysis of pesticides was removed from the groundwater monitoring program in the second quarter of 2001, per agreement with the TCEQ, based upon the characterization being complete for this class of compounds.

Volatile Organic Compounds Results. Sixty-one volatile organic compounds (VOCs) were analyzed for in the perched aquifer during 2002. Of these 61, only fourteen were detected at levels at or above their respective PQLs. These detections are indicative of impacts from historic Plant operations. Of the fourteen, all of the VOCs, except two (freon-113 and trichlorofluromethane), have been previously identified as contaminants of potential concern in the perched aquifer. Freon-113 and trichlorofluromethane were added into the groundwater monitoring program in 2001, due to previous detections in soil-gas samples taken from the Burning Ground area. Analysis of these compounds will continue for nature and extent determination of these constituents.

Semi-volatile Organic Compounds Results. One hundred and nineteen semi-volatile organic compounds were sampled for in 2002. Two were detected at or above their respective PQLs.

Miscellaneous Factors. This category of analytes is made up of various water quality indicator analyses and the analysis of perchlorate. The water quality indicators are background constituents. These detections are expected in all the wells. The analysis of water quality indicators is performed on all perched aquifer wells in order to give an indication of well problems, sampling problems, and potential contamination. The levels detected in 2002 are what are expected of these types of analyses. Perchlorate was detected in eleven out of 109 samples. Perchlorate has been detected previously in the perched, at levels comparable to the previous detections.

The average concentrations of selected contaminants of potential concern at selected investigation wells for 2002 are shown in Table 4.4.4.2-1. The selected investigation wells are located within identified plumes. Investigation wells representative of the chrome plume are: PTX06-1011, PTX06-1052, PTX08-1008, and PTX08-1009. Investigation wells PTX06-1003, PTX06-1005, PTX06-1014, and PTX06-1038 are representative of the high explosives plume. Investigation wells OW-WR-45, PTX06-1010, PTX10-1013, and PTX10-1014 are in a volatile organic compound plume (TCE). The selection criteria show an approximate extent of the areas of contamination.

Ogallala Aquifer Investigation/Monitor Wells

Analytical results for compounds detected in all Ogallala investigation and monitor wells are summarized in Table 4.4.4.2-2. Though some constituents have been detected in the Ogallala Aquifer, these detections are either one-time detections (i.e. not reproduced upon confirmation sampling), attributable to sediments in the groundwater, or an artifact of the multi-level sampling systems. Analytical results are further discussed below.

Metals Results. Of the 25 metals analyzed for in the Ogallala Aquifer, 20 were detected at or above their respective PQLs at least once during 2002. Metals, with the exception of hexavalent chromium, are naturally occurring in the soils and sediments at Pantex. The metals concentrations that have been detected in Ogallala groundwater at Pantex have been attributed to heavy sediment loads that often occur in the groundwater samples.

High Explosives Results. Of the 15 high explosives analyzed for in the Ogallala Aquifer, two were detected at or above the PQL. Neither compound could be confirmed with repeated sample analysis.

Pesticides Results. The analysis of pesticides was removed from the groundwater monitoring program in the second quarter of 2001, per agreement with the TCEQ, based upon the characterization being complete for this class of compounds.

Volatile Organic Compounds Results. There were no VOCs detected at or above the PQL in Ogallala Aquifer samples during 2002.

Semi-volatile Organic Compounds Results. One hundred thirty-one semi-volatile organic compounds were analyzed for in the Ogallala Aquifer during 2002. One compound was detected at or above its respective PQL, but was not confirmed.

Miscellaneous Factors Results. This category of analytes is made up of various water quality indicator analyses and the analysis of perchlorate. The water quality indicators are background constituents. They are expected to be detected in all wells. The analysis of water quality indicators is performed on all Ogallala Aquifer wells in order to give an indication of well problems, sampling problems, and potential contamination. The levels detected in 2002 in the Ogallala Aquifer are what are expected of these types of analyses.

Historical Comparisons-Perched Aquifer

Mean results for 1996 through 2002 are summarized in Table 4.4.4.2–3 for perched wells located within identified plumes.

Table 4.4.4.2–1. 2002 Summary Data for the Perched Aquifer

Analyte Type Code	CAS	Constituent	Number of samples	Number of detections[b]	Max (Mg/L)	Min (Mg/L)	Mean (Mg/L)	MCL (mg/L)
High Explosives								
	121-82-4	Cyclotrimethylenetrinitramine (RDX)	139	83	2.300000	0.000170	0.503102	0.002
	2691-41-0	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	133	68	0.380000	0.000081	0.061428	0.002
	1946-51-0	4-amino-2,6-Dinitrotoluene	113	42	0.031100	0.000052	0.008441	—
	35572-78-2	2-amino-4,6-Dinitrotoluene	111	17	0.045000	0.000063	0.009463	—
	121-14-2	2,4-Dinitrotoluene	113	15	0.029600	0.000084	0.010922	—
	99-35-4	1,3,5-Trinitrobenzene	97	13	0.860000	0.000040	0.069529	—
	118-96-7	2,4,6-Trinitrotoluene	111	12	0.012700	0.000210	0.005406	—
	78-11-5	Pentaerythritol tetranitrate (PETN)	102	11	0.001400	0.000180	0.000567	—
	479-45-8	Tetryl	111	10	0.001100	0.000047	0.000423	—
	99-65-0	1,3-Dinitrobenzene	102	8	0.003600	0.000046	0.000704	—
	606-20-2	2,6-Dinitrotoluene	103	7	0.000790	0.000140	0.000366	—
	88-72-2	o-Nitrotoluene (2-nitrotoluene)	103	6	0.002100	0.000086	0.000633	—
	99-99-0	p-Nitrotoluene (4-nitrotoluene)	106	4	0.000500	0.000180	0.000320	—
Metals								
	7439-97-6	Magnesium	109	109	70.700000	9.600000	28.513211	—
	7439-98-7	Barium	103	103	0.544000	0.050800	0.238799	2.0
	7440-02-0	Vanadium	92	89	0.126000	0.005150	0.015528	0.26
	7440-22-4	Boron	88	88	1.600000	0.035000	0.386336	—

Table 4.4.4.2–1. 2002 Summary Data for the Perched Aquifer *(continued)*

Analyte Type Code	CAS	Constituent[a]	Number of samples	Number of detections[b]	Max (Mg/L)	Min (Mg/L)	Mean (Mg/L)	MCL (mg/L)
Metals *(continued)*								
	7440-28-0	Iron	80	68	32.900000	0.013800	3.016231	0.3
	7440-31-5	Chromium (III) (total chromium)	164	62	14.700000	0.000714	1.288827	0.1
	7440-36-0	Manganese	59	46	0.484000	0.001820	0.064117	0.05
	7440-38-2	Nickel and compounds	63	35	1.010000	0.003900	0.172872	
	7440-39-3	Zinc	50	27	1.000000	0.003180	0.062216	5.0
	7440-41-7	Aluminum	71	26	15.200000	0.058500	1.202119	0.05-0.2
	7440-42-8	Molybdenum	32	25	0.472000	0.011500	0.069264	
	7440-43-9	Copper	68	23	0.176000	0.001880	0.034502	1.3
	7440-47-3	Arsenic	74	8	0.023000	0.004620	0.011309	0.010
	7440-48-4	Selenium	88	8	0.007500	0.002600	0.005468	0.05
	7440-50-8	Thallium	58	7	0.006300	0.000260	0.001539	0.002
	7440-62-2	Cobalt	90	7	0.033900	0.004000	0.011689	—
	7440-66-6	Lead (inorganic)	39	3	0.011100	0.001100	0.004750	0.015
	7782-49-2	Cadmium	81	2	0.001500	0.001010	0.001255	0.005
Miscellaneous Factors								
	10-33-3	Total Dissolved Solids	107	107	630.000000	139.000000	329.822430	500
	14797-73-0	Perchlorate	108	11	0.300000	0.016400	0.112964	—
	14808-79-8	Sulfate	100	100	70.800003	5.800000	22.235600	250
	16887-00-6	Chloride	87	87	123.000000	4.180000	43.262299	250
	16984-48-8	Fluoride	102	102	2.400000	0.085000	0.897412	4.0
	57-12-5	Cyanide	90	2	0.010800	0.005350	0.008075	0.2
	C-012	TOC[c]	309	309	2.110000	0.233000	0.829288	

Table 4.4.4.2–1. 2002 Summary Data for the Perched Aquifer *(continued)*

Analyte Type Code	CAS	Constituent[a]	Number of samples	Number of detections[b]	Max (Mg/L)	Min (Mg/L)	Mean (Mg/L)	MCL (mg/L)
Semivolatile Organics								
	117-81-7	Bis (2-ethyl-hexyl) phthalate	14	9	0.002900	0.000860	0.002018	6.0
	123-91-1	1,4-Dioxane	13	1	0.041000	0.041000	0.041000	—
Volatile Organics								
	79-01-6	Trichloroethylene	94	23	0.046800	0.001100	0.010335	0.005
	67-64-1	Acetone	109	21	0.009500	0.003200	0.005519	—
	75-09-2	Methylene chloride	101	14	0.004100	0.000630	0.002326	—
	107-06-2	1,2-Dichloroethane	103	13	0.015800	0.001300	0.004931	0.005
	108-88-3	Toluene	99	9	0.001800	0.000210	0.000744	1.0
	74-83-9	Bromomethane	108	8	0.001800	0.001100	0.001337	—
	127-18-4	Tetrachloroethylene	108	4	0.014700	0.002500	0.006500	0.005
	156-59-2	cis-1,2-Dichloroethylene	106	4	0.004500	0.002300	0.003475	0.07
	67-66-3	Chloroform	105	4	0.081800	0.008300	0.029600	—
	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	108	4	0.057900	0.006500	0.021400	0.005
	75-69-4	Trichlorofluoromethane	109	3	0.003800	0.001300	0.002967	—
	108-90-7	Chlorobenzene	111	2	0.003900	0.003500	0.003700	0.1
	75-71-8	Dichlorodifluoromethane	111	2	0.001000	0.000990	0.000995	—
	56-23-5	Carbon tetrachloride	106	1	0.001200	0.001200	0.001200	0.005

"— " = No MCL
RRS 2 Res = Risk Reduction Standard 2- Residential value
[a] Only those analytes that had at least one detected result were reported.
[b] A 'detection' was considered to be any value that occurred at or above the laboratory's Practical Quantitation Limit (PQL).
[c] Each Total Organic Carbon sample has 4 distinct sample runs. All runs were taken into account for the calculation of the values in this table.
Source: DOE 1995d.

Table 4.4.4.2–2. 2002 Summary Data for Ogallala Aquifer

AnalyteType Code	CAS	Constituent[a]	Number of samples	Number of detections[b]	Max (Mg/L)	Min (Mg/L)	Mean (Mg/L)	MCL (mg/L)
High Explosives								
	121-82-4	Cyclotrimethylenetrinitramine (RDX)	62	1	0.000130	0.000130	0.000130	0.002
	88-72-2	o-Nitrotoluene (2-nitrotoluene)	62	3	0.002900	0.000120	0.001906	—
Metals								
	7429-90-5	Aluminum	65	23	12.000000	0.067099	1.834534	—
	7439-89-6	Iron	65	41	12.600000	0.058999	1.932953	0..3
	7439-92-1	Lead (inorganic)	65	5	0.011000	0.002220	0.005502	0.015
	7439-95-4	Magnesium	65	65	37.200000	11.500000	24.415385	—
	7439-96-5	Manganese	65	33	0.609000	0.006320	0.069776	0.05
	7439-98-7	Molybdenum	65	6	0.019900	0.011500	0.014167	—
	7440-02-0	Nickel and compounds	65	16	0.458000	0.005980	0.102105	—
	7440-22-4	Silver	65	2	0.036100	0.006610	0.021355	0.10
	7440-31-5	Tin	65	1	0.011700	0.011700	0.011700	—
	7440-38-2	Arsenic	65	12	0.017500	0.005110	0.008028	0.010
	7440-39-3	Barium	65	63	0.449000	0.020100	0.144606	2.0
	7440-41-7	Beryllium	65	2	0.000574	0.000276	0.000425	0.004
	7440-42-8	Boron	65	55	0.223000	0.082700	0.154751	—
	7440-47-3	Chromium (III) (total chromium)	65	21	0.270000	0.005170	0.030679	0.1
	7440-50-8	Copper	65	15	0.083800	0.005010	0.002362	1.0
	7440-61-1	Uranium	3	3	0.007200	0.005300	0.006167	0.30 µg/L
	7440-62-2	Vanadium	65	58	0.052000	0.005430	0.016804	0.26
	7440-66-6	Zinc	65	36	0.294000	0.005170	0.040518	5.0
	7782-49-2	Selenium	65	6	0.006570	0.005090	0.005798	5.0
	18540-29-9	Hexavalent Chromium	60	2	9.400000	0.024000	4.711999	0.1

Table 4.4.4.2–2. 2002 Summary Data for Ogallala Aquifer *(continued)*

AnalyteType Code	CAS	Constituent[a]	Number of samples	Number of detections[b]	Max (Mg/L)	Min (Mg/L)	Mean (Mg/L)	MCL (mg/L)
Miscellaneous								
	T-005	Alkalinity	55	55	248.0000	144.0000	201.2363	—
	57-12-5	Cyanide	55	1	0.005600	0.005600	0.005600	0.2
	16887-00-6	Chloride	55	48	57.50000	4.11990	11.59062	250
	16984-48-8	Fluoride	55	52	2.30999	0.14000	1.38230	4.0
	11-02-9	Hardness	55	55	284.0000	118.0000	189.2363	
	1-005	Nitrate/Nitrate as N	2	2	1.09000	1.07000	1.08000	10
	14797-55-8	Nitrate	54	54	6.52099	0.01700	1.35750	10
	14797-65-0	Nitrite	52	46	0.05200	0.00100	0.005826	1.0
	14808-79-8	Sulfate	55	53	40.09999	5.80000	17.96377	250
	10-33-3	Total Dissolved Solids	55	55	593.0000	192.0000	275.9636	500
	C-012	TOC[c]	176	148	1.30999	0.24500	0.58102	—
Volatile Organics								
		No Detections						
Semivolatile Organics								
	117-81-7	Bis (2-ethyl-hexyl) phthalate	34	1	0.021000	0.021000	0.021000	6.0

"— "= No MCL
RRS 2 Res = Risk Reduction Standard 2- Residential value
[a] Only those analytes that had at least one detected result were reported.
[b] A 'detection' was considered to be any value that occurred at or above the laboratory's Practical Quantitation Limit (PQL).
[c] Each Total Organic Carbon sample has 4 distinct sample runs. All runs were taken into account for the calculation of the values in this table.
Source: DOE 1995d.

Table 4.4.4.2–3. Mean Results for Select Perched Aquifer Investigation Wells at Pantex for 1996-2002

Locations	1996	1997	1998	1999	2000	2001	2002
Metals (Wells selected for their proximity to existing plumes)							
Chromium, in mg/L							
PTX06-1011	0.2135	NS	0.139	0.147	0.125	2.46	0.339
PTX06-1052	NW	NW	NW	NW	6.275	6.6	6.6
PTX08-1008	6.487	8.64	10.2	13.05	8.94	11.9	8.7
PTX08-1009	3.44	2.67	0.547	0.226	0.216	0.256	0.152
Chromium, hexavalent, in mg/L							
PTX06-1011	0.0965	0.12	0.06	NS	3.07	6.95	–
PTX06-1052	NW	NW	NW	NW	6.95	6.8	5.5
PTX08-1008	7.09	9.8	11.125	10	7.03	12	8.3
PTX08-1009	3.524	2.25	0.59	0.23	0.21	0.224	0.076
Manganese, in mg/L							
PTX06-1011	0.0054	NS	0.0025	0.0023	0.0016	0.212	0.0128
PTX06-1052	NW	NW	NW	NW	0.001	0.00065	–
PTX08-1008	0.0015	0.0012	0.0022	0.00309	0.0115	–	–
PTX08-1009	0.0014	–	0.0017	0.0052	NS	0.000852	–
Thallium, in mg/L							
PTX06-1011	0.0025	NS	–	–	–	0.000526	–
PTX06-1052	NW	NW	NW	NW	26.5	–	–
PTX08-1008	13	13	13	12	13	–	–
PTX08-1009	0.00355	–	–	–	–	–	–
Explosives (Wells selected for their proximity to existing plumes) HMX, in mg/L							
PTX06-1003	0.0195	0.00078	–	0.00795	–	–	–
PTX06-1005	0.343	0.32	0.356	0.27	0.606	0.418	0.380
PTX06-1014	1.57	0.25	0.0236	–	0.155	0.1345	0.161
PTX06-1038	NW	NW	0.585	0.212	0.139	0.1625	0.195
RDX, in mg/L							
PTX06-1003	0.047	0.0028	0.0244	0.0428	0.0428	0.00052	0.0017
PTX06-1005	0.74	0.93	0.643	0.846	1.34	1.05	1.1
PTX06-1014	12.36	3.7	0.5045	1.64	1.4	1.08	1.18
PTX06-1038	NW	NW	0.5	1.505	1.38	1.09	1.18
Volatile Organic Compounds (Wells selected for their proximity to existing plumes) TCE, in mg/L							
OW-WR-45	0.0083	0.00945	0.00675	0.01	0.0027	0.0028	0.012
PTX06-1010	0.01	0.0054	0.0076	0.0058	0.0072	0.0052	0.0063
PTX10-1013	0.0357	NS	0.0328	0.0258	0.037	0.0402	0.022
PTX10-1014	0.0245	NS	0.0197	0.0193	0.011	0.0112	0.0074
Contamination Indicators and Quality Parameters Chlorides, in mg/L							
PTX06-1003	74.125	–	70.29	67.1	NS	37.7	39.2
PTX06-1005	25.02	28.79	–	24.89	NS	31.4	41.6
PTX06-1014	39.72	40.59	42.4	34.2	35.89	33.55	37.8
PTX06-1038	NW	NW	36.06	34.54	NW	34	36.3

Table 4.4.4.2–3. Mean Results for Select Perched Aquifer Investigation Wells at Pantex for 1996-2002 *(continued)*

Locations	1996	1997	1998	1999	2000	2001	2002
Sulfates, in mg/L							
PTX06-1003	33.4	–	24	26.8	NS	19.9	19.1
PTX06-1005	28	34.2	NS	27.9	NS	23	27
PTX06-1014	16.1	22.4	13.8	13.9	13.4	13.45	13.9
PTX06-1038	NW	NW	29.7	30.1	NS	35.2	36.0
Total Organic Carbon, in mg/L							
PTX06-1003	13	1.09	3.006	1.29	NS	0.8899	–
PTX06-1005	51.44	3.04	3.1	4.64	NS	2.102	1.9
PTX06-1014	21.5	1.03	3.64	1.52	0.807	1.21	1.05
PTX06-1038	NW	NS	4.07	4.58	NS	1.55	1.15

[a] "–" indicates mean was less than detection limits.
[b] NS indicates not sampled or no result for that analyte.
[c] NW indicates new well, no samples prior to indicated sample.
Source: DOE 1995d.

4.4.5 Geology and Soils

4.4.5.1 Geology

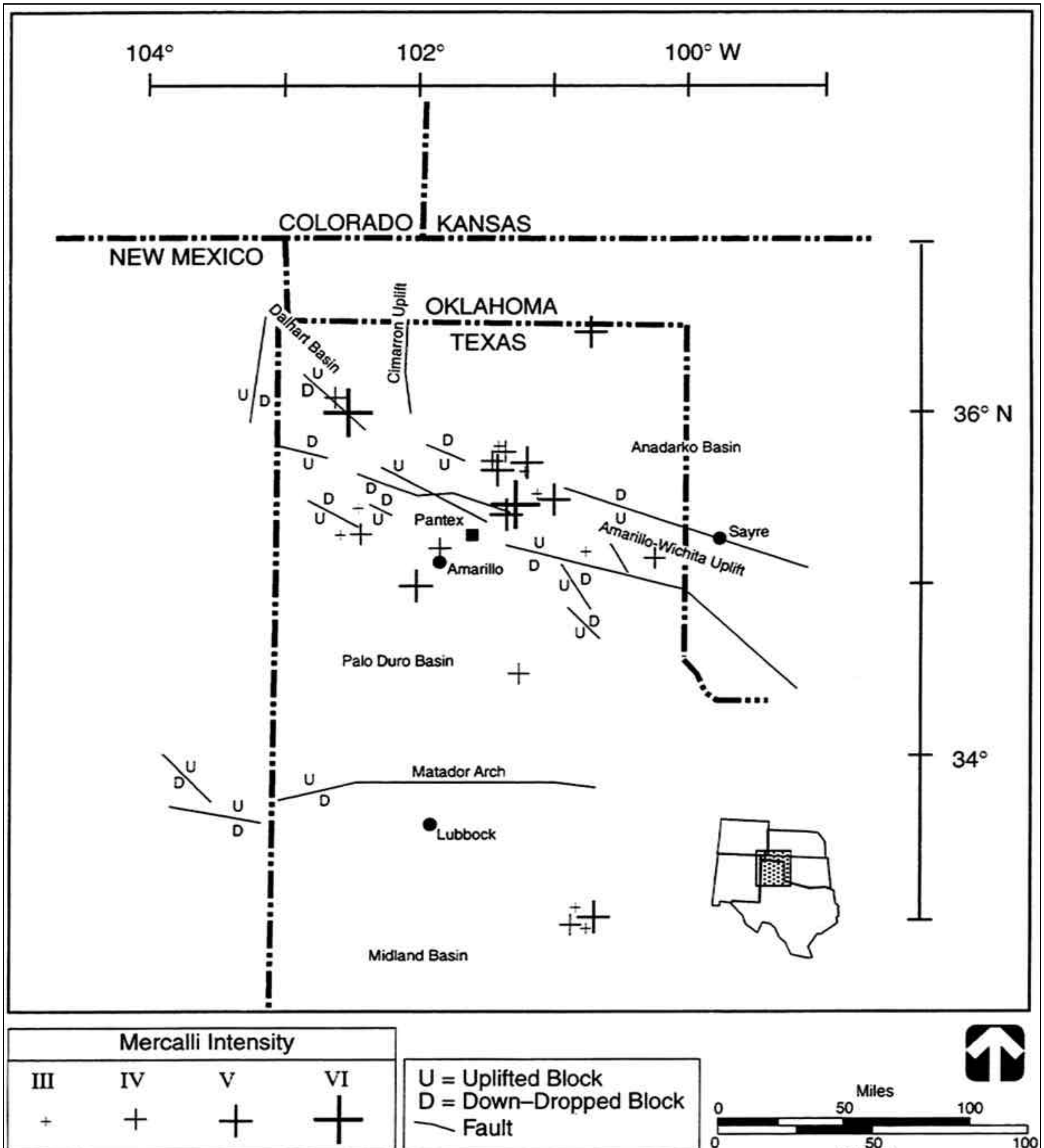
Pantex is located on the Southern High Plains portion of the Great Plains Province. The topography is relatively flat and marked by thousands of playa lakes. The representative site being evaluated for the MPF is in the center of Pantex. The Panhandle region is characterized by a number of major structural and sedimentary basins separated by uplifts. These major structural elements, the result of tectonic events, have influenced subsequent tectonic processes. Pantex is located on the Amarillo Uplift, which, along with the Oldham-Harmon Trend, comprise a west-northwest trending uplifted area that separates the Andarko Basin to the northeast and the Palo Duro Basin to the southwest. Pantex is located at the southeastern edge of the Whittenburg Trough that separates the Amarillo Uplift from Bush and Bravo Domes to the west (Figure 4.4.5.1–1) (BWXT 2002a).

Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of the ground and infrastructure at Pantex and includes potential volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

Volcanism

The closest Tertiary or Quaternary volcanism in the region surrounding Pantex is in New Mexico, over 161 km (100 mi) from the site (BWXT 2002a).



Source: DOE 1996e.

Figure 4.4.5.1–1. Earthquakes in the Texas Panhandle and Their Relation to Tectonic Features

Seismic Activity

No tectonic faulting younger than Late Permian is recognized at or near Pantex site. Three major subsurface faults and one minor surficial fault exist in the area as follows: (1) 249 km (155 mi) long, about 40 km (25 mi) north of site; (2) 69 km (43 mi) long, about 8 km (5 mi) south of site; (3) 64 km (40 mi) long, about 11 km (7 mi) north of site; and (4) the surficial fault is 6 km (4 mi) long, about 32 km (20 mi) northwest of site.

Although the Meers Fault in Oklahoma is about 241 km (150 mi) east of Pantex, it is often cited in tectonic discussions because it is on the southeastward extension of the Amarillo Uplift structure and has a Holocene scarp (a line of small cliffs or sharp rises produced by faulting) about 26 km (16 mi) in length with vertical displacements up to 5 m (16 ft). At least three episodes of movement on the Meers Fault are dated between 4,000 and 5,000 years ago using geomorphic evidence and preliminary radiometric dates, but no current microseismic activity seems associated with the fault (BWXT 2002a).

Approximately 25 earthquakes have been recorded in the Texas Panhandle. The largest earthquakes were the March 27, 1917, Panhandle event, about 24 km (15 mi) east of the site, and the July 30, 1925, event northeast of Amarillo, about 24 km (15 mi) northeast of Pantex. Both earthquakes had a maximum intensity of VI on the Modified Mercalli Scale, or 5.0 on the Richter Scale, with observed effects that include pictures falling off walls, furniture moving or overturning, and weak masonry cracks appearing (see Table 4.2.5.1–2). Most shocks in the Texas Panhandle are located along the Amarillo Uplift, although uncertainties in the calculated epicenters preclude identifying specific active faults.

In the Panhandle region, earthquakes with a Richter magnitude of 5.0 or greater are predicted to occur with a frequency on the order of four times in 100 years. At Pantex, it is assumed that the largest earthquake to be expected in the region can happen anywhere in the region including the site itself (BWXT 2002a). The potential for local or regional earthquakes with a magnitude great enough to damage structures at the site to the degree that hazardous materials would be released is extremely low. While seismic events have occurred in the region, the magnitudes have been low and infrequent (BWXT 2002a).

Slope Stability, Subsidence, and Soil Liquefaction

Slope stability is not an issue at Pantex because all structures are built on the essentially flat surfaces rather than on the gentle slopes of the playa basins. The soil classification definitions include a range of slopes for each particular soil type. In general, the surficial soil extends to depths of no more than 3 m (10 ft). The underlying Blackwater Draw Formation is the material on which larger structures are founded.

Liquefaction is not considered to be an issue at Pantex because the near-surface materials are not saturated (BWXT 2002a).

Salt dissolution, while an active and ongoing process in the Southern High Plains, poses no immediate threat to Pantex. The potential for salt dissolution to disrupt the surface at the site is extremely unlikely. Most active salt dissolution is concentrated near the eastern caprock (an overlying rock layer usually hard to penetrate) escarpment and to a lesser degree near the northern margin in the Canadian River Valley. It is important to note that salt dissolution is a geologically active process; however, it is a very slow process relative to human activities (DOE 1996d).

4.4.5.2 Soils

The primary surface deposits at Pantex are Pullman soils on the plains surface and Randall soils in the playas. The Pullman soils comprise the uppermost section of the Blackwater Draw Formation. This formation consists of a sequence of buried soil horizons with an upper unit of mostly silty clay loam and caliche that is approximately 3 m (10 ft) thick and a 10-24 m (33-79 ft) thick lower unit of silty sand with caliche (crust of calcium carbonate that forms on the stony soil of arid regions). Pantex contains several soil types that, according to the Natural Resources Conservation Service (NRCS), have been classified as prime farmland. Prime farmland, as defined in 7 CFR 657, contains the best combination of physical and chemical characteristics for producing crops. These soil types cover the majority of Pantex (DOE 1996d).

Soil Erosion

Soil erosion at Pantex is limited due to vegetation growth, relatively flat topography, and the internal drainage patters associated with the playas.

Mineral Resources

The Texas Panhandle is one of the major oil and gas producing areas in the country. There is a helium natural gas field known as the Cliffside Field located in Potter County, west of Pantex.

4.4.6 Biological Resources

4.4.6.1 Terrestrial Resources

Pantex is located on the Llano Estacado (staked plains) portion of the Southern Great Plains of Texas at an elevation of approximately 1,067 m (3,500 ft). The topography at Pantex is relatively flat, characterized by rolling, treeless, grassy plains, and numerous natural playa basins. The term “playa” is used to describe shallow lakes, mostly less than 1 km (0.6 mi) in diameter. The region is a semi-arid farming and ranching area. Pantex is surrounded by agricultural land, but several significant industrial facilities are also located nearby. Shortgrass prairie grasslands were the native vegetation until the prairie was converted to agricultural use for crops, grazing, or protective vegetative cover under the Conservation Reserve Program. The few remaining native grassland areas are heavily grazed by livestock. Such grazing has transformed much of the rangeland from the native blue grama-buffalo grass to shrubland (i.e., honey mesquite [*Prosopis glandulosa*]). Essentially all land at Pantex has been managed or disturbed to some degree. The following five basic habitat types have been identified: operational areas, grasslands, mowed areas, agricultural croplands, and playas. Approximately 229 plant species and numerous animal species are found in the Pantex area (Pantex 2001b).

Native vegetation is characterized as shortgrass prairie. The shortgrass prairie is dominated by two grass species: blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*).

Other typical, less abundant grass species include sideoats grama (*Bouteloua curtipendula*), western wheatgrass (*Agropyron smithii*), vine mesquite (*Panicum obtusum*), and silver bluestem (*Bothriochloa laguriodes*). Much of the native shortgrass prairie has been converted and used for agricultural purposes, primarily crop cultivation and cattle grazing. The current state of the altered shortgrass prairie at Pantex ranges from unvegetated, in the south-central region, to a variety of species elsewhere on the site (DOE 1996d).

The dominant vegetation on the uplands surrounding Playas 3, 5, and Pantex Lake is buffalo grass, while the uplands surrounding Playa 1 support buffalo grass, blue grama, and prickly pear (*Opuntia macrorhiza*). The area south of Playa 1 contains a small grove of crabapple (*Malus sylvestris*), Asiatic honeysuckle (*Lonicera tatarica*), and Russian olive (*Elaeagnus angustifolia*). Playa 2 uplands support buffalo grass, blue grama, and silver bluestem. Playa 4 uplands consist of buffalo grass and blue grama. The Texas Tech University Farms headquarters area has grass lawns with planted mimosa tree (*Albizia julibrissin*), Siberian elm (*Ulmus pumilia*), and black locust (*Robinia pseudoacacia*). The previously cultivated southeastern portion of Pantex is dominated primarily by silver bluestem and rare individuals of yankee weed (*Eupatorium compositifolium*). The west-central region of Pantex has vegetative composition of predominantly kochia (*Kochia scoparia*) and pigweed (*Amaranthus* spp.), with lesser extents of buffalo grass, planted Siberian elm, and cottonwood (*Populus ocifero*) (DOE 1996d).

The Southern High Plains of Texas contain relatively little native undisturbed grassland. Playas are considered “islands” of wildlife habitat, providing many species with food, cover, and water. Wildlife surveys conducted at Pantex have characterized wildlife presence and use of the entire site, rather than focusing on each playa. Animal species found at Pantex include 7 species of amphibians, 43 species of birds, 19 species of mammals, and 8 species of reptiles. Grazing is permitted onsite while hunting is not allowed. Radiological surveys of beef cattle raised on or near Pantex have not been considered necessary based on the results of a study showing that routine operations do not pose a risk to the public from the consumption of these animals. The largest source of uranium in the cattle feed was from commercial mineral supplements typically fed to cattle in the area. An ecological analysis of potential risks to various animals from either direct or indirect ingestion of radiological residues in vegetation in the immediate vicinity of Pantex obtained similar conclusions (DOE 1996d).

The uplands of Pantex support a variety of invertebrates, reptiles, amphibians, birds, and mammals. The insect class is well represented with grasshoppers, beetles, true bugs, flies, bees, wasps, ants, moths, butterflies, and dragonflies. The most frequently occurring species of reptiles and amphibians include the Great Plains toad (*Bufo cognatus*), Woodhouses toad (*Bufo woodhousei*), Plains spadefoot toad (*Scaphiopus bombifrons*), Great Plains skink (*Eumeces obsoletus*), Western coachwhip snake (*Masticophis flagellum testaceus*), bullsnake (*Pituophis melanoleucus sayi*), checkered garter snake (*Thamnophis marcianus marcianus*), and prairie rattlesnake (*Crotalus viridis viridis*) (DOE 1996d).

Some of the more common species of birds that have been observed at Pantex include the Western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), mourning dove (*Zenaida macroura*), Bewicks wren (*Thryomanes bewickii*), mockingbird (*Mimus polyglottos*), house finch (*Carpodacus mexicanus*), common nighthawk (*Chordeiles minor*), greater roadrunner (*Geococcyx californianus*), killdeer (*Charadrius ociferous*), Swainsons hawk

(*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), and turkey vulture (*Cathartes aura*) (DOE 1996d).

Representative mammals that occur at Pantex are the deer mouse (*Peromyscus maniculatus*), plains harvest mouse (*Reithrodontomys montanus*), white-footed mouse (*Peromyscus leucopus*), hispid cotton rat (*Sigmodon hispidus*), Southern Plains wood rat (*Neotoma micropus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), desert cottontail (*Sylvilagus audoboni*), black-tailed prairie dog (*Cynomys ludovicianus*), striped skunk (*Mephitis mephitis*), and coyote (*Canis latrans*) (DOE 1996d).

The 2002 revision of the *Integrated Plan for Playa Management at Pantex Plant* (BWXT 2002b) calls for adaptive management for species diversity that is consistent with the shortgrass prairie ecosystem of the Southern High Plains. Species diversity and supporting habitat have been changed by cultivation, intensive grazing, and invasion of honey mesquite (*Prosopis glandulosa*). Consequently, the importance of managed playas and shortgrass prairie has increased for wildlife and plant species. Thus preservation and management of remaining grassland is an important goal for biotic community protection. This management issue takes on special significance because few federally managed public lands occur on the Southern High Plains, an important part of the Central Flyway for migratory birds. In addition, threatened, endangered, and other rare species can be found in these habitats. Prescribed grazing is a primary tool for improving plant and animal biodiversity while vegetation and wildlife monitoring are important components of biotic community protection at Pantex. A rotational grazing system among Playa Management Units was developed in December 1999 (BWXT 2002b). This rotation is comprised of an intensive grazing treatment of 50-80 percent removal of biomass; a moderate grazing treatment of the standard Natural Resource Conservation Service 50 percent reduction rule; and a deferred grazing treatment. Prescribed burning may be cycled into this rotation within the next 5 years (Pantex 2002).

4.4.6.2 Wetlands

There are six playas on DOE-owned or leased land at Pantex: Playas 1, 2, and 3 are on the main Pantex site; Playas 4 and 5 are on land leased from Texas Tech University; and Pantex Lake is on a separate parcel of DOE-owned property, approximately 4 km (2.5 mi) northeast of the main portion of Pantex and would not be affected by the proposed project. (See Figure 4.4.4.1–1 for the locations of the playas and Pantex Lake on Pantex). Playas 1, 2, 3, and 4 and Pantex Lake are wetlands and are subject to compliance with 10 CFR 1022: EO-11990 “Protection of Wetlands” and EO-11988 “Floodplain Management.” Playa wetlands are important natural resources for two primary reasons: (1) water collected in the playas is a likely source of recharge to subsurface aquifers; and (2) playa wetlands provide valuable habitat and food for many wildlife species, including upland game birds, raptors, and waterfowl (Pantex 2001b).

Playa vegetation on the Southern High Plains varies from one playa to another and throughout the changing conditions of the seasons. When water is present within the basins for an extended period, playa vegetation is usually composed of emergent and submergent aquatic species; however, as available water subsides, the species shift to semi-aquatic or moist soil annuals. With little moisture present, playa vegetation is commonly made up of characteristic upland species. Because of the diversity among individual playas, a specific vegetative characterization is presented for each playa at Pantex.

Playa 1

This playa receives the continuous discharge from the WWTF. As such, it supports 19 obligate aquatic plant species, the highest number of any playa at Pantex. Like most wet playas, the dominant plants are emergent and submergent species. Cattail *(Typha anqustifolia)* and bulrush (*Scirpus* spp.) are present at Playa 1. Other notable obligate aquatic species present within the playa were pondweed (*Potamogeton nodosus*), arrowhead (*Sagittaria montevidensis*), spikerush (*Eleocharis macrostachya*), and smartweed. The facultative aquatic or semi-aquatic species found at Playa 1 include several species of smartweed (*Polygonum spp.*), slim aster (*Aster subulatus*), and western black willow (*Salix goodingii*). The uplands surrounding Playa 1 are typical High Plains grassland composed of buffalo grass, blue grama, and prickly pear.

Playa 2

The basin of this playa is dominated by several species of smartweed, primarily *Polygonum pensylvanicum*, *P. amphibium*, and *P. coccineum*. Other significant species within the basin included mallow (*Malvella leprosa*), ragweed (*Ambrosia grayii*), and sunflower (*Helianthus annuus*). One small association of cattails was also noted within the playa. The edge of the playa basin contains tumbleweed and frog fruit, while, slightly above the basin, the major plant species are wheatgrass and snow-on-the-mountain (*Euphorbia marginata*). The plant composition of the uplands surrounding Playa 2 is very similar to that of Playa 1.

Playa 3

This playa, adjacent to the Burning Ground, has a basin floral composition of primarily spikerush with little vervain (*Verbena bracteata*) and hairy water clover (*Marsilea vestita*). The edge of the basin is dominated by spikerush, woollyleaf bursage (*Ambrosia grayi*) and cocklebur (*Xanthium strumarium*), and the uplands surrounding Playa 3 have a species composition similar to Playas 1 and 2.

Playa 4

The low areas of this playa contain abundant spikerush and ragweed, with some hairy water clover and buffalo grass. One of the lowest areas in the basin supports cattails and several species of smartweed. Extensive stands of wheatgrass are present on the slopes leading from the basin to the uplands. The shortgrass prairie immediately adjacent to Playa 4 has a composition similar to other areas at Pantex, but with a greater coverage of buffalo grass.

Pantex Lake

Major plants within the basin of Pantex Lake are spikerush, wheatgrass, and cocklebur. The area at the edge of the basin is dominated by wheatgrasss, but there is a transition into High Plains grassland dominated by buffalo grass and, to a lesser degree, three-awn and blue grama. In the past, Pantex Lake received discharge from site activities, but does not now.

4.4.6.3 Aquatic Resources

There are no federally designated Wild and Scenic Rivers onsite. No streams or rivers flow through Pantex. Major surface water in the vicinity includes the Canadian River, 27 km (17 mi) to the north, Sweetwater Creek and the Salt Fork of the Red River, respectively 80 km (50 mi) and 32 km (20 mi) to the east, and the Prairie Dog Fork of the Red River, 56 km (35 mi) to the south. The Canadian River flows into Lake Meredith about 40 km (25 mi) north of the plant. The only naturally occurring waterbodies onsite are the playas and very small, unnamed, intermittent channels and ditches that may feed stormwater into them.

Aquatic resources at Pantex are not extensive and are comprised of the perennial Playa 1. Since Playas 1 through 4 and Pantex Lake are considered wetlands, they are detailed in Section 4.4.6.2. Playa 1 is permanently inundated with water, receiving discharge from WWTF. However, the playas are frequently dry because of the high, naturally occurring evaporation rate combined with a rate of infiltration that normally exceeds the rate of inflow. Playas in the area of Pantex may be as large as 1,220 m (4,000 ft) in diameter and more than 9 m (30 ft) deep. Most of the playas are floored with a clay accumulation at the bottom that is lens shaped, being thickest in the middle and thinning out toward the edges. These clay floors may contain desiccation cracks up to 1.8 m (6 ft) deep when the floor is dry. The only surface waterway that flows throughout the year is the one that receives flow from the WWTF and discharges into Playa 1. The remaining channels and ditches contain flows only after storm events. The playas are considered by the State of Texas to be “waters of the state” and have been designated as jurisdictional wetlands (Pantex 2001b).

The aquatic regions of Playa 1 support over six genera of plants. The dominant vegetation is cattail, great bulrush *(Scirpus validus),* and three species of smartweed (*Polygonum* spp.). During surveys in 1992, 26 families of macroinvertebrates were collected from Pantex playas. Insects identified included mayflies (one family), dragonflies and damselflies (three families), beetles (six families), true bugs (six families), and flies (three families). There were also four families of crustaceans, two families of mollusks, leeches, and water mites. Vertebrate species recorded at Playa 1 include the Plains leopard frog (*Rana blairi*), the Woodhouses toad, and the upland chorus frog (*Pseudoacris triseriata feriarum*). The concrete ponds, representing another aquatic habitat at Pantex, are inhabited by six different species of amphibians, including the barred tiger salamander (*Ambystoma tigrinum mavoritum*), the upland chorus frog, and the Great Plains toad. In May 1996, Pantex personnel resampled the earthen stock tank near Pantex Lake. Specimens of fathead minnows (*Pimephales promelus*) and one black bullhead (*Ictalurus melas*) were collected (DOE 1996d). Birds are the most conspicuous animal associated with the playas in terms of numbers, diversity, and biomass. Situated along the central flyway migratory route, the playas provide valuable habitat for migration, wintering, and nesting. The most common wintering ducks are mallards, northern pintails, green-winged teals, and American wigeons. Species known to breed in playas include the mallard, northern pintail, blue winged teal, cinnamon teal, northern bobwhite, western meadowlark, yellow-headed blackbird, red-winged blackbird, and ring-necked pheasant (Pantex 2001b).

4.4.6.4 Threatened and Endangered Species

Table 4.4.6.4–1 provides a list of Federal- and state-threatened and endangered species along with other species of special interest that occur or may occur within Carson County and/or Pantex. There is no critical habitat for any threatened or endangered species at Pantex. The bald eagle (*Haliaeetus leucocephalus*) is the only federally protected species known to inhabit Pantex for extended periods of time. Currently, it is listed as threatened by the USFWS. It winters in the high plains of Texas, usually from October through February or March (a 4- to 5-month period), and forages near waterbodies (playas), feeding on fish, waterfowl, and small mammals. The bald eagle is sighted yearly at Pantex and is considered a winter resident and a spring and fall migrant. Additional listed species that may occur on or around Pantex include the interior least tern (*Sterna antillarum athalassos*), a possible spring and fall migrant, and the whooping crane (*Grus americana*), a spring and fall migrant. The whooping crane has been sighted at Pantex in recent years (BWXT 2002b, DOE 1996d).

Species that are federally proposed or candidates for listing as threatened or endangered do not receive legal protection under the *Endangered Species Act.* However, USFWS encourages the consideration of impacts to these species in project planning since their status can be changed to threatened or endangered in the foreseeable future. Two candidate species occur in Carson County with one present at Pantex. The candidate species are the black-tailed prairie dog (*Cynomys ludovicianus*), which is a Pantex resident, and the lesser prairie chicken (*Tympanuchus pallidicinctus*). No suitable habitat exists at Pantex for the lesser prairie chicken. The mountain plover (*Charadrius montanus*) is a federally proposed threatened species that has been sighted at Pantex in 2002 (BWXT 2002b, DOE 1996d).

Four special-status species may be found within the Pantex environs. The ferruginous hawk *(Buteo regalis)* is a common winter resident that feeds on prairie dogs and cottontail rabbits. The area west of Zone 4 West is a potential feeding location because of its prairie dog towns. Also associated with the prairie dog towns is the western burrowing owl *(Athene cunicularia hypugaea)*. Up to 10 pairs of western burrowing owls have been identified as nesting in the area just west of Zone 4 West. The Texas horned lizard (*Phrynosoma cornutum*) is a Pantex resident and has state-threatened status. The state also lists the white-faced ibis (*Plegadis chihi*), a spring and fall migrant and summer resident at Pantex, as threatened (BWXT 2002b, DOE 1996d).

There are no protected plant species known to occur at Pantex or within Carson County.

4.4.7 Cultural and Paleontological Resources

4.4.7.1 Cultural Resources

All undertakings at Pantex are conducted in compliance with relevant cultural resource Federal legislation, particularly Sections 110 and 106 of the NHPA, and DOE orders and policies that address cultural resource protection and management. A Programmatic Agreement has been implemented in consultation with the Texas SHPO and the Advisory Council on Historic

Table 4.4.6.4–1. Listed Federal- and State-Threatened and Endangered Species and Other Special Interest Species that Occur or May Occur within Carson County and Pantex, Texas

Species	Federal Classification	State Classification	Occurrence at Carson County/Pantex
Mammals			
American black bear *Ursus americanus*	Not Listed	Threatened	Transient in Carson County and Pantex
Black-footed Ferret *Mustela nigripes*	Endangered	Endangered	Extirpated in Texas
Black-tailed Prairie Dog *Cynomys ludovicianus*	Candidate	Rare but with no regulatory listing status	Carson County and present at Pantex
Cave Myotis Bat *Myotis velifer*	Not Listed	Rare but with no regulatory listing status	Carson County/No record from Pantex
Plains Spotted Skunk *Spilogale putorius interrupta*	Not Listed	Rare but with no regulatory listing status	Carson County/No record from Pantex
Swift Fox *Vulpes velox*	Removed from Candidate listing October 30, 2001	Rare but with no regulatory listing status	Carson County may occur at Pantex
Birds			
American Peregrine Falcon *Falco peregrinus anatum*	Delisted	Endangered	Carson County and Pantex
Arctic Peregrine Falcon *Falco peregrinus tundrius*	Delisted	Threatened	Carson County and Pantex
Baird's Sparrow *Ammodramus bairdii*	Not Listed	Rare but with no regulatory listing status	Carson County/No record from Pantex
Bald Eagle *Haliaeetus leucocephalus*	Threatened–Proposed for Delisting	Threatened	Winter Resident within Carson County and Pantex
Ferruginous Hawk *Buteo regalis*	Not Listed	Rare but with no regulatory listing status	Winter Resident within Carson County and Pantex
Interior Least Tern *Sterna antillarum athalassos*	Endangered	Endangered	Potential migrant within Carson County and Pantex
Lesser Prairie Chicken *Tympanuchus pallidicinctus*	Candidate	Rare but with no regulatory listing status	Carson County/Suitable Habitat at Pantex
Mountain Plover *Charadrius montanus*	Proposed Threatened	Rare but with no regulatory listing status	Carson County and Pantex
Snowy Plover *Charadrius alexandrinus*	Not Listed	Rare but with no regulatory listing status	Potential migrant within Carson County and Pantex
Western Burrowing Owl *Athene cunicularia hypugaea*	Not Listed	Rare but with no regulatory listing status	Resident within Carson County and Pantex
White Faced Ibis *Plegadis chihi*	Not Listed	Threatened	Summer resident within Carson County and Pantex
Whooping Crane *Grus americana*	Endangered	Endangered	Migrant within Carson County and Pantex
Reptiles			
Texas Garter Snake *Thamnophis sirtalis annectens*	Not Listed	Rare but with no regulatory listing status	Carson County/No suitable habitat at Pantex
Texas Horned Lizard *Phrynosoma cornutum*	Not Listed	Threatened	Carson County and Pantex Resident

Sources: Swepston 2002, TX P&W 2002, USFWS 2002.

Preservation to provide for more efficient and effective review of Pantex projects having the potential to impact historic properties. In addition, a draft Cultural Resource Management Plan was completed in September 2000 (DOE 2002e). The ROI for cultural resources is the entire Pantex Site.

Prehistoric Resources

Systematic archaeological inventories at Pantex have included approximately half of the facility acreage (DOE and Texas Tech University areas combined). Through these inventories, 57 prehistoric sites have been identified (DOE 1996d, DOE 2002e). Archaeological test excavations conducted at 23 of these sites suggest that a majority of the sites were occupied during the Late Archaic and Late Prehistoric periods (1000 B.C.-A.D. 1541). These sites are generally associated with local playas, located within 0.40 km (0.25 mi) of the playa margin or along distinct drainages into playa. However, some sites are located in the upper areas between playas. Sites consist mainly of lithic scatters with varying amounts of fire-cracked rock. DOE, in consultation with the Texas SHPO, has determined that of the 57 prehistoric sites identified, only 2 sites are potentially eligible for listing on the NRHP. The remaining 55 sites are determined to be ineligible for listing due to a lack of contextual integrity. DOE also has decided to protect 22 of the 55 ineligible sites because they are a unique grouping of Southern High Plains sites. The uniqueness is based on the sites' location near contiguous playas and the sites' research potential to illuminate prehistoric human use of the region's playas (DOE 1995c). This is the largest such grouping of sites currently under Federal protection.

Historic Resources

Historic resources located at Pantex include archaeological sites dating to pre-1942, World War II-era resources, and Cold War-era resources. Twelve pre-1942 Euro-American historic sites have been identified at Pantex. These sites include foundations of demolished buildings such as homes and agricultural support structures (e.g., barns, windmills), and surface scatters of metal, ceramic, and glass artifacts. DOE has determined, in consultation with the Texas SHPO, that these 12 sites lack integrity, and thus are not eligible for the NRHP (DOE 2002e).

The entire Pantex Site has been surveyed for World War II-era structures and foundations, and all such properties have been systematically recorded. These resources are part of the original Pantex Ordnance Plant, which was in operation from 1942-1945. Current discussions between DOE and the SHPO suggest that none of these properties are eligible due to a lack of integrity (DOE 2002e). A number of World War II-era original drawings and documents have been identified at Pantex and are now preserved in the environmentally controlled records storage area at the site.

From 1951-1991, Pantex had a Cold War mission centered around nuclear weapons, including fabrication of high explosives, assembly and disassembly, and repair and modification (DOE 1996d). A literature search was conducted that identified approximately 700 buildings and structures and a large inventory of related equipment and documents from this era. To assess these properties for significance, an oral history program has been established to record information from Pantex employees, a building survey is underway, and a draft historical context has been prepared and reviewed by the Texas SHPO. To date, all Cold War-era buildings have been surveyed on a preliminary basis, all design drawings have been reviewed, and approximately half of the buildings have been documented in a survey format. DOE has determined that 183 buildings are eligible for inclusion in the NRHP. Continuing consultations are being conducted between DOE and the SHPO regarding formal eligibility for World War II- and Cold War-era resources.

Native American Resources

To date, no known Native American traditional cultural properties, sacred sites, or mortuary remains have been identified at Pantex, and based on completed inventories, none are anticipated. A recently completed search of treaty records has indicated that no federally recognized Native American tribes have recognized title or treaty rights to Pantex land area (DOE 2002e). However, the U.S. Indian Claims Commission has found that the Kiowa, Comanche, and Apache Tribes of Oklahoma have legally recognized traditional interests in the Texas Panhandle (DOE 1996d).

Native American groups thought to have traditional interests in the Pantex area have been contacted regarding operations at Pantex. These tribes include the Comanche Tribe of Oklahoma, Kiowa Tribe of Oklahoma, Apache Tribe of Oklahoma, the Mescalero Apache Tribe, the Jicarilla Apache Tribe, the Cheyenne-Arapaho Tribe of Oklahoma, the Wichita and Affiliated Tribes, the Caddo Tribe of Oklahoma, the Delaware Tribe of Western Oklahoma, and the Fort Sill Apache Tribe (DOE 1996c, DOE 1996d). The Jicarilla and Mescalero Apache have both stated that they have no concerns for the central Texas Panhandle. The Kiowa and Apache Tribes of Oklahoma have since been in further contact with the Pantex Site (BWXT 2002a).

Cultural Resources on the Reference Location

The reference location at Pantex has been surveyed to locate any cultural resources. No prehistoric or historic archaeological sites are located at the reference location. All of the World War II and Cold War-era properties are located south of the reference location.

4.4.7.2 Paleontological Resources

The surficial geology of the Pantex region consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation contains Late Pleistocene vertebrate remains, including bison, camel, horse, mammoth, and mastodon, with occasional and significant evidence of their use by early North American populations. Evidence of woolly mammoths has been found north of Pantex near the Canadian River (DOE 1996c). However, no paleontological resources have been found on the Pantex Site.

4.4.8 Socioeconomics

Socioeconomic characteristics addressed at Pantex include employment, income, population, housing, and community services. These characteristics are analyzed for a four-county ROI consisting of Armstrong, Carson, Potter, and Randall Counties in Texas, where almost 96 percent of site employees reside (DOE 1996c), as shown in Table 4.4.8-1.

Table 4.4.8–1. Four-County ROI Where Pantex Employees Reside

County	Percent of Total
Armstrong	1
Carson	11
Potter	34
Randall	50
ROI Total	**96**

Source: DOE 1996c.

4.4.8.1 Employment and Income

The service sector employs the greatest number of workers in the ROI with more than 30 percent of the workforce. Other important sectors of employment include retail trade (18.8 percent); government (12.5 percent); and finance, insurance, and real estate (10.3 percent) (BEA 2002).

The labor force in the ROI increased 13.7 percent from 1990 to 2001, an average of 1.2 percent each year. In comparison, the State of Texas labor force increased at a greater rate, a total of 21.4 percent over the same time period. Total employment in the ROI increased at a faster pace than the labor force, a total of 15.8 percent. Unemployment fell from 4.9 percent in 1990 to 3.1 percent in 2001. In comparison, the Texas state-wide average unemployment fell from 6.3 percent in 1990 to 4.9 percent in 2001 (BLS 2002a).

In 2000, per capita income in the ROI ranged from a high of $29,207 in Carson County to a low of $19,465 in Armstrong County. The average per capita income in the ROI was approximately $24,520, compared to the Texas average of $27,752. Per capita income increased by almost 46 percent from 1990-2000, compared to a state-wide increase of 59 percent (BEA 2002).

4.4.8.2 Population and Housing

From 1990 to 2000, the ROI population grew from 196,111 to 226,522, an increase of 15.5 percent. This was a slower rate of growth than that of Texas, which grew at a rate of 22.8 percent during the same time period. Randall County had the highest rate of growth at 16.3 percent, while the population of Carson County decreased by 0.9 percent (Census 2002).

In 2000, the total number of housing units in the ROI was 91,594 with 85,272 occupied. There were 56,173 owner-occupied housing units and 29,099 occupied rental units. In 2000, the homeowner vacancy rate in the ROI ranged from a high of 3.5 percent in Carson County to a low of 1.4 percent in Randall County. The rental vacancy rate ranged from 12 percent in Armstrong County to 6.4 percent in Randall County. This is comparable to the State of Texas rates of 1.8 percent homeowner vacancy and 8.5 percent rental vacancy. The greatest number of housing units in the ROI is in Potter County with almost 49 percent of the total housing units. Randall County has more than 47 percent of the housing units in the ROI (Census 2002).

4.4.8.3 Community Services

There are a total of 9 school districts in the ROI serving over 40,000 students. The student-to-teacher ratio in these districts ranges from a high of 15.8 in the Canyon Independent School

District (ISD) in Randall County to a low of 9.7 in the Groom ISD in Carson County. The average student-to-teacher ratio in the ROI is 14.5 (NCES 2002).

The ROI is served by 6 hospitals with a capacity of over 1,300 beds, almost all of which are located in Amarillo (AHA 1995). There are approximately 470 doctors in the ROI, the majority of which are concentrated in Amarillo.

4.4.9 Radiation and Hazardous Chemical Environment

4.4.9.1 Radiation Exposure and Risk

An individual's radiation exposure in the vicinity of Pantex amounts to approximately 399 mrem/yr as shown in Table 4.4.9.1–1 and is comprised of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; weapons test fallout; consumer and industrial products; and nuclear facilities. All radiation doses mentioned in this EIS are effective dose equivalents. Effective dose equivalents include the dose from internal deposition of radionuclides and the dose attributable to sources external to the body.

Table 4.4.9.1–1. Sources of Radiation Exposure to Individuals in the Pantex Vicinity Unrelated to Pantex Operations

Source	Radiation Dose (mrem/yr)
Natural Background Radiation	
Total external (cosmic and terrestrial)	95
Internal terrestrial and global cosmogenic	40[a]
Radon in homes (inhaled)	200[a]
Other Background Radiation[a]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	**399**

[a] An average for the United States.
Source: NCRP 1987.

Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to Pantex operations.

Releases of radionuclides to the environment from Pantex operations provide another source of radiation exposure to individuals in the vicinity of Pantex. Types and quantities of radionuclides released from Pantex operations in 2000 are listed in the *2000 Site Environmental Report for Pantex Plant* (Pantex 2001b).

The doses to the public resulting from these releases are presented in Table 4.4.9.1–2. The radionuclide emissions contributing the majority of the dose to the offsite MEI were tritium, thorium-232, uranium-234, and uranium-238. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

Table 4.4.9.1–2. Radiation Doses to the Public From Normal Pantex Operations in 2000 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Offsite MEI (mrem)	10	1.61×10^{-4}	4	0	100	1.61×10^{-4}
Population within 80 km (person-rem)	None	1.59×10^{-3}	None	0	None	1.59×10^{-3}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-mrem/yr limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.

Source: Pantex 2001b.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the offsite MEI due to radiological releases from Pantex operations is estimated to be 8.1×10^{-11} or 8.1 cancer deaths in a population of 100 billion. The estimated probability of this maximally exposed person dying of cancer at some point in the future from radiation exposure associated with 1 year of Pantex operations is less than one in 1 million (it takes several to many years from the time of radiation exposure for a cancer to potentially manifest itself).

According to the same risk estimator, 7.9×10^{-7} excess fatal cancers are projected in the population living within 80 km (50 mi) of Pantex from normal Pantex operations. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population of 292,877 living within 80 km (50 mi) of Pantex was 585. This expected number of fatal cancers is much higher than the 7.9×10^{-7} fatal cancers estimated from Pantex operations in 2000.

External radiation doses have been measured in areas of Pantex for comparison with offsite natural background radiation levels. Measurements taken in 2000 showed an average dose onsite of 72.2 mrem (Pantex 2001b).

Pantex workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at Pantex from operations in 2001 are presented in Table 4.4.9.1–3. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among Pantex workers from normal operations in 2001 is 0.017. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 4.4.9.1–3. Radiation Doses to Workers From Normal Pantex Operations in 2001 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (mrem)	5,000[a]	149
Collective radiation worker dose[b] (person-rem)	None	43.6

[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 mrem/yr (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] There were 293 workers with measurable doses in 2001.
Source: DOE 2001f.

4.4.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Pantex workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at Pantex via inhalation of air containing hazardous chemicals released to the atmosphere by Pantex operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Nonradiological ambient air monitoring was conducted at a single location designated in TNRCC Hazardous Waste Permit HW-50284. The maximum measurement of hydrogen fluoride at this air monitoring site was 3.9 percent of the TNRCC Effects Screening Level (ESL) for hydrogen fluoride. The maximum measurement for any VOC was 87.5 percent of its ESL. This VOC (hexachlorobutadiene) was measured on a day when thermal treatment (burning) was not being conducted at the Burning Ground. The maximum concentration of respirable particulate matter measured at the site designated in HW-50284 was 78.9 percent of the NAAQS, 24-hour average concentration (150 $\mu g/m^3$).

4.4.10 Traffic and Transportation

4.4.10.1 Regional Transportation Infrastructure

Pantex is in the northern Texas panhandle approximately 27 km (17 mi) northeast of Amarillo, Texas. I-40 provides the main east-west route in the region. I-27 connects Amarillo with locations to the south as far as Lubbock, which is 199 km (124 mi) away. Truck shipments to Pantex from the east would arrive on I-40, exiting at FM 2373 (Figure 4.4.10.1–1). The shipping gate is off FM 2373.

4.4.10.2 Local Traffic Conditions

The area adjacent to Pantex is entirely agricultural, with an extremely low population density (8 persons per km^2 [3 persons per mi^2]). Local roads have more than adequate capacity to handle Pantex traffic, which originates in the Amarillo metropolitan area. Table 4.4.10.2–1 provides information on traffic on important roads.

Table 4.4.10.2–1. Traffic Conditions on Principal Access Roads to the Pantex Plant

Access Road	Annual Average Daily Traffic	Peak Hourly Traffic	Volume to Capacity Ratio	Level of Service[a]
U.S. 60 between FM 552 and the Pantex boundary	7,100	NA	NA	A-B
FM 683 adjacent to the plant	590	NA	NA	A-B
FM 2373 south of Pantex gate	2,200	NA	NA	A-B

NA = not available.
[a] Levels of Service:
A. Free flow of the traffic stream; users are unaffected by the presence of others.
B. Stable flow in which the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished.
C. Stable flow that marks the beginning of the range of flow in which the operation of individual users is significantly affected by interactions with the traffic stream.
D. High-density, stable flow in which speed and freedom to maneuver are severely restricted; small increases in traffic will generally cause operational problems.
E. Operating conditions at or near capacity level causing low but uniform speeds and extremely difficult maneuvering that is accomplished by forcing another vehicle to give way; small increases in flow or minor perturbations will cause breakdowns.
F. Defines forced or breakdown flow that occurs wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. This situation causes the formation of queues characterized by stop-and-go waves and extreme instability.

Source: Oeding 2002.

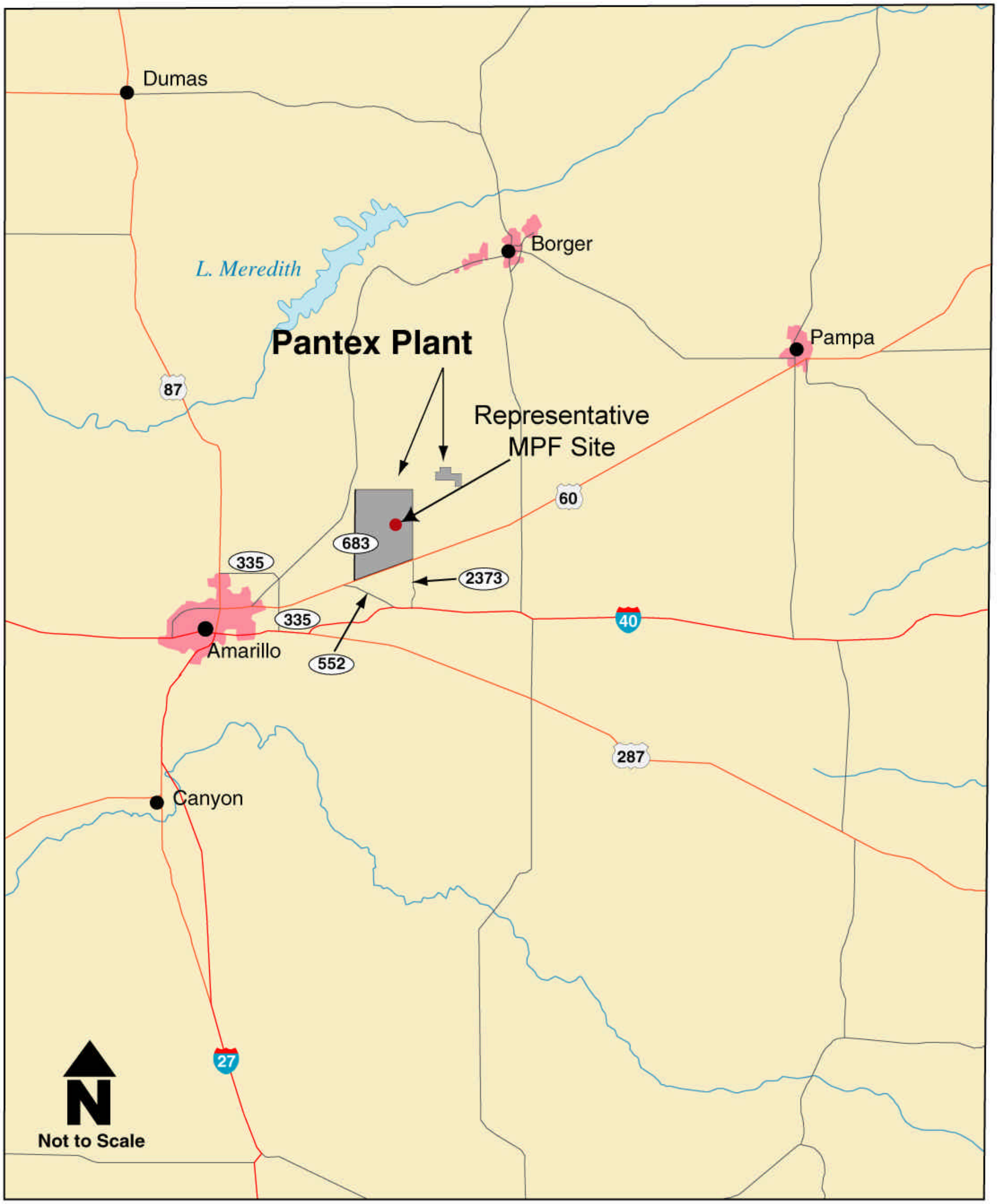


Figure 4.4.10.1–1. Highways in the Region of the Pantex Site

4.4.11 Waste Management

This section describes the DOE waste generation baseline that will be used to gauge the relative impact of MPF construction and operations on the overall waste generation at Pantex and on DOE's capability to manage such waste. Pantex manages LLW, mixed LLW, hazardous waste, and sanitary waste. TRU waste and mixed TRU waste are not normally generated and no high-level waste is generated at Pantex. Table 4.4.11–1 provides the routine waste generation rates at Pantex. Table 4.4.11–2 summarizes the waste management capabilities at Pantex.

Table 4.4.11–1. Annual Routine Waste Generation from Pantex Operations (m^3)

Waste Type	1996	1997	1998	1999	2000	2001
Transuranic	0	0	0	0	0	0
Low-level	135	65.6	55.1	91.8	93.9	52.4
Mixed	23.6	13.7	2.16	1.04	3.77	4.18
Hazardous[a]	190	128	153	121	122	140
Sanitary[b]	592	691	657	619	570	636

[a] Includes state-regulated waste. Hazardous waste reported in metric tons.
[b] From DOE 2002o (1996 data) and DOE's Central Internet Database (available at http://cid.em.doe.gov). Sanitary waste reported in metric tons.
Source: DOE 2002o.

4.4.11.1 Low-Level Radioactive Waste

Compactible solid LLW is processed at the LLW compactor and stored along with non-compactible materials for shipment to NTS, where most Pantex LLW is disposed of, or to a commercial vendor. Radioactively contaminated classified weapons components are sent to the classified LLW repository at NTS. Soil contaminated with depleted uranium has been disposed of at a commercial facility, and the possibility for disposal of other LLW at commercial facilities is being pursued where technically and economically advisable (DOE 1999h).

4.4.11.2 Mixed Low-Level Waste

Most Pantex mixed waste consists of paper products contaminated with solvents and low-level radionuclides, and inorganic debris (including metals) contaminated with low levels of radionuclides. Mixed waste is disposed of offsite. The majority of the mixed waste has been shipped to Envirocare of Utah. Small amounts are shipped to specialized treatment facilities, such as Diversified Scientific Services, Inc., in Tennessee.

Pantex treats mixed LLW onsite in three facilities: Building 11-9S, Building 16-18, and the Burning Ground. Both Building 11-9S and 16-18 are permitted for the treatment and processing of mixed LLW and hazardous waste in containers. The Burning Ground is permitted to treat explosives and explosive-contaminated waste by open burning. In some cases, a large volume reduction is attained by this treatment, and some wastes are rendered nonhazardous due to elimination of the reactivity hazard.

Table 4.4.11–2. Waste Management Facilities at Pantex

Facility/ Description	Capacity	Status	Applicable waste types				
			LLW	Mixed LLW	TRU Waste	Hazardous Waste	Nonhazardous Waste
Treatment Facility (m^3 per year)							
12-17—Evaporator for Tritiated Water	Campaign	Online	X				
12-19 East—Rotary Evaporator Vacuum Distillation Units	Campaign	Online					X
12-19 East—Fractional Distillation Unit	Campaign	Online					X
12-19 East—HE Precipitation Process	Campaign	Online					X
HWTPF—Waste Compacting	90	Online	X	X		X	X
HWTPF—Drum Crushing	208	Online	X	X		X	X
HWTPF—Wastewater Evaporation System	45	Online	X				X
HWTPF—Misc. Drum Operations (including neutralization and filtration)	Various[b]	Online	X	X		X	
HWTPF—Drum Rinsing System	45	Online				X	
HWTPF—Fluorescent Bulb Crusher	12	Online				X	
HWTPF—Scintillation Vial Crushing	90	Online	X				X
Burning Ground Thermal Processing Units	Variable[c]	Online		X		X	
Wastewater Treatment Facility	946,250	Online					X
Storage Facility (m^3)							
16-16 Building—Hazardous Waste Staging Facility	1,047	Online	X	X		X	X
Magazine 4-50	62	Online	X	X		X	X
Magazine 4-72	62	Online	X	X		X	X
Building 9-121	17	Online	X	X		X	X
Building 9-122	17	Online	X	X		X	X
Disposal Facility (m^3)							
Construction Debris Landfill (Zone 10)	21,208	Online	X				X

[a] Facility operates as needed when sufficient backlog has accumulated.
[b] Capacity varies with type of operation.
[c] Permit limitations are per burning event
Source: DOE 1999h, TNRCC 1996.

DOE decided to construct a Hazardous Waste Treatment and Processing Facility (HWTPF, Building 16-18) in its ROD for the *Final Environmental Impact Statement for the Continued Operation of Pantex and Associated Storage of Nuclear Weapon Components* (62 FR 3880; January 27, 1997). DOE completed construction and initiated operations of the HWTPF in FY2000 (DOE 2001a). Building 16-18 is assuming more of the treatment and processing as Building 11-9S is scheduled for closure. Operations currently consist of segregating and downgrading production line generated waste, destruction of classified and sensitive matter, evaporation of tritiated water, waste compaction, and segregation of scintillation vials into solid and liquid waste streams. There is also the capability to solidify liquids and to rinse drums for reuse, should the need arise.

4.4.11.3 Transuranic and Alpha Waste

Normal operations at Pantex do not generate TRU or alpha wastes, although there are procedures in place to manage TRU waste if it is generated. The small quantity of TRU waste (<1 m^3 [<35.3 ft^3]) that had been stored in Building 12-42 was moved to LANL pending disposal at WIPP.

4.4.11.4 Hazardous Waste

Hazardous wastes generated at Pantex include explosives-contaminated wastewater, spent organic solvents, and solids. Most hazardous waste generated at Pantex is shipped offsite for recycle, treatment, or disposal at commercial facilities. High explosives and high-explosive contaminated materials are burned under controlled conditions at the Burning Ground. Ash, debris, and residue resulting from this burning are transported offsite for disposal at a commercial RCRA-permitted facility. PCB waste is transported to offsite permitted facilities for treatment and disposal (DOE 1999h).

4.4.11.5 Sanitary Waste

The Texas Commission on Environmental Quality (TCEQ) requires solid waste to be characterized as Class 1, Class 2, or Class 3. The nonhazardous waste generated at Pantex falls under the Class 1 or Class 2 designation. Some solid waste (inert and insoluble materials like certain scrap metals, bricks, concrete, glass, dirt, and certain plastics and rubber items that are not readily degradable) are designated as Class 2 nonhazardous waste and are disposed of in the onsite landfill. The onsite landfill is approved for both Class 2 and Class 3 wastes. The remainder of the Class 2 nonhazardous waste generated at Pantex is sanitary waste such as cafeteria and lunchroom waste, paper towels, and office waste. Most of this waste is disposed offsite at permitted landfills (such as the City of Amarillo Landfill), although some goes to offsite commercial incinerators (DOE 1999h).

Class 1 nonhazardous waste (such as asbestos), although not hazardous by EPA's RCRA definitions, is handled in much the same manner as hazardous waste and is sent to offsite treatment or disposal facilities. Medical waste is managed through a commercial vendor who picks up and transports the waste offsite (DOE 1999h).

4.4.11.6 Wastewater

Pantex's sanitary sewage and industrial wastewater are treated by Pantex WWTF and discharged to Playa 1. The treated effluent from the system either evaporates or infiltrates into the ground. The WWTF consists of a treatment lagoon and an irrigation storage pond. The treatment lagoon has a compacted clay liner and the storage pond has a synthetic liner. The treatment lagoon covers 97 ha (39 ac) and has a capacity of 41.58 million L (11 million gal). The irrigation storage pond is the same size and capacity. Construction of the new system was designed to allow Pantex to use treated effluent for irrigation purposes. In 2001, an application for a Texas Land Application Permit was filed with the TCEQ. This application has not been approved, thus Pantex continues to discharge to Playa 1. If the pending application is approved, Pantex will design and build an irrigation system to allow beneficial use of the treated effluent.

4.4.11.7 Pollution Prevention

The total waste (routine waste as well as environmental restoration and D&D waste) generated by Pantex was 906 m^3 (31,995 ft^3) in FY2001, accounting for 0.14 percent of DOE's overall waste generation. Waste streams are reviewed for beneficial use potential and recycled when this is determined to be a viable option (e.g., scrap metal). Implementing pollution prevention projects reduced the total amount of waste generated at Pantex in 2001 by approximately 10,600 m^3 (374,339 ft^3). Examples of Pantex pollution prevention projects completed in 2001 include the reduction of sanitary waste by 10,400 metric tons (11,400 tons) by recycling large quantities of asphalt and concrete. These activities included milling of pavement for reuse onsite (454 metric tons [500 tons]) and bulk removal of paving material for recycle by an offsite paving contractor (9,910 metric tons [10,900 tons]) (DOE 2002g).

Volume II, Appendix G, of the *Final Environmental Impact Statement for the Continued Operations of the Pantex Plant and Associated Storage at Nuclear Weapons Components* provides detailed information regarding pollution prevention and waste minimization at Pantex (DOE 1996d). Pantex established a Pollution Prevention and Waste Minimization Program to comply with the waste minimization requirements under RCRA. In 1996, the Pantex program received the White House Closing the Circle Award and the Vice Presidents Hammer Award for achievements in recycling and waste prevention (DOE 1996d).

4.4.11.8 Waste Management PEIS Records of Decision

A discussion of DOE's hazardous waste, LLW, mixed LLW, and TRU waste decisions based on the Waste Management PEIS is provided in Section 4.2.11.8. The Waste Management PEIS RODs affecting Pantex are shown in Table 4.4.11.8–1.

Table 4.4.11.8–1 Waste Management PEIS Records of Decision Affecting Pantex

Waste Type	Preferred Action
TRU waste	DOE has decided to store and prepare TRU waste onsite prior to disposal at WIPP. [a]
LLW	DOE has decided to treat Pantex's LLW onsite and to ship the waste to either the Hanford Site or NTS for disposal.[b]
Mixed LLW	DOE has decided to regionalize treatment of mixed LLW at the Hanford Site, INEEL, ORR, and SRS. DOE has decided to ship Pantex's mixed LLW to either the Hanford Site or NTS for disposal.[b]
Hazardous waste	DOE has decided to continue to use commercial facilities for treatment of Pantex's non-wastewater hazardous waste.[c]

[a] From the ROD for TRU waste (63 FR 3629) and the ROD for the WIPP Disposal Phase SEIS (63 FR 3624).
[b] From the ROD for LLW and mixed LLW (65 FR 10061).
[c] From the ROD for hazardous waste (63 FR 41810).

4.5 SAVANNAH RIVER SITE

The following sections describe the affected environment at SRS for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, and socioeconomics. In addition, radiation and hazardous chemical environment, transportation, and waste management are described.

4.5.1 Land Use and Visual Resources

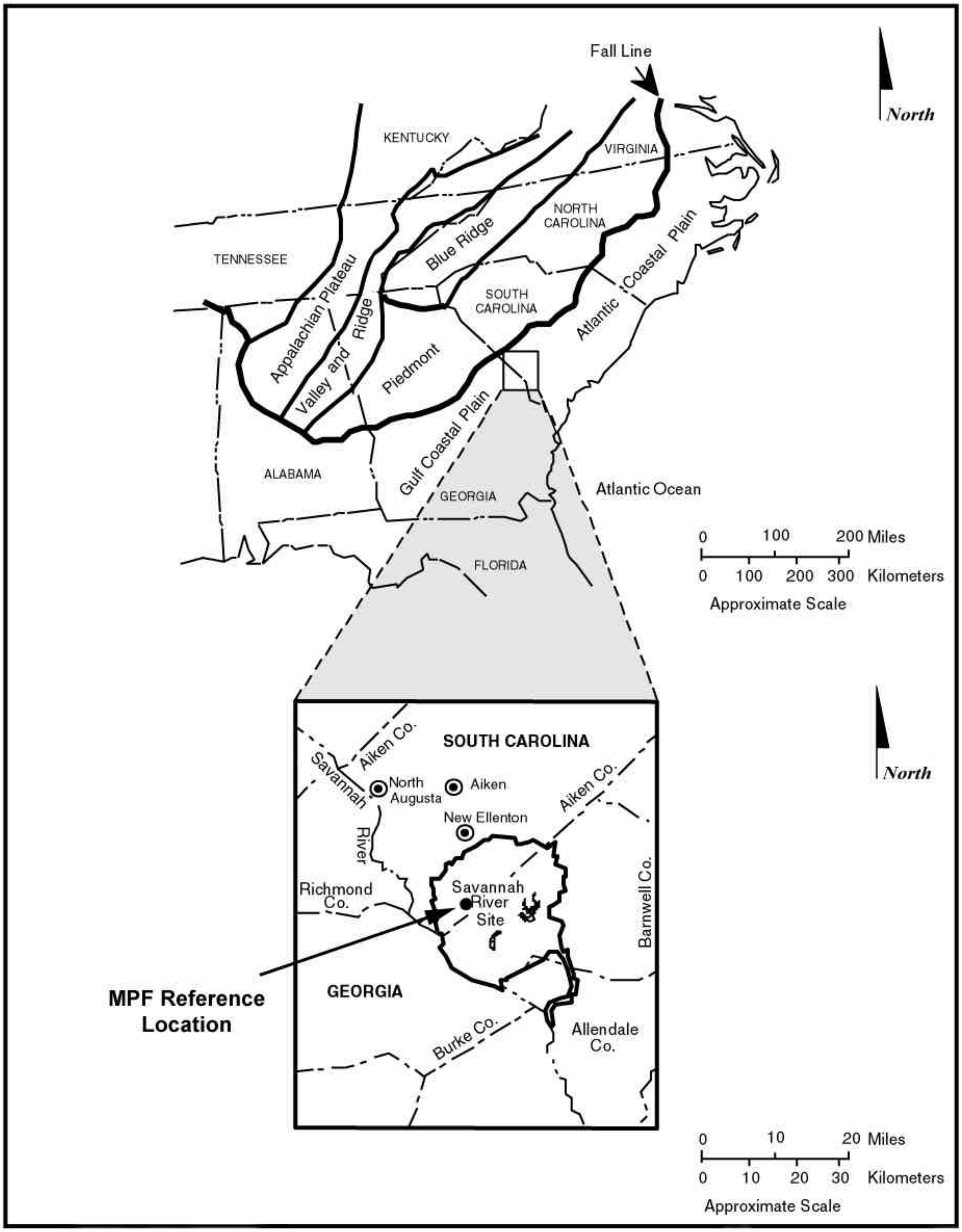
4.5.1.1 Land Use

SRS is located in south-central South Carolina and occupies an area of approximately 803 km^2 (310 mi^2) in Aiken, Barnwell, and Allendale Counties. The site's center is approximately 37 km (23 mi) southeast of Augusta, Georgia, and 32 km (20 mi) south of Aiken, South Carolina, the two closest major population centers. A marked property line establishes the site's boundary to the north, south, and east. The Savannah River forms the site's southwestern boundary for 32 km (20 mi) on the South Carolina/Georgia border. The southern tail of the site, commonly referred to as the Lower Three Runs Corridor, follows the path of Lower Three Runs Creek, and is bounded on both sides by marked property line to the river (see Figure 4.5.1.1–1).

SRS is situated on the Upper Atlantic Coastal Plain. Land use around SRS is varied and includes residential, industrial, commercial, transportation, recreation, and agricultural activities. Regional industrial land uses include a commercial nuclear power plant near Waynesboro, Georgia; a regional, low-level nuclear waste repository in Barnwell, South Carolina; a variety of conventional chemical industries near Augusta; and a variety of manufacturing industries in Aiken.

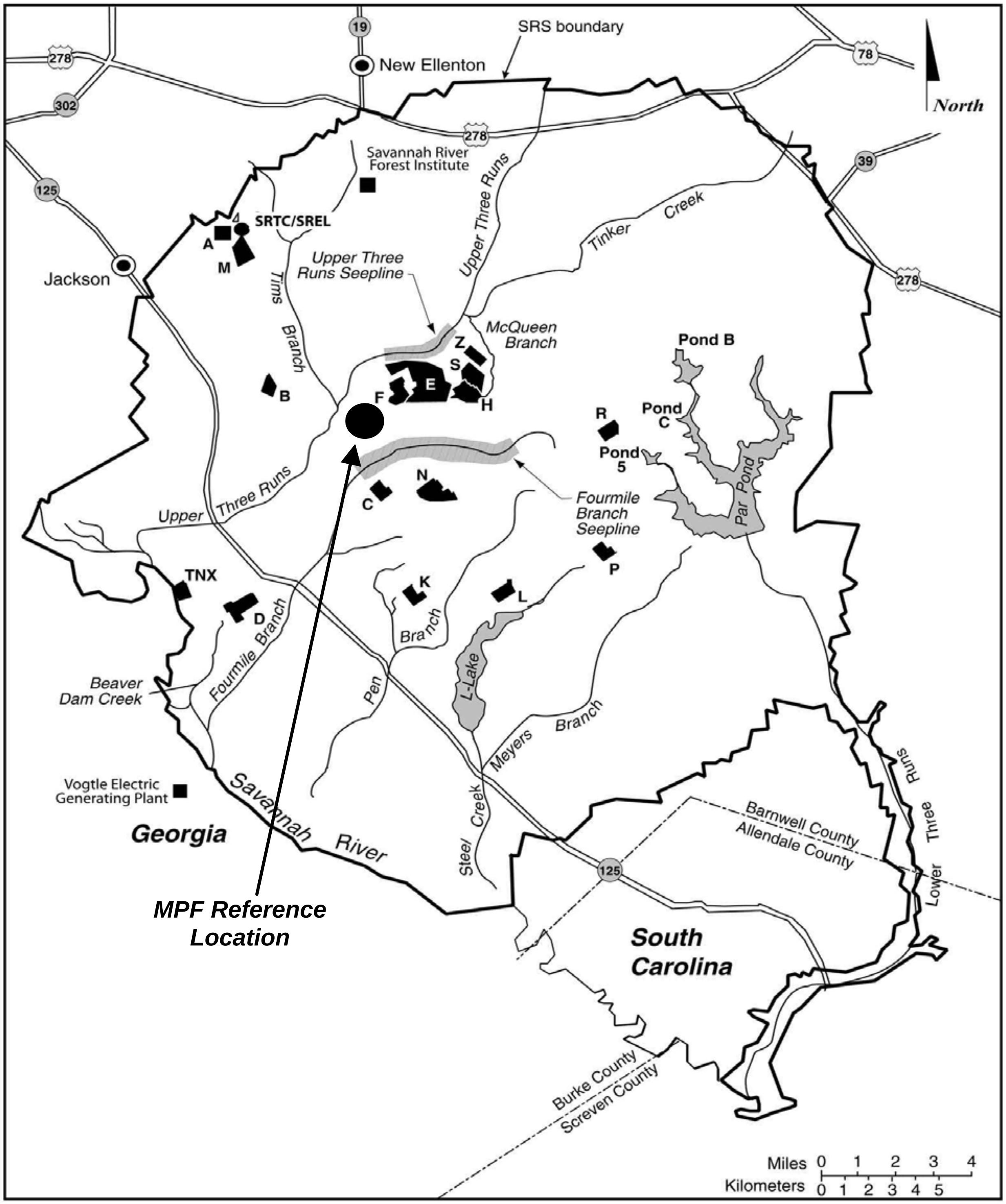
The site is drained by several streams: Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek. The streams form the basis for subdividing the site into watershed units used in environmental restoration and long-term stewardship planning. Two large water impoundments, L-Lake and Par Pond, were developed to support past reactor activities and currently serve as important ecological research areas (see Figure 4.5.1.1–2).

SRS ecology has always been a concern, starting with a census of all wildlife before construction began. Beginning in the early 1950s, the U.S. Forest Service reforested prior crop and pasture lands to stabilize and rehabilitate the soil to support native plant and animal life, reduce erosion, and minimize dust generation that could impact nuclear facility operations. In addition, this reforestation also reduced the movement of surface contamination, protecting downstream aquatic resources and domestic water supplies. In 1972, DOE designated SRS as the Nation's first National Environmental Research Park, providing a large tract of land where the effects of anthropogenic-related activities upon the environment could be studied.



Source: DOE 2001d.

Figure 4.5.1.1–1. Generalized Location of SRS and its Relationship to Physiographic Provinces of the Southeastern United States



Source: Modified from DOE 2001d.

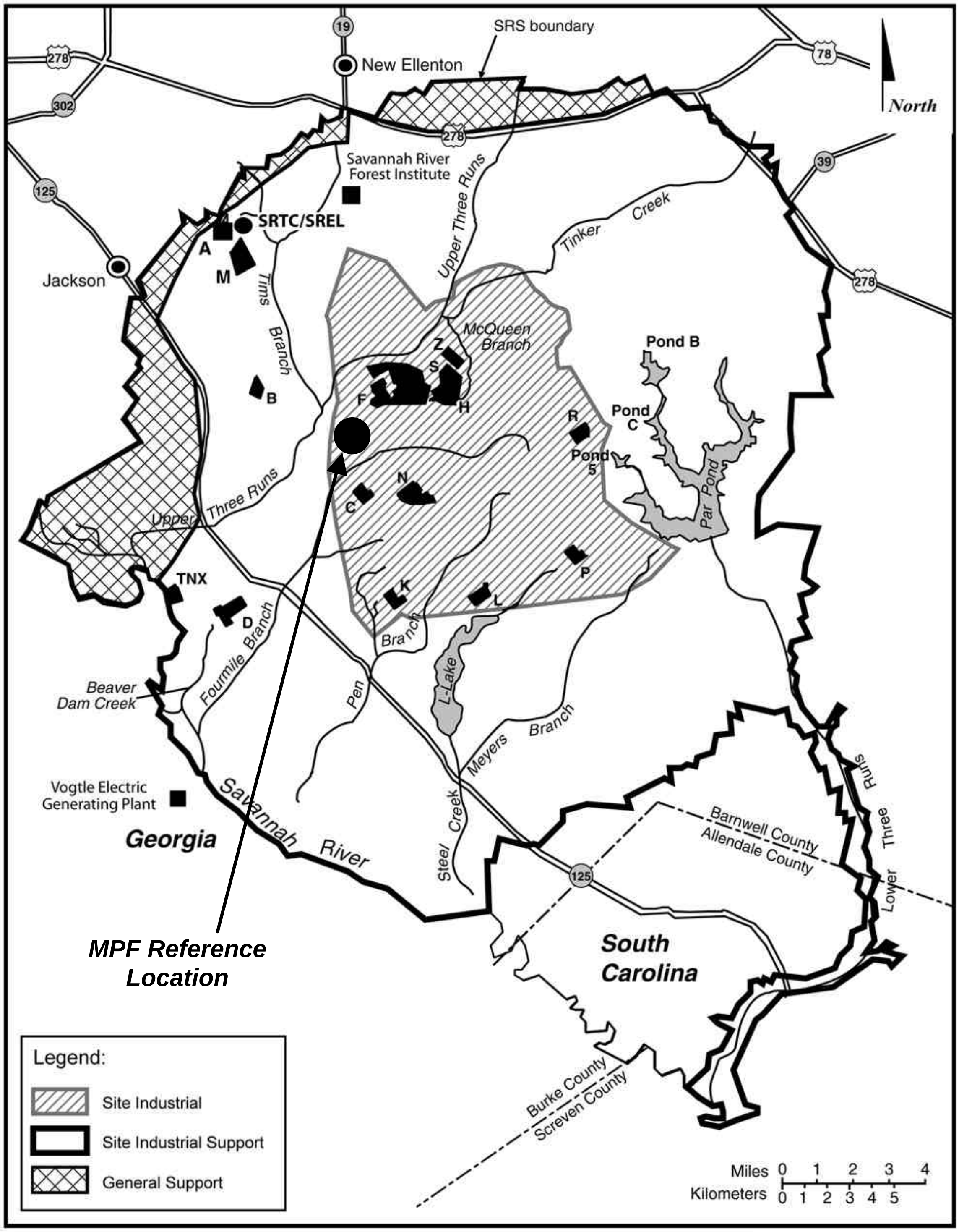
Figure 4.5.1.1–2. Savannah River Site

Currently, more than 90 percent of the site is covered in forest or other natural vegetation. Production and support facilities, infrastructure, R&D, and waste management areas account for the remaining 10 percent of the site property (DOE 2000g). The original facility layout of SRS was designed to isolate major radioactive operations away from the site boundaries, creating a buffer zone that provided both security and a reduced risk of accidental exposure to the general public. DOE has designated the entire site as a property protection area with limited public access (see Figure 4.5.1.1–2).

In December 2000, the Discussion Draft of the *Savannah River Site Long Range Comprehensive Plan* (DOE 2000g) was formally issued. It defines the future of the site and was developed in partnership with all major site contractors, support agencies, DOE Headquarters, and stakeholders. According to this document, the future configuration for SRS has been developed using the Integral Site Future Use Model.

The Integral Site Model most realistically accommodates the site's mission and vision over the next 50 years. As a remnant of the 1950s site configuration, functional areas (labeled by capital letters) are inefficiently distributed across the site. M-, C-, and P-areas are currently inactive, and primary site administrative activities are performed in A-, B-, H-, and G-areas. Nuclear research activities are performed in A-Area, which is near the site boundary. In this model, site boundaries would remain intact and land use would not change significantly. The industrial footprint, however, would shrink and be consolidated to the center of the site in a "reconfigured" land use. This scenario would allow for the accommodation of new missions, as well as the option of expanding the site core if a national need arises, terrorist activities increase, or other external causes of significant re-industrialization occur. The amount of environmental cleanup would be related to the intended future use, but potential new missions that complement existing site uses would be less likely to alter the existing land use. Land uses that require extensive unrestricted public access would not be compatible with this scenario. The key advantages of this model are that it allows flexibility for planned and future missions, provides a maximum safety buffer, and allows for research, natural resource management, biological diversity, and cultural resource management. An important prerequisite is DOE ownership of SRS land area into the foreseeable future. In selecting this model, SRS management has strengthened its commitment to the application of the future use policy guidelines and planning considerations. It should be noted that residential use would not be allowed, and site security and other institutional controls would be maintained in all zones (DOE 2000g).

SRS planners developed a zoned planning model specifically designed to address SRS's future land use circumstances, including concurrent, compatible land uses. Using this concept, SRS is divided into three principal planning zones: Site Industrial, Site Industrial Support, and General Support (see Figure 4.5.1.1–3). The most intensive uses occur in the Site Industrial Zone, located close to the site's center, to minimize the effect on surrounding communities, maintain controlled site access, and ensure the integrity of the established safety buffer. The Site Industrial Support and General Support Zones accommodate uses of decreasing intensity, particularly as they approach the site's boundaries. Each zone is restricted to the types of uses specified for that zone. Site reconfiguration would address consolidation and collocation of functions to improve efficiency and optimize security (DOE 2000g).



Source: Modified from DOE 2001d.

Figure 4.5.1.1–3. Savannah River Site Future Land Use Zoning Concentrates Industrial Activities to the Center of the Site

The reference location for MPF at SRS is located on a heavily wooded 32-ha (80-ac) tract immediately south of Road C near Burma Road. The site is flat and located on a topographic divide so surface drainage is both west toward Upper Three Runs and east toward Fourmile Branch streams. The reference location would be located on land categorized as Site Industrial (see Figure 4.5.1.1–3).

4.5.1.2 Visual Resources

The dominant aesthetic settings in the SRS vicinity are agricultural and forest, with limited industrial and residential areas. SRS is almost completely forested with 10 percent in use for nuclear processing purposes (i.e., industrial uses) (DOE 2000g). The industrial areas are primarily located in the interior of the site, away from public access. Because of the distance to the boundary from the industrialized areas, the gently rolling terrain, and heavy vegetation, SRS facilities are not generally visible from public access roads.

4.5.2 Site Infrastructure

An extensive network of existing infrastructure provides services to SRS activities and facilities as shown in Table 4.5.2–1. These services are discussed in detail in the following sections. Two categories of infrastructure—transportation access and utilities—are described below for SRS. Transportation access includes roads, railroads, and airports while utilities include electricity and fuel (e.g., natural gas, gasoline, and coal).

Table 4.5.2–1. Savannah River Site-Wide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	230	NA
Railroads (km)	103	NA
Electricity		
Energy consumption (MWh/yr)	370,000	4,400,000
Peak load (MWe)	70	330
Fuel		
Natural gas (m^3/yr)	0	NA
Oil (L/yr)	28,400,000	Not limited[a]
Coal (t/yr)	210,000	Not limited[a]

NA = Not applicable.
[a] Low supplies can be replenished by truck or rail.
Source: DOE 1999h, DOE 2000e.

4.5.2.1 Transportation

SRS has 230 km (140 mi) of roads to meet its intrasite transportation requirements. SRS also contains 103 km (64 mi) of railroad tracks that support large volume deliveries of coal and oversized structural components (DOE 2000g).

Aiken is part of the Augusta-Aiken, Georgia-South Carolina metropolitan area. Aiken Municipal Airport serves Aiken and Aiken County and is owned by the city of Aiken. Aiken Municipal Airport is about 8 km (5 mi) from Aiken and provides general aviation services. The nearest commercial airport is Augusta Regional Airport in Augusta, Georgia, approximately 56 km (35 mi) from Aiken. Augusta Regional Airport and Columbia Metropolitan Airport in Columbia, South Carolina, approximately 95 km (59 mi) from Aiken, receive jet air passenger and cargo service from both national and local carriers. There also are numerous smaller private airports located in Aiken and surrounding areas.

4.5.2.2 Electrical Power

SRS receives electrical power from South Carolina Electric and Gas Company via one 160-MVA and two 115-MVA capacity transmission lines. SRS is located in and draws its power from the Virginia-Carolina Subregion, an electric power pool area that is part of the Southeastern Electrical Reliability Council. The majority of the power from the Virginia-Carolina Subregion is generated from coal-fired and nuclear-powered generating plants (DOE 2000g).

Current site electricity consumption and site capacity are approximately 370,000 MWh/yr and 4.4 million MWh/yr, respectively. The peak load capacity for the entire site is 330 MWe with peak load usage at approximately 70 MWe (DOE 2000g).

4.5.2.3 Fuel

Coal and oil are used at SRS primarily to power steam plants. Coal is delivered by rail and is stored in piles in A-, D-, and H-areas. Oil is delivered by truck to the K-Area. Natural gas is not used at SRS (DOE 2000g).

4.5.3 Air Quality and Noise

4.5.3.1 Climate and Meteorology

The SRS region has a temperate climate with short, mild winters and long, humid summers. Throughout the year, the climate is frequently affected by warm, moist maritime air masses. The average annual temperature at SRS is 18.2°C (64.7°F). July is the warmest month of the year, with an average daily maximum of 33.3°C (92°F) and an average daily minimum near 22.2°C (72°F). January is the coldest month, with an average daily high around 13.3°C (56°F) and an average daily low of 2.2°C (36°F). Temperature extremes recorded at SRS since 1961 range from a minimum of -19.4°C (-3°F) in January 1985 to a maximum of 41.7°C (107°F) in July 1986.

Annual precipitation at SRS averages 125.7 cm (49.5 in) and is distributed fairly evenly throughout the year. Summer is the wettest season of the year with an average monthly rainfall of 13.2 cm (5.2 in). Autumn is the driest season with a monthly average rainfall of 8.4 cm (3.3 in). Relative humidity averages 70 percent annually, with an average daily maximum of 91 percent and an average daily minimum of 45 percent. An average of 54 thunderstorm days per year were recorded by the National Weather Service in Augusta, Georgia, between 1950 and 1996. About half of the annual thunderstorms occurred during the summer.

The observed wind at SRS indicates no prevailing wind direction, which is typical for the lower Midlands of South Carolina. According to wind data collected from 1992-1996, winds are most frequently from the northeast sector (9.7 percent) followed by winds from the north-northeast sector (9.4 percent). The average annual wind speed at the Augusta National Weather Service Station is 2.9 m/s (6.5 mph). Measurements of air turbulence are used to determine whether the atmosphere has relatively high, moderate, or low potential to disperse airborne pollutants (commonly identified as unstable, neutral, or stable atmospheric conditions, respectively). Generally, SRS atmospheric conditions were categorized as unstable 56 percent of the time (DOE 2001d).

Since operations began at SRS, 10 confirmed tornadoes have occurred on or in close proximity to the site. Several of these tornadoes, one of which was estimated to have winds up to 241 km/hr (150 mph) did considerable damage to forested areas of SRS. None caused damage to structures. Tornado statistics indicate that the average frequency of a low intensity tornado striking SRS is 2×10^{-4} times per year or about once every 5,000 years (WSRC 1998). A tornado of this frequency would have a maximum wind speed (3-second gust) of 72 km/hr (soft return) (45 mph). Similarly, a tornado with a maximum wind speed of 193 km/hr (120 mph) would occur approximately once every 25,000 years. The highest sustained wind recorded by the Augusta National Weather Service Station is 132 km/hr (82 mph). Hurricanes struck South Carolina 36 times from 1700-1992, which equates to an average recurrence frequency of once every 8 years. A hurricane-force wind of 119 km/hr (74 mph) or greater has been observed at SRS only once, during Hurricane Gracie in 1959 (DOE 2001d).

4.5.3.2 Nonradiological Releases

SRS operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. SRS is located near the center of the Augusta-Aiken Interstate AQCR. The area encompassing SRS and its surrounding counties is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) (40 CFR 81.311 and 81.341). No PSD Class I areas exist within 100 km (62 mi) of SRS. None of the facilities at SRS have been required to obtain a PSD permit (DOE 2001d).

Significant sources of criteria and toxic air pollutants at SRS include coal-fired boilers for power and steam production, diesel generators, chemical storage tanks, Defense Waste Processing Facilities (DWPF), groundwater air strippers, and various other process facilities. Another source of criteria pollutant emissions at SRS is the prescribed burning of forested areas across the site by the U.S. Forest Service. Table 4.5.3.2–1 shows the actual atmospheric emissions from all SRS sources in 2000.

Prior to 1991, ambient monitoring of sulfur dioxide, nitrogen dioxide, TSP, carbon monoxide, and ozone was conducted at five sites across SRS. Because there is no regulatory requirement to conduct air quality monitoring at SRS, all of these stations have been decommissioned. Ambient air quality data collected during 1997 from monitoring stations operated by the South Carolina Department of Health and Environmental Control (SCDHEC) in Aiken County and Barnwell County, South Carolina, are summarized in Table 4.5.3.2–2. These data indicate that ambient concentrations of the measured criteria pollutants are generally much less than the standard.

Table 4.5.3.2–1. SRS Criteria Pollutant Air Emissions in 2000

Pollutant	SRS Emissions [a] (metric tons per year)
Carbon monoxide	2.66×10^{3}
Nitrogen dioxide	3.51×10^{2}
Sulfur dioxide	4.83×10^{2}
PM_{10}	1.49×10^{2}
Total Suspended Particulates	3.72×10^{2}
Lead	1.30×10^{-1}
VOC	1.44×10^{2}
Gaseous fluorides (as hydrogen fluoride)	1.23×10^{-1}

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
VOC = Volatile organic compounds. VOC are ozone precursors.
[a] From all SRS sources (permitted and non-permitted).
Source: WSRC 2001.

Table 4.5.3.2–2. SCDHEC Ambient Air Monitoring Data for 2001

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Ambient Concentration (micrograms per m^3)
Carbon monoxide	8-hour	10,000	6,800
	1-hour	40,000	10,100
Nitrogen dioxide	Annual	73.7	9
Sulfur dioxide	Annual	80	4
	24-hour	365	18
	3-hour	1,300	50
PM_{10}	Annual	50	19
	24-hour	150	41
Lead	Quarterly	1.5	0.03
Total suspended particulates	Annual	75	28
Ozone	1-hour	235	220

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
Source: SCDHEC 2002.

SCDHEC also requires dispersion modeling as a means of evaluating local air quality. Periodically, all permitted sources of regulated air emissions at SRS must be modeled to determine estimates of ambient air pollution concentrations at the SRS boundary. The results are used to demonstrate compliance with ambient standards and to define a baseline from which to assess the impacts of any new or modified sources.

Table 4.5.3.2–3 provides a summary of the most recent regulatory compliance modeling for SRS emissions. These calculations were performed with EPA's Industrial Source Complex air dispersion model and site-wide maximum potential emissions data. Model estimates of ambient SRS boundary concentrations for all air pollutants emitted at SRS are less than their respective ambient standards.

Table 4.5.3.2–3. Nonradiological Ambient Air Concentrations from SRS Sources, 2001

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Ambient Concentration (micrograms per m^3)
Carbon monoxide	8-hour	10,000	263
	1-hour	40,000	67
Nitrogen dioxide	Annual	100	17
Sulfur dioxide	Annual	80	27
	24-hour	365	337
	3-hour	1,300	1,171
Ozone	1-hour	235	NA
PM_{10}	Annual	50	7
	24-hour	150	97
Total suspended particulates	Annual	75	46.6

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
NA = Not available.
[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period.
Source: Gordon 2001.

4.5.3.3 Radiological Releases

In the SRS region, airborne radionuclides originate from natural sources (i.e., terrestrial and cosmic), worldwide fallout, and SRS operations. DOE maintains a network of 23 air sampling stations on and around SRS to determine concentrations of radioactive particulates and aerosols in the air. DOE provides detailed summaries of radiological releases to the atmosphere from SRS operations, along with resulting concentrations and doses, in a series of annual environmental data reports. Table 4.5.3.3–1 lists 2001 radionuclide releases from each major operational group of SRS facilities. All radiological impacts are within regulatory requirements.

Table 4.5.3.3–1. Radionuclide Releases from SRS Facilities, 2001

Nuclide	Reactors (ci/yr)	Separations (ci/yr)	Reactor Materials (ci/yr)	SRTC (ci/yr)	Diffuse & Fugitive (ci/yr)	Total (ci/yr)
Gases and Vapors						
Tritium	2.41×10^{3}	4.44×10^{4}			6.07×10^{2}	4.74×10^{4}
Carbon-14		1.70×10^{-1}			8.76×10^{-5}	1.7×10^{-1}
Krypton-85		6.47×10^{4}				6.47×10^{4}
Xenon-133		4.82×10^{-6}				4.82×10^{-6}
Xenon-135		7.57×10^{-2}				7.57×10^{-2}
Iodine-129		1.29×10^{-2}			1.29×10^{-6}	1.29×10^{-2}
Iodine-131		2.05×10^{-6}		6.13×10^{-6}		8.18×10^{-6}
Iodine-133				4.26×10^{-4}		4.26×10^{-4}
Particulates						
Actinium-228					4.07×10^{-6}	4.07×10^{-6}
Americium-241		1.52×10^{-4}	5.72×10^{-9}		1.15×10^{-4}	2.67×10^{-4}
Americium-243					9.90×10^{-7}	9.90×10^{-7}
Antimony-124					8.09×10^{-9}	8.09×10^{-9}

Table 4.5.3.3–1. Radionuclide Releases from SRS Facilities, 2001 *(continued)*

Nuclide	Reactors (ci/yr)	Separations (ci/yr)	Reactor Materials (ci/yr)	SRTC (ci/yr)	Diffuse & Fugitive (ci/yr)	Total (ci/yr)
Particulates *(continued)*						
Antimony-125					5.37×10^{-5}	5.37×10^{-5}
Bismuth-214					1.29×10^{-6}	1.29×10^{-6}
Cerium-141					4.16×10^{-5}	4.16×10^{-5}
Cerium-144					1.43×10^{-4}	1.43×10^{-4}
Curium-242					1.43×10^{-8}	1.43×10^{-8}
Curium-244		3.9×10^{-6}	2.23×10^{-9}		4.76×10^{-5}	5.15×10^{-5}
Curium-245					4.18×10^{-7}	4.18×10^{-7}
Curium-246					1.01×10^{-6}	1.01×10^{-6}
Cobalt-58					1.27×10^{-4}	1.27×10^{-4}
Cobalt-60		4.4×10^{-8}		3.25×10^{-7}	8.59×10^{-4}	8.59×10^{-4}
Chromium-51					1.21×10^{-4}	1.21×10^{-4}
Cesium-134		1.94×10^{-8}			1.31×10^{-4}	1.31×10^{-4}
Cesium-137		1.18×10^{-3}			2.22×10^{-3}	3.40×10^{-3}
Europium-152					4.15×10^{-5}	4.15×10^{-5}
Europium-154					1.53×10^{-5}	1.53×10^{-5}
Europium-155					7.85×10^{-7}	7.85×10^{-7}
Mercury-203					2.29×10^{-10}	2.29×10^{-10}
Manganese-54					2.52×10^{-8}	2.52×10^{-8}
Sodium-22					2.09×10^{-8}	2.09×10^{-8}
Niobium-94					4.56×10^{-8}	4.56×10^{-8}
Niobium-95					1.13×10^{-4}	1.13×10^{-4}
Nickel-63					4.38×10^{-6}	4.38×10^{-6}
Neptunium-237					1.09×10^{-8}	1.09×10^{-8}
Neptunium-239					1.24×10^{-7}	1.24×10^{-7}
Protactinium-233					2.29×10^{-10}	2.29×10^{-10}
Protactinium -234					1.76×10^{-8}	1.76×10^{-8}
Lead-212					2.74×10^{-6}	2.74×10^{-6}
Lead-214					6.58×10^{-7}	6.58×10^{-7}
Plutonium-147					1.34×10^{-5}	1.34×10^{-5}
Plutonium -236					1.22×10^{-10}	1.22×10^{-10}
Plutonium -238		9.15×10^{-5}	3.67×10^{-9}		3.99×10^{-5}	1.31×10^{-4}
Plutonium -239		2.62×10^{-4}	1.37×10^{-8}		1.94×10^{-3}	2.20×10^{-3}
Plutonium -240					8.51×10^{-7}	8.51×10^{-7}
Plutonium -241					6.70×10^{-6}	6.70×10^{-6}
Plutonium -242					2.09×10^{-8}	2.09×10^{-8}
Radium-226					5.25×10^{-6}	5.25×10^{-6}
Radium-228					4.16×10^{-6}	4.16×10^{-6}
Ruthenium-103					4.23×10^{-5}	4.23×10^{-5}
Ruthenium-106					9.92×10^{-7}	9.92×10^{-7}

Table 4.5.3.3–1. Radionuclide Releases from SRS Facilities, 2001 *(continued)*

Nuclide	Reactors (ci/yr)	Separations (ci/yr)	Reactor Materials (ci/yr)	SRTC (ci/yr)	Diffuse & Fugitive (ci/yr)	Total (ci/yr)
Particulates *(continued)*						
Selenium-79					4.58×10^{-9}	4.58×10^{-9}
Tin-126					1.69×10^{-7}	1.69×10^{-7}
Strontium-89					3.34×10^{-7}	3.34×10^{-7}
Strontium-90		1.42×10^{-4}			3.57×10^{-3}	3.71×10^{-3}
Technetium-99					1.89×10^{-6}	1.89×10^{-6}
Thorium-228					3.97×10^{-6}	3.97×10^{-6}
Thorium -230					2.71×10^{-6}	2.71×10^{-6}
Thorium -232					1.75×10^{-6}	1.75×10^{-6}
Thorium -234					1.03×10^{-4}	1.03×10^{-4}
Thalium-208					2.58×10^{-6}	2.58×10^{-6}
Uranium-232					4.46×10^{-11}	4.46×10^{-11}
Uranium-233					3.90×10^{-8}	3.90×10^{-8}
Uranium-234		3.85×10^{-5}	3.43×10^{-6}		2.84×10^{-4}	3.26×10^{-4}
Uranium-235		3.91×10^{-6}	5.16×10^{-7}		6.59×10^{-6}	1.10×10^{-5}
Uranium-236					7.17×10^{-10}	7.17×10^{-10}
Uranium-238		9.33×10^{-5}	4.93×10^{-7}		3.18×10^{-4}	4.12×10^{-4}
Zinc-65					2.23×10^{-5}	2.23×10^{-5}
Zirconium-95					1.68×10^{-5}	1.68×10^{-5}
Alpha	5.49×10^{-5}	3.69×10^{-5}		1.49×10^{-8}	1.33×10^{-3}	1.42×10^{-3}
Beta-Gamma	3.81×10^{-4}	1.70×10^{-4}	1.10×10^{-5}		3.22×10^{-2}	3.28×10^{-2}
Total	**2.41×10^{3}**	**1.09×10^{5}**	**1.55×10^{-5}**	**4.32×10^{-4}**	**6.07×10^{2}**	**1.12×10^{5}**

Source: WSRC 2002h.

4.5.3.4 Noise

Major noise sources at SRS are primarily in developed or active areas and 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). Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations.

Existing SRS-related noise sources of importance to the public are those related to transportation of people and materials to and from the site, including trucks, private vehicles, helicopters, and trains. Another important contributor to noise levels is traffic to and from SRS operations along access highways through the nearby towns of New Ellenton, Jackson, and Aiken. Noise measurements recorded during 1989 and 1990 along State Route 125 in the town of Jackson at a point about 15 m (50 ft) from the roadway indicate that the 1-hour equivalent sound level from traffic ranged from 48 to 72 dBA. The estimated day-night average sound levels along this route were 66 dBA for summer and 69 dBA for winter. Similarly, noise measurements along State Route 19 in the town of New Ellenton at a point about 15 m (50 ft) from the roadway indicate that the 1-hour equivalent sound level from traffic ranged from 53-71 dBA. The estimated average day-night average sound levels along this route were 68 dBA for summer and 67 dBA for winter.

Most industrial facilities at SRS are far enough from the site boundary that noise levels from these sources at the boundary would not be measurable or would be barely distinguishable from background levels. The States of Georgia and South Carolina, and the counties in which SRS is located, have not established any noise regulations that specify acceptable community noise levels, with the exception of a provision in the Aiken County Zoning and Development Standards Ordinance that limits daytime and nighttime noise by frequency band (DOE 2001d).

The 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). It is expected that for most residences near SRS, the day-night average sound level is less than 65 dBA and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

4.5.4 Water Resources

4.5.4.1 Surface Water

The Savannah River bounds SRS on its southwestern border for about 32 km (20 mi), approximately 257 river km (160 river mi) from the Atlantic Ocean. Five upstream reservoirs—Jocassee, Keowee, Hartwell, Richard B. Russell, and Strom Thurmond Clarks Hill—reduce the variability of flow downstream in the area of SRS. River flow averages about 283 m^3/s (10,000 ft^3/s) at SRS (DOE 2002f).

Upstream of SRS, the Savannah River supplies domestic and industrial water for Augusta, Georgia, and North Augusta, South Carolina. Approximately 209 river km (130 river mi) downstream of SRS, the river supplies domestic and industrial water for Savannah, Georgia, and Beaufort and Jasper Counties in South Carolina through intakes at about River Mile 29 and River Mile 39, respectively (DOE 2002f).

Figure 4.5.1.1–2 in Section 4.5.1 shows the surface water features at SRS. There are two lakes or ponds on SRS: L-Lake and Par Pond. Five tributaries discharge directly to the Savannah River from SRS: Upper Three Runs, Beaver Dam Creek, Fourmile Branch, Steel Creek, and Lower Three Runs. A sixth stream, Pen Branch, which does not flow directly into the river, joins Steel Creek in the Savannah River floodplain swamp. Each of the six streams originates on the Aiken Plateau in the Coastal Plain and descends 15-60 m (50-200 ft) before discharging into the river (DOE 2002f). The streams, which historically have received varying amounts of effluent from SRS operations, are not commercial sources of water.

Water has been withdrawn from the Savannah River for use mainly as cooling water; some, however, has been used for domestic purposes. Most of the water that is withdrawn is returned to the river through discharges to various tributaries (DOE 2002f).

Upper Three Runs, the longest of the SRS streams, is a large blackwater stream that discharges to the Savannah River. It drains an area of over 505 km^2 (195 mi^2) and is approximately 40 km (25 mi) long, with its lower 27 km (17 mi) within SRS. It is the only major stream on SRS that has not received thermal discharges (DOE 2002f).

Fourmile Branch is a blackwater stream that originates near the center of SRS and flows southwest for 24 km (15 mi) before emptying into the Savannah River (DOE 2002f). It drains an area of about 57 km^2 (22 mi^2) inside SRS, including much of F-, H-, and C-areas. Fourmile Branch flows parallel to the Savannah River behind natural levees and enters the river through a breach downriver from Beaver Dam Creek. In its lower reaches, Fourmile Branch broadens and flows via braided channels through a delta.

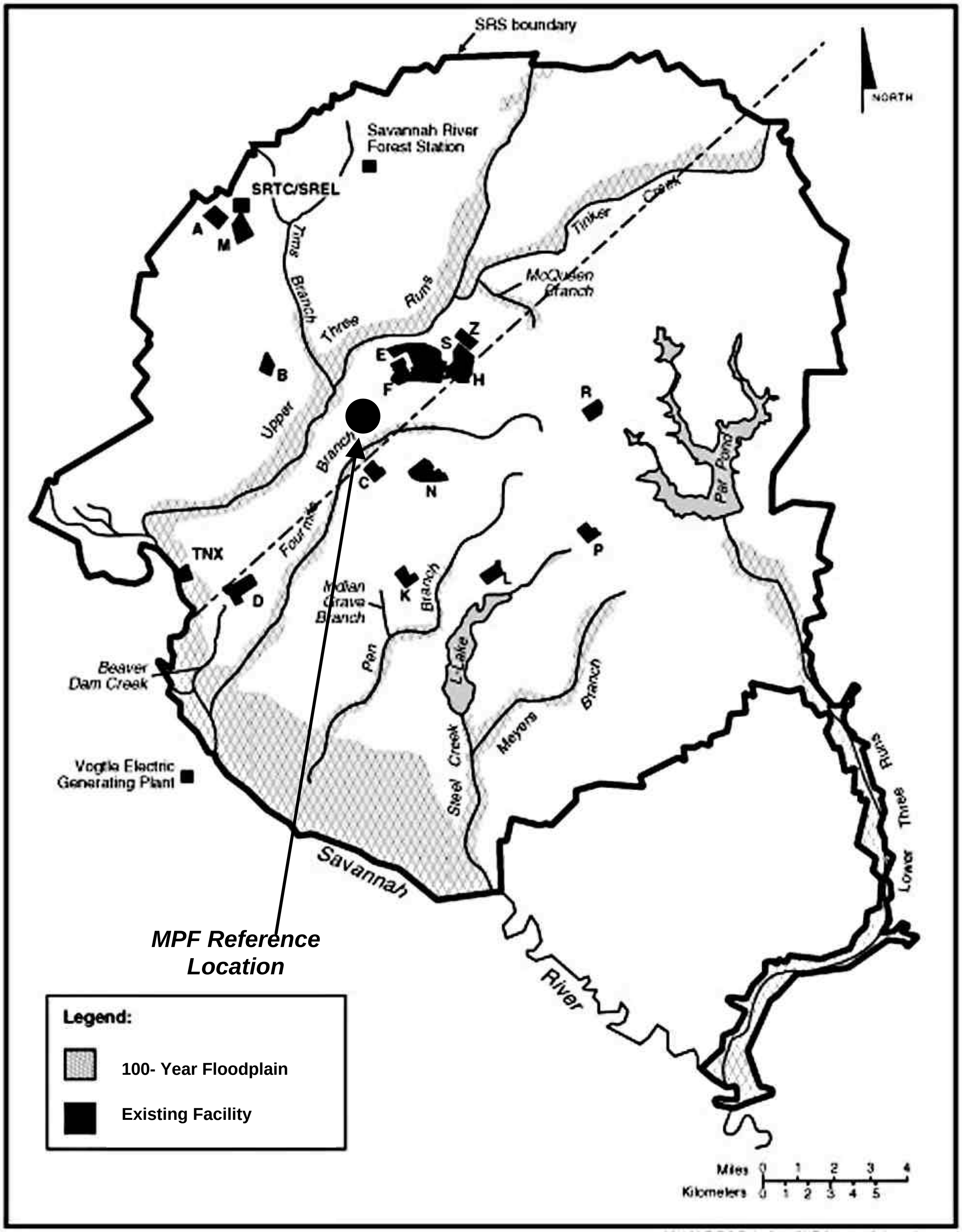
Downstream of the delta, the channels rejoin into one common channel. Most of the flow discharges into the Savannah River, while a small portion flows west and enters Beaver Dam Creek (DOE 2002f).

The natural flow of SRS streams ranges from about 0.3 m^3/s (0.39 yd^3/s) in smaller streams to 7 m^3/s (9 yd^3/s) in Upper Three Runs. From 1974-1995, the mean flow of Upper Three Runs at Road A was 7 m^3/s (9 yd^3/s), and the 7Q10 (minimum 7-day average flow that occurs with an average frequency of once in 10 years) was 3 m^3/s (4 yd^3/s) (DOE 2002l). The mean flow of Fourmile Branch southwest of South Carolina State Highway (S.C.) 125 from 1976-1995 was 3 m^3/s (4 yd^3/s) and the 7Q10 was 0.2 m^3/s (0.26 yd^3/s) (DOE 2002f).

The 100-year floodplain is shown on Figure 4.5.4.1–1. Site-wide information concerning 500-year floodplains at SRS is not available. Based on review of the U.S. Geological Survey topographic map (New Ellenton SW quad), the elevation of the reference location is approximately 73 m (240 ft) above mean sea level. Upper Three Runs lies approximately 1.6 km (1 mi) to the west of the reference location at an elevation of approximately 35 m (115 ft) above mean sea level. Fourmile Branch lies approximately 0.6 km (0.4 mi) southeast of the reference location at an elevation of approximately 53 m (175 ft) above mean sea level. No federally designated Wild and Scenic Rivers occur within the site (DOE 2002f).

Surface Water Quality

The SCDHEC regulates the physical properties and concentrations of chemicals and metals in SRS effluents under the NPDES program. SCDHEC, which also regulates water quality standards for SRS waters, has classified the Savannah River and SRS streams as "Freshwater." In 1998, 99.3 percent of the NPDES water quality analysis on SRS effluents were in compliance with the SRS NPDES permit; only 42 of 5,790 analyses exceeded permit limits (DOE 2002f).



Source: DOE 2000c.

Figure 4.5.4.1–1. 100-Year Flood Plain on the Savannah River Site

In 2001, SRS discharged water into site streams and the Savannah River under three NPDES permits. In 2001, 28 of the 31 outfalls permitted were used for discharge. Results from 24 of the 5,386 sample analyses performed during the year exceeded permit limits. A list of 2001 NPDES exeedances appears in Table 4.5.4.1–1. The toxicity failures of A-11 and G-10 outfalls are believed to be caused by the softness of the effluent.

Table 4.5.4.1–1. 2001 Exceedances of NPDES Permit Liquid Discharge Limits

Outfall	Date	Parameter Exceeded	Results	Possible Causes	Corrective Action
K-06	Jan. 24	pH	8.7 SU	High-pH Boiler discharge	Coordinate discharge with cooling water
K-06	Jan. 25	pH	8.8 SU	High-pH boiler discharge	Coordinate discharge with cooling water
A-01	Oct. 8	C-TOX	Fail	Unknown	Under Investigation
A-01	Nov. 5	C-TOX	Fail	Unknown	Under Investigation
A-11	Jan. 8	C-TOX	Fail	Unknown	Under Investigation
A-11	Feb. 12	C-TOX	Fail	Unknown	Under Investigation
A-11	March 5	C-TOX	Fail	Unknown	Under Investigation
A-11	April 16	C-TOX	Fail	Unknown	Under Investigation
A-11	May 7	C-TOX	Fail	Unknown	Under Investigation
A-11	June 6	C-TOX	Fail	Unknown	Under Investigation
A-11	July 26	C-TOX	Fail	Unknown	Under Investigation
A-11	Aug. 7	C-TOX	Fail	Unknown	Under Investigation
A-11	Sept. 14	C-TOX	Fail	Unknown	Under Investigation
A-11	Oct. 8	C-TOX	Fail	Unknown	Under Investigation
A-11	Nov. 5	C-TOX	Fail	Unknown	Under Investigation
A-11	Dec. 4	C-TOX	Fail	Unknown	Under Investigation
X-08	Jan. 25	TSS	43 mg/L	S-8B system work led to detritus discharge	Conduct work in no-discharge mode
G-10	April 30	C-TOX	Fail	Unknown	Under Investigation
G-10	May 20	C-TOX	Fail	Unknown	Under Investigation
G-10	Nov. 26	C-TOX	Fail	Unknown	Under Investigation
G-10	Aug. 11	C-TOX	Fail	Unknown	Under Investigation
G-10	Aug. 12	C-TOX	Fail	Unknown	Under Investigation
H-16	Sept. 4	Frequency of BOD analysis	3 of 30 reported; 4 of 30 required	Subcontract lab missed hold time	Lab revised procedures/responsibilities

BOD = Biochemical oxygen demand.
C-TOX = Chronic toxicity.
SU = Standard unit.
TSS = Total suspended solids.
Source: WSRC 2002h.

Liquid effluents are sampled continuously by automatic samples at or very near their points of discharge to the receiving streams. The SRS liquid radioactive releases for 2001 are shown in Table 4.5.4.1–2.

Table 4.5.4.1–2. Annual Radioactive Liquid Releases by Source for 2001 (Including Direct and Seepage Basin Migration Releases)

Radionuclides	Reactors (Ci)	Separations[a] (Ci)	Reactor Materials (Ci)	SRTC (Ci)	Total (Ci)	MCL or DCG (pCi/L)
Hydrogen-3	$1.28x10^{3}$	$3.03x10^{3}$	—	$7.94x10^{-1}$	$4.32x10^{3}$	2,000,000
Strotium-90	$5.92x10^{-5}$	$2.04x10^{-2}$	—	—	$2.05x10^{-2}$	1,000
Technetium-99	—	$4.56x10^{-2}$	—	—	$4.56x10^{-2}$	100,000
Iodine-129	—	$7.82x10^{-2}$	—	—	$7.82x10^{-2}$	500
Cesium-137	$2.25x10^{-2}$	$5.80x10^{-2}$	—	—	$8.05x10^{-2}$	3,000
Uranium-234	—	$2.09x10^{-5}$	$3.10x10^{-5}$	$4.28x10^{-5}$	$9.47x10^{-5}$	500
Uranium-235	—	$9.05x10^{-7}$	—	$7.92x10^{-7}$	$1.70x10^{-6}$	600
Uranium-238	—	$3.97x10^{-5}$	$2.85x10^{-5}$	$2.92x10^{-6}$	$4.50x10^{-5}$	600
Plutonium-238	—	$1.36x10^{-5}$	$2.85x10^{-5}$	—	$7.43x10^{-6}$	40
Plutonium-239	—	$5.12x10^{-6}$	$2.31x10^{-6}$	—	$7.43x10^{-6}$	30
Americium-241	—	$1.35x10^{-6}$	$5.72x10^{-6}$	—	$7.09x10^{-6}$	NS
Curium-244	—	$1.22x10^{-6}$	$5.87x10^{-6}$	—	7.09x10-6	
Alpha	$3.26x10^{-3}$	$1.98x10^{-2}$	$2.59x10^{-3}$	$3.09x10^{-3}$	$2.87x10^{-2}$	15
Beta-Gamma	$2.56x10^{-2}$	$5.63x10^{-2}$	$1.73x10^{-4}$	$3.05x10^{-3}$	$8.51x10^{-2}$	4 mrem/yr

"—" Indicates no quantifiable activity
pCi/L = picocuries/Liter
SRTC = Savannah River Technology Center.
TNX = a technology development facility adjacent to the Savannah River.
NS = No standard.
[a] Includes separations, waste management, and tritium facilities.
Source: WSRC 2002h.

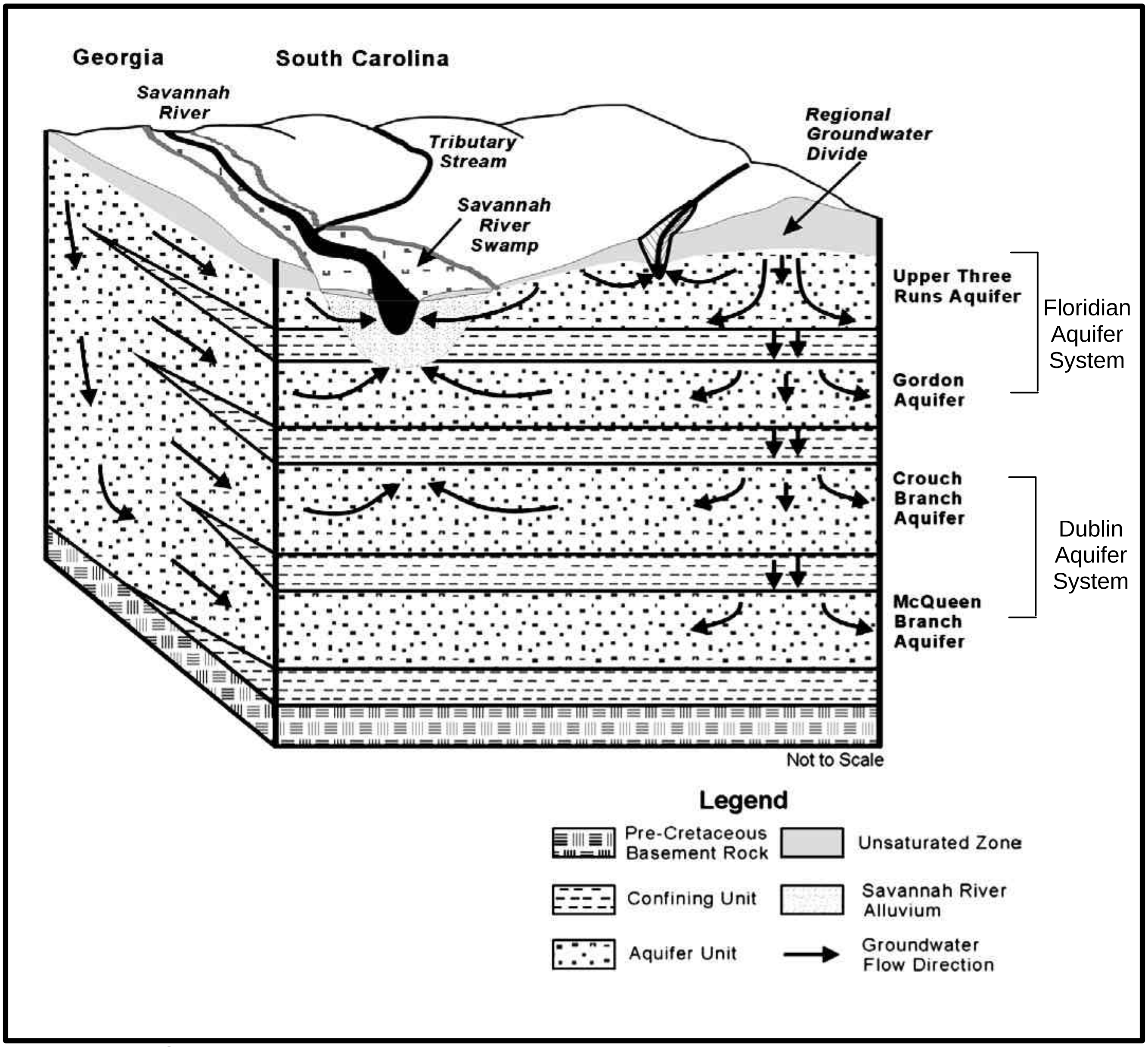
Each SRS stream receives treated wastewater and stormwater from site facilities. Stream locations are sampled for water quality on monthly and quarterly frequencies (WSRC 2002h). Nitrate levels for the majority of river and stream locations ranged below 0.5 mg/L, which is below the legal EPA MCL of 10 mg/L. Average phosphate levels were typically higher in the Savannah River than in onsite streams. River levels ranged from an average of 0.0105 mg/L to 0.151 mg/L, below the EPA MCL of 5.0 mg/L. Total suspended solids averaged lower onsite than in the river, with the average ranging from 2.5 mg/L to 6.5 mg/L. There is no EPA MCL established for total suspended solids. Aluminum, cadmium, chromium, copper, iron, manganese, nickel, and zinc were all detected in surface waters at all river and stream locations. Mercury was detected above the PQL in the Savannah River and in onsite streams. Levels ranged from 0.05 mg/L to below the PQL of 0.0005 mg/L. One pesticide, Beta BHC, was found in 2001 near the quantitation limit of 0.050 µg/L, but no herbicides were detected during 2001 (WSRC 2002h).

4.5.4.2 Groundwater

In the SRS region, the subsurface contains two hydrogeologic provinces. The uppermost, consisting of a wedge of unconsolidated Coastal Plain sediments of Late Cretaceous and Tertiary age, is the Atlantic Coastal Plain Hydrogeologic Province. Beneath the sediments of the Atlantic Coastal Plain Hydrogeologic Province are rocks of the Piedmont Hydrogeologic Province. These rocks consist of Paleozoic igneous and metamorphic basement rocks and lithified mudstone, sandstone, and conglomerates of the Dunbarton basin of the Upper Triassic. Sediments of the Atlantic Coastal Plain Hydrogeologic Province are divided into two main aquifer systems, the Floridan Aquifer System, and the Dublin Aquifer System. These systems are separated from one another by the Meyers Branch Confining System.

Groundwater within the Floridan Aquifer System (the shallow aquifer beneath SRS) flows slowly toward SRS streams and swamps and into the Savannah River at rates ranging from inches to several hundred feet per year. The Floridan Aquifer System is divided into the overlying Upper Three Runs Aquifer and the underlying Gordon Aquifer. The depth to which onsite streams cut into sediments, the lithology of the sediments, and the orientation of the sediment formations control the horizontal and vertical movement of the groundwater. The valleys of smaller perennial streams allow discharge from the shallow saturated geologic formations. The valleys of major tributaries of the Savannah River (e.g., Upper Three Runs) drain formations of intermediate depth, and the river valley drains deep formations. With the release of water to the streams, the hydraulic head (i.e., pressure) of the aquifer unit releasing the water can become less than that of the underlying unit. If this occurs, groundwater has the potential to migrate upward from the lower unit to the overlying unit.

Groundwater flow in the shallow aquifer (Floridan) system is generally horizontal, but may have a vertically downward component. In the regional groundwater divide (areas between surface water drainages), the vertical component of groundwater flow is downward. In areas along the lower reaches of most of the site streams, groundwater moves generally in a horizontal direction and has vertically upward potential from deeper aquifers to the shallow aquifers. In the vicinity of these streams, the potential for vertically upward flow occurs across a confining unit where the underlying aquifer has not been incised by an overlying stream (DOE 2002f). For example, in the area south of H-Area where Fourmile Branch cuts into the Upper Three Runs Aquifer, but does not cut into the Gordon Aquifer, the Gordon Aquifer discharges into the Fourmile Branch because of its greater hydraulic head. At these locations, any contaminants in the overlying aquifer system are prevented from migrating into deeper aquifers by the greater hydraulic head in the underlying aquifer system as well as the low permeability of the confining unit. Groundwater flow in the General Separations Area, which includes F- and H-areas, is toward Upper Three Runs and its tributaries to the north and Fourmile Branch to the south. Figure 4.5.4.2–1 illustrates the aquifer systems beneath SRS.



Source: WSRC 2002h.

Figure 4.5.4.2–1. Groundwater at the Savannah River Site

Groundwater is the source of domestic, municipal, and industrial water throughout the Upper Coastal Plain. Regional domestic water supplies come primarily from the shallow aquifers, including the Gordon Aquifer and the Upper Three Runs Aquifer (water-table aquifer). Most municipal and industrial water supplies in Aiken County are from the Crouch Branch and McQueen Branch Aquifers. In Barnwell and Allendale Counties, some municipal water supplies are from the Gordon Aquifer and overlying units that thicken to the southeast. SRS derives its own drinking and production water supply from groundwater from the Crouch Branch and McQueen Branch Aquifers. SRS ranks as South Carolina's largest self-supplied industrial consumer of groundwater, utilizing approximately 20 million L (5.3 million gal) per day. SRS domestic and process water systems are supplied from a network of approximately 40 groundwater wells in widely scattered locations across the site. Treated well water is supplied to the larger site facilities by the A-Area, D-Area, and K-Area domestic water systems. The wells range in capacity from 757-5,678 L/min (200-1,500 gal/min) and supply an average of 4.1 million L/day (1.1 million gal/day) of domestic water to customers in the area. The central domestic water system has an estimated excess capacity of 1,680 L/min (444 gal/min), which could be increased by installing an additional elevated storage tank (DOE 2000e).

Groundwater rights in South Carolina are traditionally associated with the absolute ownership rule. The owners of land overlying a groundwater resource are allowed to withdraw from their wells all the water they wish for whatever purpose they desire. However, the South Carolina *Surface Water Withdrawal and Reporting Act* (Title 49, Waters, Water Resources and Drainage, Chapter 4) requires that all users of 379,000 L (100,000 gal) or more per day (136 million L/yr [35.9 million gal/yr]) of water to report their withdrawal rates to the South Carolina Water Resource Commission. SRS exceeds this amount of groundwater use and must report its withdrawal rates to the commission.

Groundwater Quality

Monitoring wells are extensively used at SRS to assess the effect of site activities on groundwater quality. Most of the wells monitor the upper groundwater zone, although wells in lower zones are present at the sites with the larger groundwater contamination plumes. The SRS groundwater program was audited in 2000 and 2001 by both DOE and the Westinghouse Savannah River Company (WSRC), the management and operations contractor at SRS. Findings of these assessments resulted in the early revision of the site Groundwater Protection Management Program Plan to codify improvements to the program (WSRC 2002h). A summary of groundwater contamination by area and its corrective actions is listed in Table 4.5.4.2–1.

Table 4.5.4.2–1. Summary of Groundwater Monitoring in 2001

Area	Contamination	Corrective Action
A-Area and M-Area	VOC, particularly trichloroethylene and tetrachloroethylene	Dynamic underground stripping technology (DUS)
C-Area	Tritium and trichloroethylene	
D-Area	VOC, particularly trichloroethylene	Phytoremediation system being tested for treatment of groundwater contaminated with trichloroethylene
TNX-Area	Radionuclides, heavy metals, VOC	Geosiphon wells
General Separation and Waste Management Areas	Tritium, metals, other radionulcides, VOCs	Complex groundwater cleanup system in operation
K-Area	Trichloroethylene, tetrachloroethylene and tritium	Investigation under RCRA/CERCLA
L-Area and Chemicals, Metals, and Pesticides Pits	L-Area- burning/rubble pit, carbon tetrachloride Trichloroethylene, tetrachloroethylene and tritium	Groundwater modeling begins in fiscal year 2002
N-Area	Organic compounds, heavy metals	Effort under way to administratively create new groundwater operable unit in this area
P-Area	Tritium and trichloroethylene plumes	No site specific groundwater modeling document available yet in this area
R-Area	Tritium, strontium-90, tetrachloroethylene, and trichloroethylene	Vadose zone modeling and flow and transport modeling in progress
Sanitary Landfill	General wastes, low concentrations of VOC, tritium, metals, and other radionuclides	RCRA-style cap installed over the main and southern expansion sections, biosparging system

Source: WSRC 2002h.

4.5.5 Geology and Soils

4.5.5.1 Geology

SRS is located in west-central South Carolina, approximately 161 km (100 mi) from the Atlantic Coast (Figure 4.5.1.1–1). It is on the Aiken Plateau of the Upper Atlantic Coastal Plain, about 40 km (25 mi) southeast of the Fall Line that separates the Atlantic Coastal Plain from the Piedmont.

The Aiken Plateau, the subdivision of the Coastal Plain that includes SRS, is highly dissected and characterized by broad, flat areas between streams and narrow, steep-sided valleys. It slopes from an elevation of approximately 200 m (650 ft) at the Fall Line to an elevation of about 75 m (250 ft) on the southeast edge of the plateau.

The sediments of the Atlantic Coastal Plain dip gently seaward from the Fall Line thickening from essentially 0 m (0 ft) thick at the Fall Line to more than 1,219 m (4,000 ft) at the coast. At SRS, the plateau is underlain by 150-420 m (500-1,400 ft) of sands, clays, and limestones of

Tertiary and Cretaceous age. These sediments are underlain, in turn, by sandstones of Triassic age and older metamorphic and igneous rocks (Arnett and Mamatey 1996).

Because of the proximity of SRS to the Piedmont Province, it has more relief than areas that are nearer the coast, with onsite elevations ranging from 27-128 m (89-420 ft) above mean sea level.

Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of the ground and infrastructure at SRS and includes potential volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

Volcanism

There is no geologic evidence of volcanism in the region.

Seismic Activity

Identification of faults is important because earthquakes can occur along these faults. Several fault systems occur offsite, northwest of the Fall Line. The most active seismic zones in the southeastern United States are all located over 160 km (100 mi) away from the site. The *Final Environmental Impact Statement for the Continued Operation of K, L and P Reactors at SRS* contains a detailed discussion of these offsite geologic features (DOE 1990). Faults identified onsite include the Pen Branch, Steel Creek, Advanced Tactical Training Area, Crackerneck, Ellenton, and Upper Three Runs. The Upper Three Runs Fault, which passes approximately 1.6 km (1 mi) northwest of F-Area, is a Paleozoic fault that does not cut Coast Plain sediments (DOE 2002f). The *Environmental Impact Statement Accelerator Production of Tritium at the Savannah River Site* (DOE 1997c) contains information on SRS fault location and earthquake occurrences. A study of geophysical evidence (Wike, Moore-Shedrow, and Shedrow 1996) identified an unnamed fault just south of the MPF reference location. The lines shown on Figure 4.5.5.1–1 represent the projection of the faults to the ground surface. The actual faults do not reach the surface, but rather stop several hundred feet below.

Based on information developed to date, none of the faults discussed in this section are considered “capable,” as defined by the Nuclear Regulatory Commission in 10 CFR 100.23. The capability of a fault is determined by several criteria, one of which is whether the fault has moved at or near the ground surface within the past 35,000 years.

Earthquakes of large magnitude may cause considerable damage to structures and underground pipes. Two major earthquakes have occurred within 300 km (186 mi) of SRS. The Charleston, South Carolina, earthquake of 1886 had an estimated Richter scale magnitude of 6.8; it occurred approximately 145 km (90 mi) from the SRS area, which experienced an estimated peak horizontal acceleration of 10 percent of gravity (URS/Blume 1982). The Union County, South Carolina, earthquake of 1913 had an estimated Richter scale magnitude of 6.0 and occurred about 160 km (99 mi) from the site (Bollinger 1973). The magnitudes of these earthquakes are estimated from reports of damage and effects (see Table 4.2.5.1–2). Because these earthquakes are not associated conclusively with a specific fault, researchers cannot determine the amount of displacement resulting from the earthquakes. A small earthquake (with approximate Richter scale magnitude of 4.2) occurred off the coast about 48 km (30 mi) south-southwest of Charleston, South Carolina, on November 11, 2002. It shook doors and rattled windows but did no damage. Three days earlier a smaller earthquake (with approximate Richter scale magnitude of 3.5) occurred 249 km (155 mi) south-southwest of Charleston, South Carolina.

In recent years, three earthquakes occurred inside the SRS boundary. An earthquake occurred on May 17, 1997, with a Richter scale magnitude of 2.3 and a calculated focal depth (depth below the surface of the earth where the earthquake begins) of 5.44 km (3.38 mi). Its epicenter (position on the surface of the earth where the earthquake begins) was southeast of K-Area. On August 5, 1988, an earthquake occurred with a local Richter scale magnitude of 2.0 and a focal depth of 2.68 km (1.66 mi). Its epicenter was northeast of K-Area. On June 8, 1985, an earthquake occurred with a local Richter scale magnitude of 2.6 and a focal depth of 0.96 km (0.59 mi). Its epicenter was south of C-Area and west of K-Area. Existing information does not relate these earthquakes conclusively with known faults under the site. Figure 4.5.5.1–1 shows the locations of the epicenters of these earthquakes.

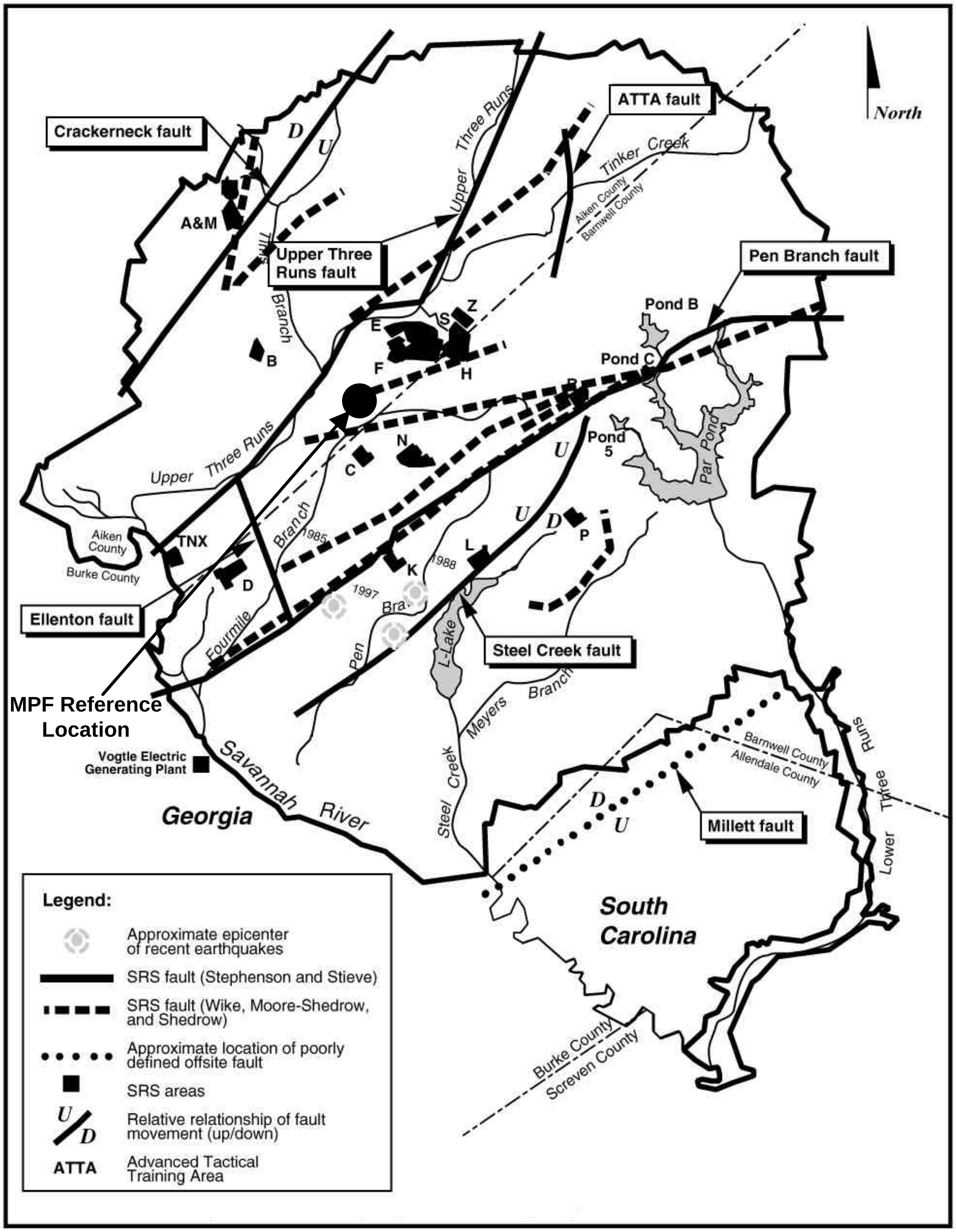
Outside the SRS boundary, an earthquake with a Richter scale magnitude of 3.2 occurred on August 8, 1993, approximately 16 km (10 mi) east of the city of Aiken near Couchton, South Carolina. People reported feeling this earthquake in Aiken, New Ellenton (immediately north of SRS), North Augusta (approximately 40 km [25 mi]) northwest of the SRS, and onsite (Aiken Standard 1993).

Slope Stability, Subsidence, and Soil Liquefaction

Subsidence (lowering of the ground surface) and soil liquefaction are two geologic processes that are more likely to affect SRS than rockfalls or landslides. Rock strata under some areas of SRS include layers of pockets of carbonate rock that are subject to dissolution. Sites underlain by these “soft zones” are considered unsuitable for structural formations unless extensive soil stabilization is done. There are no carbonate soft zones in the overall area of the MPF representative location (WSRC 2000a).

4.5.5.2 Soils

Undisturbed soils at SRS generally consist of sandy surface layers above a subsoil containing a mixture of sand, silt, and clay. These soils are gently sloping to moderately steep (0 to 10 percent grade) and have a slight erosion hazard (USDA 1990). Some soils on uplands are nearly level, and those on bottomlands along the major streams are level. Soils in small, narrow drainage valleys are steep. Most of the upland soils are well drained to excessively drained. The well-drained soils have a thick, sandy surface layer that extends to a depth of 2 m (7 ft) or more in some areas. The soils on bottomlands range from well-drained to very poorly drained. Some soils on the abrupt slope breaks have a dense, brittle subsoil (DOE 1998b). About 15 percent of the soils at SRS is considered prime farmland (White and Gaines 2000).



Source: DOE 2002f.

Figure 4.5.5.1–1. Fault Lines and Earthquake Epicenters on Savannah River Site

Mineral Resources

There are no active mines, mills, pits, or quarries on DOE land at SRS.

4.5.6 Biological Resources

4.5.6.1 Terrestrial Resources

The United States acquired the SRS property in 1951. At that time, the site was approximately 60 percent forest and 40 percent cropland and pasture (DOE 1995b). Forest and agricultural land predominate in the areas bordering SRS. There are also significant open water and nonforested wetlands along the Savannah River. Incorporated and industrial areas are the only other significant land uses. There is limited urban and residential development bordering SRS. Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. Approximately 58,500 ha (144,600 ac), or 73 percent of the site, is undeveloped. Wetlands, streams, and lakes account for 18,000 ha (44,500 ac), or 22 percent of the site. Developed facilities, including production and support areas, roads, and utility corridors, encompass 4,000 ha (9,900 ac), or 5 percent of SRS.

SRS land management practices have maintained the biodiversity in the region. Satellite imagery reveals that SRS is a circle of wooded habitat surrounded by a matrix of cleared uplands and narrow forested wetland corridors. SRS provides more than 730 km^2 (280 mi^2) of contiguous forest that supports plant communities in various stages of succession. Carolina bay depressional wetlands, the Savannah River Swamp, and several relatively intact longleaf pine-wiregrass (*Pinus palustris-Aristida stricta)* communities contribute to the biodiversity of SRS and the region. Woodland areas are managed primarily for timber production. At present, more than 90 percent of SRS is forested. An extensive forest management program conducted by the Savannah River Forest Station, which is operated by the U.S. Forest Service under an interagency agreement with DOE, has converted many former pastures and fields to pine plantations. Except for SRS production and support areas, natural succession has reclaimed many previously disturbed areas. The U.S. Forest Service harvests about 730 ha (1,800 ac) of timber from SRS each year. In 1972, SRS was the first site to be designated by DOE as a National Environmental Research Park. The National Environmental Research Park is used by the national scientific community to study the impacts of human activities on the cypress swamp and hardwood forest ecosystems. DOE has set aside approximately 5,700 ha (14,100 ac) of SRS exclusively for non-destructive environmental research (DOE 2000c).

The loblolly-longleaf-slash pine community *(P. taeda-P. palustris-P. elliottii)* is the dominant community covering approximately 65 percent of the site. Swamp forests and bottomland hardwood forests are found along the Savannah River. SRS is near the transition between northern oak-hickory-pine forest and southern mixed forest. Thus, species typical of both associations are found on SRS. Farming, fire, soil, and topography have strongly influenced SRS vegetation patterns. A variety of plant communities occur in the upland areas. Typically, scrub oak communities are found on the drier, sandier areas. Longleaf pine, turkey oak (*Quercus laevis*), bluejack oak (*Q. incana*), and blackjack oak (*Q. marilandica*) dominate these communities, which typically have understories of wire grass and huckleberry (*Vaccinium* spp.). Oak-hickory communities are usually located on more fertile, dry uplands; characteristic species are white oak *(Q. alba)*, post oak (*Q. stellata*), red oak *(Q. falcata)*, mockernut hickory (*Carya tomentosa*), pignut hickory (*Carya glabra*), and loblolly pine *(Pinus taeda)*, with an understory of sparkleberry (*Vaccinium arboreum*), holly (*Ilex* spp.), greenbriar (*Smilax* spp.), and poison ivy (*Toxicodendron radicans*).

The departure of residents in 1951 and the subsequent reforestation have provided the wildlife of SRS with excellent habitat. SRS supports a diverse and abundant wildlife community, including 43 amphibian, 58 reptile, 213 bird, and 54 mammal species. The reptiles and amphibian species of SRS include 17 salamanders, 26 frogs and toads, 1 crocodilian, 12 turtles, 9 lizards, and 36 snakes. Furbearers such as gray fox (*Urocyon cinereoargenteus*), opossum (*Didelphis virginiana*), and bobcat (*Felis rufus*) are relatively common throughout the site. Game species such as gray squirrel (*Sciurus carolinensis*), fox squirrel (*S. niger*), white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), mourning dove (*Zenaida macroura*), northern bobwhite (*Colinus virginianus*), and eastern wild turkey (*Meleagris gallopavo*) are also common. Waterfowl, which have been studied extensively, are common on most SRS wetlands, ponds, reservoirs, and in the Savannah River Swamp (DOE 1995b).

4.5.6.2 Wetlands

Wetlands on the SRS encompass approximately 19,850 ha (49,030 ac), or over 20 percent of the SRS area, and are extensively and widely distributed. These wetlands include bottomland hardwood forests, cypress-tupelo swamp forests, floodplains, creeks, impoundments, and over 300 isolated upland Carolina bays and wetland depressions. Carolina bays are unique wetland features of the southeastern United States. They are isolated wetland habitats dispersed throughout the uplands of SRS that exhibit extremely variable hydrology and a range of plant communities from herbaceous marsh to forested wetland (DOE 2002f, DOE 1999b). A major wetland area is the Savannah River swamp that borders the Savannah River and covers about 49 km^2 (19 mi^2) of SRS. The predominant forest cover in this swamp is second-growth bald cypress *(Taxodium distichum)*, water tupelo *(Nyssa aquatica)*, black-gum *(Nyssa sylvatica)*, and other hardwood species. The floodplains of the five major streams draining the site are composed of bottomland hardwood forests and scrub-shrub wetlands in varying stages of succession. Dominant species include red maple *(Acer rubrum)*, box elder *(Acer negundo)*, bald cypress, water tupelo, sweetgum *(Liquidambar styraciflua)*, and black willow *(Salix nigra)*. The bottomland hardwoods on SRS are typical of the mixed hardwood forests found in low wet areas of the southeastern Coastal Plain. Wetlands along Lower Three Runs downstream of Par Pond consist of bottomland hardwood swamps. Common tree species include oak species, sweetgum, cottonwood *(Populus heterophylla)*, American elm *(Ulmus americana)*, sycamore *(Platanus occidentalis)*, and red maple. Some cypress-tupelo areas are found near the confluence of Lower Three Runs and the Savannah River.

4.5.6.3 Aquatic Resources

The aquatic resources of SRS have been the subject of intensive study for more than 50 years (DOE 1997c, DOE 1999c). Research has focused on the flora and fauna of the Savannah River, the tributaries of the river that drain SRS, and the artificial impoundments on two of the tributary systems. In addition, several monographs, the eight-volume comprehensive cooling water study, and several site-specific EISs describe the aquatic biota (fish and macroinvertebrates) and aquatic systems of SRS.

The Savannah River, which forms the boundary between the States of Georgia and South Carolina, bounds the SRS on its southwestern border for about 32 km (20 mi). Three large upstream reservoirs—Hartwell, Richard B. Russell, and Strom Thurmond/Clarks Hill—minimize the effects of droughts and the impacts of low flow on downstream water quality and fish and wildlife resources in the river. The river floodplain supports an extensive swamp, covering about 49 km^2 (19 mi^2) of SRS and a natural levee separates the swamp from the river. Timber was cut in the swamp in the late 1800s. At present, the swamp forest consists of second-growth bald cypress, black gum, and other hardwood species.

The five principal tributaries to the Savannah River on the SRS are Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs. These tributaries drain almost all of SRS. Each of these streams originates on the Aiken Plateau in the Coastal Plain and descends 15-60 m (50-200 ft) before discharging into the river.

Six streams drain SRS and eventually flow into the Savannah River. Each stream has floodplains with bottomland hardwood forests or scrub-shrub wetlands in varying stages of succession. Dominant species include red maple, box elder, bald cypress, water tupelo, sweetgum, and black willow.

Based on studies by the Academy of Natural Sciences of Philadelphia and others, Upper Three Runs has one of the richest aquatic insect faunas of any stream in North America. At least 551 species of aquatic insects have been identified. Many insect species found in the creek are considered endemic, rare, or of limited distribution. Raccoon (*Procyon lotor*), beaver (*Castor canadensis*), and otter (*Lutra canadensis*) are relatively common throughout the wetlands of SRS. The Savannah River Ecology Laboratory has conducted extensive studies of reptile and amphibian use of the wetlands of SRS. Survey results indicate that fish communities are fairly typical of southeastern Coastal Plain streams. A mixed assemblage of sunfish, shiners, and pirate perch dominates the shallow, relatively narrow upstream areas. The wider, deeper downstream areas are dominated by spotted suckers *(Minytrema melanops),* largemouth bass *(Micropterus salmoides)*, and creek chubsuckers *(Erimyzon oblongus)* (WSRC 2000b). Fish densities have reached 380 fish per 100 m^2 (119 yd^2) with 37 different species recorded including the game fish species of largemouth bass, red-breasts *(Lepomis auritus),* and bullheads *(Ictalurus sp.)* (DOE 1999b).

4.5.6.4 Threatened and Endangered Species

Under the *Endangered Species Act* of 1973, the Federal Government provides protection to six species that are known to occur on the SRS: American alligator (*Alligator mississippiensis*, threatened due to similarity of appearance to the endangered American crocodile); shortnose sturgeon (*Acipenser brevirostrum*, endangered); bald eagle (*Haliaeetus leucocephalus*, threatened); wood stork (*Mycteria americana*, endangered); red-cockaded woodpecker (*Picoides borealis*, endangered); and smooth purple coneflower (*Echinacea laevigata*, endangered). Brief descriptions of those federally-listed species known to occur on SRS are provided later in this

Table 4.5.6.4–1. Listed Federal- and State-Threatened and Endangered Species that Occur or May Occur at the SRS, South Carolina

Species	Federal Classification	State Classification	Occurrence at SRS
Mammals			
Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*	Not listed	Endangered	Present in Aiken County
Southeastern myotis *Myotis austroriparius*	Not listed	Threatened	Present at SRS
Birds			
Bald eagle *Haliaeetus leucocephalus*	Threatened	Endangered	Present at SRS
Red-cockaded woodpecker *Picoides borealis*	Endangered	Endangered	Present at SRS
Wood stork *Mycteria americana*	Endangered	Endangered	Present at SRS
Amphibians			
Gopher frog *Rana capito capito*	Not listed	Endangered	Present in Aiken County
Reptiles			
American alligator *Alligator mississippiensis*	Threatened	Not listed	Present at SRS
Gopher tortoise *Gopherus polyphemus*	Not listed	Endangered	Present in Aiken and Allendale Counties. Record for SRS
Fish			
Shortnose sturgeon *Acipenser brevirostrum*	Endangered	Endangered	Present at SRS
Plants			
Relict Trillium *Trillium reliquum*	Endangered	Endangered	Present in Aiken County
Canby's Dropwort *Oxypolis canbyi*	Endangered	Endangered	Present in Barnwell and Allendale Counties
Harperella *Ptilimnium Nodosum*	Endangered	Endangered	Present in Barnwell County
Pondberry *Lindera melissifolia*	Endangered	Endangered	Possible occurrence in Barnwell County
American chaffseed *Schwalbea americana*	Endangered	Endangered	Possible occurrence in Barnwell County
Smooth coneflower *Echinacea laevigata*	Endangered	Endangered	Present at SRS

Sources: SCDNR 2002, SC E&G 2002, WSRC 1997.

section. SRS contains no designated critical habitat for any listed threatened or endangered species (DOE 2001d). Table 4.5.6.4–1 presents the federally- and state-listed species that occur or may occur at SRS. There are over 50 other species that are not listed but are of special interest due to potential rarity or threats to their long-term stability.

The American alligator, an inhabitant of wetland ecosystems in the southeast and near its northern limits at SRS, occurs in a variety of SRS habitats, including rivers, swamps, small streams, abandoned farm ponds, and Par Pond and L-Lake. Par Pond contains the largest concentrations of alligators, with more than 200 animals present in 1996.

Shortnose sturgeon are only found on the east coast of North America and are typically residents of large coastal (tidal) rivers and estuaries. Shortnose sturgeon have not been collected in the tributaries of the Savannah River that drain the SRS, but do occur in the Savannah River up and downstream of SRS. Before 1982, shortnose sturgeon were not known to occur in the middle reaches of the Savannah River. However, 12 shortnose sturgeon larvae were collected near SRS during a 4-year (1982-1985) DOE study of ichthyoplankton abundance and entrainment in reactor cooling water systems. Sturgeon spawn in the main channel of the Savannah River in areas where current velocities and turbulence are high, maintaining a scoured clay-gravel bottom. There are three tentatively identified spawning locations in the Savannah River: one upstream, one adjacent to, and one downstream site from SRS.

Bald eagles are found on SRS in all months of the year, with most sightings in the winter and spring months (November through May). This is the time of the year when the birds are nesting and wintering in South Carolina. Eagles seen during the summer and early fall are most likely transients migrating either north or south. There are three bald eagle nesting territories on SRS. The Eagle Bay nest, discovered in 1986, is southwest of the Par Pond dam. Eagles have nested intermittently at the Eagle Bay location since its discovery in 1986. The Pen Branch nest, discovered in 1990, is west of L-Lake and the recently discovered Road G nest is east of Par Pond. Chicks have hatched at the Pen Branch nest every year from 1990-1996. To date, no young have been observed at the Road G nest. In the winter of 1997-1998, this nest was in a state of disrepair and was not used by eagles. Bald eagles forage in both Par Pond and L-Lake and in recent years, eagles have been observed on a regular basis foraging around Pond C and Pond B, and have been seen occasionally at Pond 2.

The wood stork, which is the only "true" stork to nest in the United States, feed in the Savannah River Swamp and the lower reaches of Steel Creek, Pen Branch, Beaver Dam Creek, and Fourmile Branch. They currently nest only in Florida, Georgia, and South Carolina. Wood storks do not nest at SRS.

The red-cockaded woodpecker population historically nested in open pine stands in wetlands. Encroachment of hardwood species has resulted in the deterioration of habitat quality and subsequent nesting success. Within the SRS, the red-cockaded woodpecker inhabits and uses open pine forest with mature trees (older than 70 years for nesting and 30 years for foraging).

The smooth coneflower is the only federally-listed plant species on SRS. The habitat of the smooth coneflower is open woods, cedar barrens, roadsides, clear-cuts, and power line rights-of-way. Optimum sites are characterized by abundant sunlight with little competition in the herbaceous layer (DOE 1997c, DOE 1999c).

4.5.7 Cultural and Paleontological Resources

4.5.7.1 Cultural Resources

All undertakings at SRS are conducted in compliance with relevant cultural resource Federal legislation, particularly Sections 110 and 106 of the NHPA, and DOE orders and policies that address cultural resource protection and management. Cultural resources at SRS are managed under the terms of a 1990 Programmatic Memorandum of Agreement among DOE Savannah River Operations Office, the South Carolina SHPO, and the Advisory Council on Historic Preservation. Guidance on the management of cultural resources at SRS is included in the *Archaeological Resources Management Plan of the Savannah River Archaeological Research Program* (SRARP 1989). Through a cooperative agreement with DOE, the South Carolina Institute of Archaeology and Anthropology at the University of South Carolina manages the Savannah River Archaeological Research Program to provide the services required by Federal law for the protection and management of cultural resources. Archaeological investigations are usually initiated by the Site Use Program, which requires completion of the Section 106 compliance process prior to issuing a permit for any land clearing on SRS (DOE 2002f). The ROI for cultural resources is the entire SRS site.

The archaeological survey program at SRS started in 1974 and has included reconnaissance inventories, shovel test transects, and intensive site testing and data recovery excavations. Approximately 60 percent of SRS has been inventoried and 858 archaeological (prehistoric and historic) sites have been identified (DOE 1999h, DOE 2000e) with sixty-seven of these sites are considered potentially eligible for listing on the NRHP; however, most of the sites have not been evaluated for eligibility. To facilitate management of these resources, SRS is divided into three archaeological zones based upon an area’s potential for containing sites of historical or archaeological significance. Zone 1 areas have the greatest potential for possessing significant resources; Zone 2 areas have moderate potential; and Zone 3 areas have the lowest potential.

Prehistoric Resources

Prehistoric resources at SRS consist of villages, base camps, limited activity sites, quarries, and workshops. Evidence of prehistoric use of the area is present at approximately 800 of the 858 archaeological sites. Fewer than 8 percent of these sites have been evaluated for NRHP eligibility.

Historic Resources

Historic resources at SRS consist of farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farm dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. Evidence of historic use of the area has been found at approximately 400 of the 858 recorded archaeological sites. About 10 percent of the historic sites have been evaluated for NRHP eligibility. Systematic historic building surveys have not yet been conducted at SRS. Many of the pre-SRS historic structures were demolished during the initial establishment of SRS in 1950. No nuclear production facilities have been nominated to the

NRHP and there are no plans for nominations. Existing SRS facilities lack architectural integrity and do not contribute to the broad historic theme of Manhattan Project or World War II-era nuclear materials. From a Cold War perspective, SRS has been involved in tritium operations and other nuclear material production for more than 40 years; therefore, some existing facilities and engineering records may become significant once they attain the 50-year age criterion.

Native American Resources

Native American groups with traditional ties to the SRS area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from French, Spanish, or other Native American groups. During the 1800s, most of the remaining Native Americans residing in the region were relocated to Oklahoma Territory (DOE 1999h). Native American resources in the region include villages, ceremonial lodges, burials, cemeteries, and natural areas containing traditional plants used in ceremonies. In 1991, DOE conducted a survey of Native American concerns about religious rights in the central Savannah River Valley. Six Native American groups—the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian People's Muskogee Tribal Town Confederacy, the Pee Dee Indian Nation, the Ma Chis Lower Alabama Creek Indian Tribe, and the United Keetoowah Band of the Cherokee—have expressed concerns about sites and items of religious significance within SRS, including plant species traditionally used by them in ceremonies that exist on the SRS (DOE 2000e, DOE 1999h). DOE has continued to consult with the interested tribal organizations by notifying them about major planned actions at SRS and by providing environmental reports that address proposed actions at SRS to the organizations for their review and comment (DOE 1999b, DOE 2000e).

Cultural Resources on the Reference Location

The reference location at SRS is located in an area surrounded by Archaeological Zones 1, 2, and 3. It is also located in an area that has not been disturbed by construction. Thus, it is likely that cultural resources are located at the reference location or in the area immediately surrounding it.

4.5.7.2 Paleontological Resources

Paleontological resources at SRS date from the Eocene Age (54-39 million years ago) and include fossil plants, numerous invertebrate fossils, and deposits of giant oysters, other mollusks, and bryozoa. All resources from SRS are marine invertebrate deposits and, with the exception of the giant oysters, are relatively widespread and common fossils. Therefore, the assemblages have relatively low research potential or scientific value (DOE 1999h; DOE 1996c).

4.5.8 Socioeconomics

Socioeconomic characteristics addressed at SRS include employment, income, population, housing, and community services. These characteristics are analyzed for a four-county ROI consisting of Aiken and Barnwell Counties in South Carolina, and Columbia and Richmond Counties in Georgia, where over 87 percent of site employees reside (DOE 1996c), as shown in Table 4.5.8–1.

Table 4.5.8–1. Four-County ROI where SRS Employees Reside

County	Percent of Total
Aiken	51.9
Barnwell	7.3
Columbia	10.6
Richmond	17.5
ROI Total	**87.3**

Source: DOE 1996c.

4.5.8.1 Employment and Income

The service and government sectors employ the greatest number of workers in the ROI. The government sector provides more than 20 percent of all employment, while the service sector provides 29 percent of the jobs in Columbia and Richmond Counties. Data on service sector employment is not available for Aiken or Barnwell Counties. Other important sectors of employment include retail trade (17.4 percent) and manufacturing (11.8 percent) (BEA 2002).

The labor force in the ROI increased 2.9 percent from 1990 to 2001, an average of 0.3 percent each year. In comparison, the state-wide labor force in both South Carolina and Georgia increased at a greater rate, a total of 12.1 percent in South Carolina and 25.2 percent in Georgia over the same time period. Total employment in the ROI increased at the same pace as the labor force, a total of 2.9 percent. Unemployment remained constant at 5.0 percent in both 1990 and 2001. In comparison, the state-wide average unemployment increased in South Carolina from 4.8 percent in 1990 to 5.4 percent in 2001 and decreased in Georgia from 5.5 percent to 4.0 percent (BLS 2002a).

In 2000, Per capita income in the ROI ranged from a high of $26,080 in Columbia County to a low of $21,027 in Barnwell County. The average per capita income in the ROI was approximately $24,175, compared to the South Carolina average of $24,000 and the Georgia average of $27,794. Per capita income increased in the ROI by almost 36.5 percent between 1990 and 2000, compared to a state-wide increase of 49.6 percent in South Carolina and 56.8 percent in Georgia (BEA 2002).

4.5.8.2 Population and Housing

Between 1990 and 2000, the ROI population grew from 397,034 to 455,093, an increase of 14.6 percent. This was a slower rate of growth than for either South Carolina or Georgia, which grew at rates of 15.1 percent and 26.4 percent, respectively, during the same time period. Columbia County had the highest rate of growth at 35.2 percent, while Richmond County experienced the lowest growth rate at 5.3 percent (Census 2002).

In 2000, the total number of housing units in the ROI was 187,811 with 169,648 occupied. There were 117,243 owner-occupied housing units and 52,405 occupied rental units. In 2000, the homeowner vacancy rate in the ROI ranged from a high of 2.9 percent in Columbia County to a low of 1.5 percent in Barnwell County. The rental vacancy rate ranged from 12.1 percent in Aiken County to 9.1 percent in Columbia County. This is slightly higher than the state rates of 1.9 percent homeowner vacancy and 8.2 percent rental vacancy in Georgia and 1.9 percent homeowner vacancy and 12 percent rental vacancy in South Carolina. The greatest number of housing units in the ROI is in Richmond County with almost 44 percent of the total housing units (Census 2002).

4.5.8.3 Community Services

There is a total of 6 school districts in the ROI serving almost 85,000 students. The student-to-teacher ratio in these districts ranges from a high of 17.5 in the Barnwell County School District 19 to a low of 14.3 in the Barnwell County School District 29. The average student-to-teacher ratio in the ROI is 16.6 (NCES 2002).

The ROI is served by 10 hospitals with a capacity of over 3,200 beds located throughout the ROI (AHA 1995). The closest hospital to SRS is the Aiken Regional Medical Center in Aiken, South Carolina. There are approximately 1,600 doctors in the ROI, the majority of which are concentrated in Augusta, Georgia, and Aiken, South Carolina.

4.5.9 Radiation and Hazardous Chemical Environment

4.5.9.1 Radiation Exposure and Risk

An individual's radiation exposure in the vicinity of SRS amounts to approximately 357 mrem (see Table 4.5.9.1–1), and is comprised of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; weapons test fallout; consumer and industrial products, and nuclear facilities. All radiation doses mentioned in this EIS are effective dose equivalents. Effective dose equivalents include the dose from internal deposition of radionuclides and the dose attributable to sources external to the body.

Table 4.5.9.1–1. Sources of Radiation Exposure to Individuals in the SRS Vicinity Unrelated to SRS Operations

Source	Radiation Dose (mrem/yr)
Natural Background Radiation	
Total external (cosmic and terrestrial)	53
Internal terrestrial and global cosmogenic	40[a]
Radon in homes (inhaled)	200[a]
Other Background Radiation[a]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	**357**

[a] An average for the United States.
Source: Derived from data in NCRP 1987.

Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to SRS operations.

Releases of radionuclides to the environment from SRS operations provide another source of radiation exposure to individuals in the vicinity of SRS. Types and quantities of radionuclides released from SRS operations in 2001 are listed in *Savannah River Site Environmental Report for 2001* (WSRC 2002h). The doses to the public resulting from these releases are presented in Table 4.5.9.1–2. The radionuclide emissions contributing the majority of the dose to the offsite MEI from liquid releases were tritium, cesium-137, and plutonium-239 (WSRC 2002h). For atmospheric releases, the radionuclides contributing the majority of the dose to the offsite MEI were tritium, iodine-129, and plutonium-239. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

Table 4.5.9.1–2. Radiation Doses to the Public From Normal SRS Operations in 2001 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Offsite MEI (mrem)	10	0.05	4	0.13	100	0.18
Population within 80 km (person-rem)	None	2.9	None	4.3	None	9.9

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-mrem/yr limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.

Source: WSRC 2002h.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the offsite MEI due to radiological releases from SRS operations is estimated to be 9×10^{-8}, or 9 cancer deaths in a population of 10 million. The estimated probability of this maximally exposed person dying of cancer at some point in the future from radiation exposure associated with 1 year of SRS operations is less than one in 1 million (it takes several to many years from the time of radiation exposure for a cancer to potentially manifest itself).

According to the same risk estimator, 0.005 excess fatal cancers are projected in the population living within 80 km (50 mi) of SRS from normal SRS operations. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population of 689,486 living within 80 km (50 mi) of SRS was 1,379. This expected number of fatal cancers is much higher than the 0.005 fatal cancers estimated from SRS operations in 2000.

External radiation doses have been measured in areas of SRS for comparison with offsite natural background radiation levels. Measurements taken in 2000 showed average doses on SRS of about 75 mrem (WSRC 2002h).

SRS workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at SRS from operations in 2001 are presented in Table 4.5.9.1–3. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among SRS workers from normal operations in 2001 is 0.083. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 4.5.9.1–3. Radiation Doses to Workers From Normal SRS Operations in 2001 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (mrem)	5,000[a]	57
Collective radiation worker dose[b] (person-rem)	None	207.6

[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 mrem/yr (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] There were 3,640 workers with measurable doses in 2001.
Source: DOE 2001f.

4.5.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. SRS workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at SRS via inhalation of air containing hazardous chemicals released to the atmosphere by SRS operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Nonradioactive air emissions originating at SRS facilities are monitored at their points of discharge by direct measurement, sample extraction and measurement, or process knowledge. Air monitoring is used to determine whether all emissions and ambient concentrations are within applicable regulatory standards. At SRS, there are 172 permitted/exempted nonradiological air emission sources, 133 of which were in operation in some capacity during 2001. The remaining 39 sources either were being maintained in a "cold standby" status or were under construction (WSRC 2002h).

Major nonradiological emissions of concern from stacks at SRS facilities include sulfur dioxide, carbon monoxide, oxides of nitrogen, PM_{10}, VOCs, and toxic air pollutants. Emissions from SRS sources are determined during an annual emissions inventory from calculations using source operating parameters such as fuel oil consumption rates, total hours of operation, and the emission factors provided in the EPA "Compilation of Air Pollution Emission Factors."

Under existing regulations, SRS is not required to conduct onsite monitoring for ambient air quality; however, the site is required to show compliance with various air quality standards. To accomplish this, air dispersion modeling was conducted during 2001 for new emission sources or modified sources as part of the sources' construction permitting process. The modeling analysis showed that SRS air emission sources were in compliance with applicable regulations.

4.5.10 Traffic and Transportation

4.5.10.1 Regional Transportation Infrastructure

SRS is surrounded by a system of interstate highways, U. S. highways, state highways, and railroads. The regional transportation network services the four South Carolina counties (Aiken, Allendale, Bamberg, and Barnwell) and two Georgia counties (Columbia and Richmond) that generate nearly all of the SRS commuter traffic. Figure 4.5.10.1–1 shows the regional transportation infrastructure.

I-20 serves the SRS region, providing the primary east-west corridor. I-520 provides a partial loop around Augusta, Georgia. Truck shipments to (or from) the SRS or from (or to) other DOE sites normally enter the region from the west on I-20. In Augusta, Georgia, the trucks typically take I-520 to the Georgia/South Carolina border where U.S. 278 and S.C. 125 route the trucks into the site at the Jackson gate.

4.5.10.2 Local Traffic Conditions

As indicated in Figure 4.5.10.1–1, there are six principal access roads to the site: three from the north—S.C. 125, S.C. 57, and S.C. 19—and three from the east and south—S.C. 125, S.C. 64, and S.C. 39. The eastern and southern accesses are from rural areas and do not bear a large fraction of the SRS commuting traffic. Those from the north, however, provide access to SRS from the metropolitan areas surrounding Augusta, Georgia, and Aiken and North Augusta, South Carolina. The traffic on these access roads can be heavy at times, with a significant contribution from SRS traffic. Table 4.5.10.2–1 provides the current peak hourly traffic and the Level of Service for these roads.

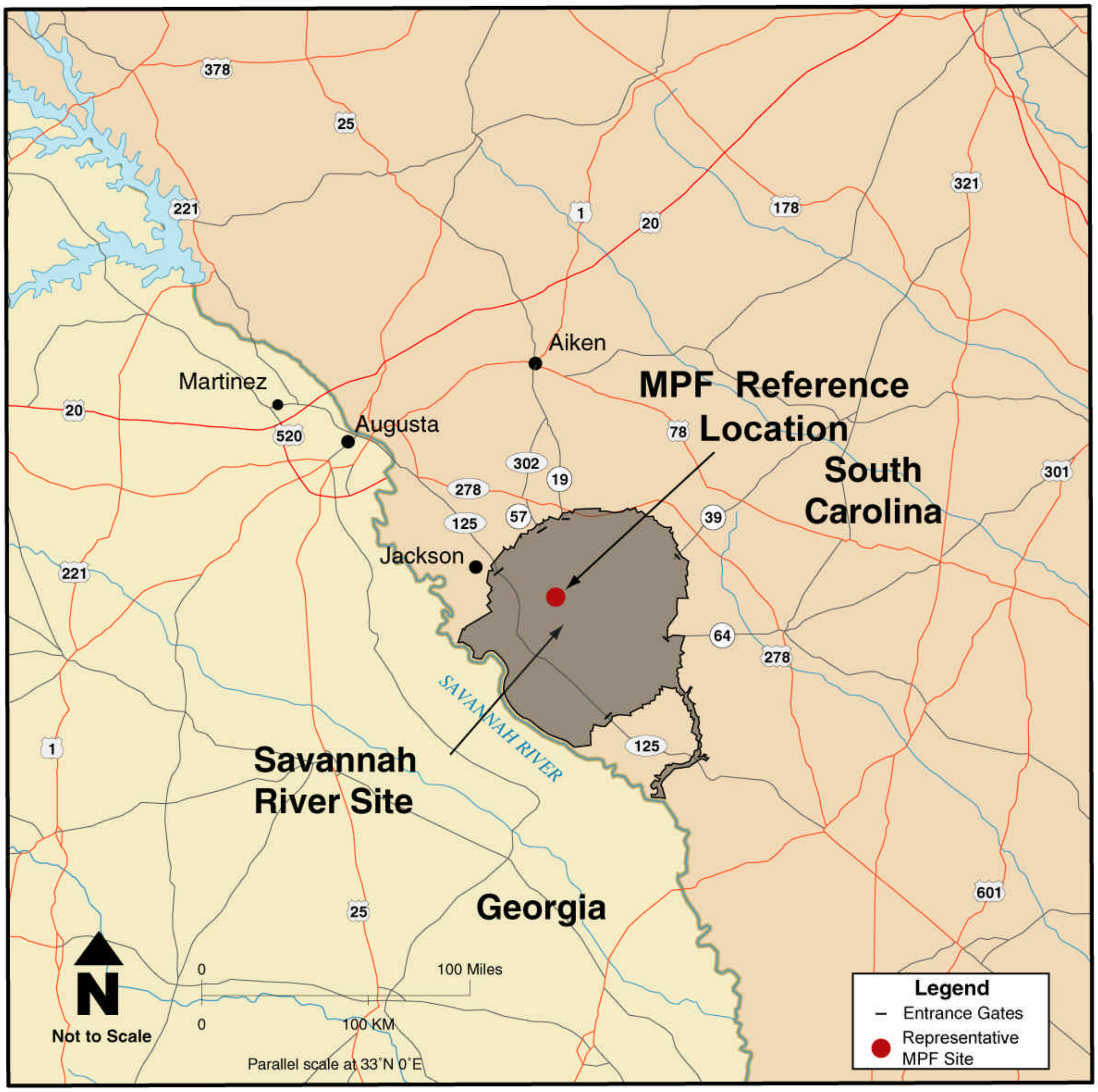


Figure 4.5.10.1–1. Highways in the Region of SRS

Table 4.5.10.2–1. Traffic Conditions on Principal Access Roads to the SRS

Access Road	Annual Average Daily Traffic	Peak Hourly Traffic	Volume to Capacity Ratio	Level of Service[a]
S.C. 125 at Jackson, South Carolina	12,600	588	1.02	D
State Road 57 (from S.C. 302 and US 278)	NA	NA	NA	NA
S.C. 19 at New Ellenton, South Carolina	12,500	583	1.01	D

NA = not available.
[a] Levels of Service:

A. Free flow of the traffic stream; users are unaffected by the presence of others.
B. Stable flow in which the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished.
C. Stable flow that marks the beginning of the range of flow in which the operation of individual users is significantly affected by interactions with the traffic stream.
D. High-density, stable flow in which speed and freedom to maneuver are severely restricted; small increases in traffic will generally cause operational problems.
E. Operating conditions at or near capacity level causing low but uniform speeds and extremely difficult maneuvering that is accomplished by forcing another vehicle to give way; small increases in flow or minor perturbations will cause breakdowns.
F. Defines forced or breakdown flow that occurs wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. This situation causes the formation of queues characterized by stop-and-go waves and extreme instability.

Source: Gunter 2002, Fulmer 2002.

4.5.11 Waste Management

This section describes DOE waste generation baseline that will be used to gauge the relative impact of MPF construction and operations on the overall waste generation at SRS and on DOE's capability to manage such waste. SRS manages high-level waste, LLW, mixed LLW, TRU (including alpha-contaminated) waste, hazardous waste, and sanitary waste. This EIS considers each of these waste types, except high-level waste. Table 4.5.11–1 provides the routine waste generation rates, excluding high-level waste, at SRS. Table 4.5.11–2 summarizes the waste management capabilities at SRS.

Table 4.5.11–1. Annual Routine Waste Generation from SRS Operations (m^3)

Waste Type	1996	1997	1998	1999	2000	2001
Transuranic	165	119	61.9	42.4	54	64.1
Low-level	5,780	6,620	6,520	4,970	5,220	4,610
Mixed	452	286	463	402	290	380
Hazardous[a]	57.0	55.0	177	26.5	30.8	45.3
Sanitary[b]	2,780	2,770	2,640	1,760	1,550	1,560

[a] Hazardous waste reported in metric tons.
[b] From DOE 2002o (1996 data) and DOE's Central Internet Database (available at http://cid.em.doe.gov). Sanitary waste reported in metric tons.
Source: DOE 2002o.

Table 4.5.11–2. Waste Management Facilities at SRS

Facility Name/ Description	Capacity	Status	Applicable Waste Types				
			LLW	Mixed LLW	TRU Waste	Hazardous Waste	Nonhazardous Waste
Treatment Facility (m^3/yr)							
Macroencapsulation	(a)	Submit permit application in FY03		X			
TRU waste characterization/ certification		Online			X		
Category II TRU waste facility[b]	(a)	2015			X		
Category III TRU waste facility[b]	(a)	2004			X		
Saltstone Manufacturing and Disposal Facility		Campaign	X				
Effluent Treatment Facility	NA	Online	X	X			
Storage Facility (m^3)							
Hazardous Waste Storage Facility (645-N, 645-2N, 645-4N, SWSP)	2,956	Online		X		X	
Mixed Waste Storage Building 643-29E	504	Online		X			
Mixed Waste Storage Building 643-43E	1,651	Online		X			
Mixed Waste Storage Building 316-M	117	Online		X			
TRU Waste Pads 1-19	15,257	Online			X		
Long-lived waste storage buildings	140[a]	Online	X				
DWPF OWST	568	Online		X			
STRC Mixed Waste Storage Tanks	198	Online		X			
Liquid Waste Solvent Tanks S33-S36	454	Online		X			

Table 4.5.11–2. Waste Management Facilities at SRS *(continued)*

Facility Name/ Description	Capacity	Status	Applicable Waste Types				
			LLW	Mixed LLW	TRU Waste	Hazardous Waste	Nonhazardous Waste
Disposal Facility (m^3)							
E-Area shallow land disposal trenches	(d)	Online	X				
E-Area low-activity waste vaults	30,500[e]	Online	X				
E-area intermediate-activity waste vaults	5,300[f]	Online	X				
Saltstone Manufacturing and Disposal Facility	80,000[g]	Online	X				
Burma Road structural fill	NA[h]						X
Three Rivers Landfill	NA[i]	Online					X

[a] Facility capacity has not yet been determined.
[b] Refers to hazard category of the treatment process. Category II facility would provide sorting and segregation capabilities for high activity TRU waste. Category III facility will provide repackaging, sorting, and size reduction capabilities for low activity TRU waste.
[c] Capacity per building. One exists. DOE plans to construct additional buildings as needed.
[d] Different types of trenches of varying capacities exist for different waste types.
[e] This is the approximate capacity of a double vault. One single and one double vault have been constructed. Future vaults are currently planned as double vaults.
[f] Capacity per vault. One vault exists and another vault is planned.
[g] Capacity per vault. Two vaults exist and five more may be constructed.
[h] Current destination for SRS demolition/construction wastes.
[i] Current destination for SRS sanitary waste. Located onsite at intersection of S.C. 125 and Road 2.
Source: DOE 2001d, Gould 2002, WSRC 2002h.

4.5.11.1 Low-Level Radioactive Waste

DOE uses a number of methods for treating and disposing of LLW at SRS, depending on the waste form and activity. The Waste Sort Facility, located in cell 12 of the Low Activity Waste Vaults, segregates LLW for future treatment and/or disposal. In FY2001, about 4,970 m^3 (175,515 ft^3) of LLW were processed at the Waste Sort Facility (WSRC 2002g). After sorting (if required), the LLW is disposed in low-activity waste vaults, intermediate-level waste vaults, engineered trench or slit trenches in E-Area.

Approximately 40 percent of SRS LLW is characterized as low-activity waste. After volume reduction (e.g., supercompaction), if applicable, this waste is packaged in B-25 boxes and placed in either shallow land disposal or vault disposal in E-Area. During FY2001, about 3,370 m^3 (119,011 ft^3) of compactible LLW was processed at the Supercompactor Facility located in cell 11 of the Low Activity Waste Vaults (WSRC 2002g).

DOE places LLW of intermediate activity and some tritiated LLW in intermediate activity vaults. In addition, long-lived LLW (e.g., spent deionizer resins) is placed in the long-lived waste storage buildings in E-Area, where it will remain until DOE determines the final disposition.

In 2001, SRS implemented a "components-in-grout" disposal method for equipment that is physically too large for vault disposal but contaminated at levels that require vault-like isolation. The technique consists of placing the item onto a grout base in the trench, filling any void space within the item with a specially formulated grout mixture, and placing grout around it using the trench walls as a form.

DOE uses offsite disposal for LLW that is not technically or economically suitable for disposal at SRS. In July 2001, DOE made its first shipment of LLW from SRS to NTS for disposal. That shipment contained demolition debris from an old tritium facility. Over a 10-year shipping campaign, DOE will dispose of several LLW streams that do not meet criteria for disposal at SRS or that are more economical to dispose at NTS.

The Saltstone Facility treats liquid wastes by mixing the waste with grout formers and pumping the mixture to engineered concrete vaults in Z-Area where it is allowed to cure. Operations of the Saltstone Facility were suspended in 1999 pending DOE's decision on processing the salt portion of the SRS high-level waste inventory. The facility resumed operations in 2002 to process the backlog of waste.

4.5.11.2 Mixed Low-Level Waste

As described in the *Approved Site Treatment Plan* (WSRC 2001), storage facilities for mixed LLW are in several different SRS areas. These facilities are dedicated to solid, containerized, or bulk liquid waste and all are approved for this storage under RCRA as interim status or permitted facilities, or as CWA-permitted tank systems.

Several treatment processes described in the *Approved Site Treatment Plan* (WSRC 2001) exist or are planned for mixed LLW. These facilities include the Consolidated Incineration Facility (CIF) and the Savannah River Technology Center Mixed Waste Storage Tanks. Additional waste treatment capabilities are provided as needed, such as decontamination of radioactively contaminated lead waste. In FY2003, DOE will submit a permit application for a macro-encapsulation process using vendor equipment housed in an existing SRS building. The macro-encapsulation facility will be used to treat contaminated debris and lead wastes.

Operations of the SRS CIF were suspended in April 2000. After completing a study of alternative treatment technology for CIF waste streams, DOE has decided not to restart the CIF. Legacy Plutonium-Uranium Extraction Process (PUREX) waste originally slated for treatment at CIF will instead be treated through a combination of direct stabilization (for the organic portion) and treatment at the Saltstone Facility (for the aqueous portion).

The Savannah River Technology Center Mixed Waste Storage Tanks are equipped with an ion exchange probe to remove toxic metals and benzene from laboratory wastewater. The facility has a treatment capacity of about 1.73 million L/yr (457,000 gal/yr), the majority of which is for treatment of low activity waste (WSRC 2001).

Some mixed LLW is shipped offsite for treatment and disposal. In August 2001, DOE initiated shipments of mixed LLW (consisting of treatment residues from the CIF) to the Envirocare facility in Utah. In September 2001, DOE initiated shipments of mixed waste (HEPA filters from the CIF's offgas treatment system) to the Materials and Energy Corporation in Oak Ridge, Tennessee, for treatment (WSRC 2002g). Also, in September 2001, DOE initiated shipments of radioactive waste contaminated with PCBs to the TSCA incinerator at Oak Ridge. Although not mixed waste, these PCB wastes are subject to TSCA regulation.

4.5.11.3 Transuranic and Alpha Waste

Current SRS efforts consist primarily of providing continued safe storage pending treatment and disposal. Currently, DOE manages low-level alpha waste with activities from 10-100 nanocuries per gram (nCi/g) (referred to as alpha waste) as TRU waste at SRS. At the end of FY2001, 11,000 m^3 (388,465 ft^3) of legacy solid TRU waste remained in storage at SRS (WSRC 2002g).

Before disposition, DOE plans to measure the radioactivity levels of the wastes stored on the TRU waste storage pads and segregate the alpha waste. After segregation and repackaging, DOE could dispose of much of the alpha waste as either mixed LLW or LLW.

DOE uses a mobile vendor for the inspection, characterization, and shipment of TRU waste from SRS to WIPP. The vendor's equipment was set up on TRU Pads 3 and 4 and began operations in FY2001 using three mobile systems: a real-time radiography trailer, nondestructive assay trailer, and drum headspace gas sampling system. After inspection/characterization of the waste is completed, a mobile loading unit places the drums into Transuranic Package Transporter (TRUPACT-II) containers for transport to WIPP. The vendor processes are supported by the SRS Visual Examination Facility located on Pad 6.

A low-activity TRU waste facility will be constructed to process the lower activity SRS waste in preparation for shipment to WIPP. A semi-remotely operated "handling and segregating system for 55-gallon drums" ("HANDSS-55") will be installed at an existing SRS facility that has been modified to provide containment, ventilation, fire protection, and other services. The facility will also allow visual examination of the waste to confirm radiography results. This Hazard Category-3 facility is scheduled to begin operations by September 30, 2004 (Gould 2002).

A high-activity TRU waste facility would be constructed to process the higher activity SRS waste. This facility would include culvert opening and drum removal equipment as well as repackaging, sorting, and size reduction technologies. It would also have the capability to open the "black boxes" used to store large bulk TRU waste equipment, and to remove, characterize, size reduce (as necessary), and repackage the items in standard waste boxes. DOE is scheduled to submit a RCRA permit application for this Hazard Category-2 facility in 2008 (WSRC 2001). Operations would begin in 2015.

In May 2001, DOE made its first shipment of SRS TRU waste to WIPP for disposal. The current SRS baseline calls for completing shipments of 4,900 m^3 (173,043 ft^3) of low-activity TRU waste to WIPP by 2034. SRS recently proposed to accelerate this schedule to complete low-level legacy waste shipments by 2014. In addition, SRS proposes to accelerate processing of approximately 5,400 m^3 (190,701 ft^3) of high-activity TRU waste and bulk equipment. This waste would be processed and shipped to WIPP by 2015, 9 years ahead of the current baseline of 2024. Instead of constructing a large Hazard Category-2 facility, DOE would use existing facilities as infrastructure and containment for TRU waste processing equipment, such as the Remotely Operated Size Reduction System that SRS obtained from Rocky Flats for processing large items of bulk equipment (WSRC 2002a). SRS is one of the sites being considered as the contract handled TRU waste hub under the Eastern Small Quantity Site Acceleration Program described in the *Transuranic Waste Performance Management Plan* (DOE 2002m).

4.5.11.4 Hazardous Waste

At present, DOE stores hazardous wastes in three buildings and on three pads that have RCRA permits. SRS hazardous waste streams consist of a variety of materials, including mercury, chromate, lead, paint solvents, and various laboratory equipment. Hazardous waste is sent to offsite treatment and disposal facilities. DOE also plans to continue to recycle, reuse, or recover certain hazardous wastes, including metals, excess chemicals, solvents, and chlorofluorocarbons.

4.5.11.5 Sanitary Waste

SRS sanitary waste volumes have declined due to increased recycling and the decreasing workforce. DOE uses the city of North Augusta's Material Recovery Facility as part of its recycling program. The facility recovered 448 metric tons (494 tons) of sanitary waste in 2001. A total of 1,750 metric tons (1,930 tons) of industrial wastes were recycled onsite through the SRS Salvage and BSRI Construction organizations. DOE sends sanitary waste that is not recycled or reused to the Three Rivers Regional Landfill located on SRS. Noncombustible materials from SRS environmental restoration activities are transferred to the Three Rivers Regional Landfill for use as daily cover (WSRC 2002g).

The SRS Burma Road construction and demolition waste landfill was filled to capacity in FY2001. A majority of the materials traditionally disposed at the Burma Road Landfill are now disposed in a state-approved borrow pit. About 15 percent of the material that would have been disposed at Burma Road is now sent to the Three Rivers Regional Landfill. For example, wood waste and untreated pallets are transferred to Three Rivers where they are shredded with a grinder and piled in long rows where leachate collected from the landfill is sprayed onto the material. This process helps to both treat the leachate and accelerate the breakdown of the wood waste into compost that can be recycled (WSRC 2002g).

In 2001, DOE constructed an onsite facility to convert combustible (paper and cardboard) sanitary waste to fuel. The pelletized paper is burned in the A-Area boiler, offsetting the need for coal as fuel.

4.5.11.6 Wastewater

The Effluent Treatment Facility processes low-level radioactive and chemically contaminated wastewater from the high-level waste Tank Farm and reprocessing facility evaporators. The facility has also treated wastewater from the CIF and contaminated well water from Environmental Restoration Program activities. Waste is transferred to the facility via pipeline from the Tank Farm and Separations facilities or is offloaded from tankers at the unloading station. Treatment processes include microfiltration, organic removal, ion exchange and reverse osmosis. After treatment, approximately 99 percent of the initial waste volume is discharged to an NPDES-permitted outfall. The remainder is transferred to Tank 50 and eventually to the Saltstone Facility where it is stabilized for disposal. In FY2001, the Effluent Treatment Facility treated more than 60.5 million L (16 million gal) of wastewater.

Sanitary wastewater is treated in the Centralized Sanitary Wastewater Treatment Facility and discharged to the Fourmile Branch tributary.

4.5.11.7 Pollution Prevention

The total waste (routine waste as well as environmental restoration and D&D waste) generated by SRS was 18,500 m^3 (653,327 ft^3) in FY2001, accounting for 3 percent of DOE's overall waste generation. Implementing pollution prevention projects reduced the total amount of waste generated at SRS in 2001 by approximately 4,270 m^3 (150,795 ft^3). Examples of SRS pollution prevention projects completed in 2001 include the reduction of LLW by 2,080 m^3 (73,455 ft^3) by *in situ* stabilization of radioactively contaminated soils in lieu of a "dig and haul" remediation strategy for the K-Area Basin and 281 m^3 (9,923 ft^3) through the recovery of active contamination areas within the Nuclear Materials Stabilization and Storage Division's facilities (DOE 2002g).

4.5.11.8 Waste Management PEIS Records of Decision

A discussion of DOE's hazardous waste, LLW, mixed LLW, and TRU waste decisions based on the Waste Management PEIS is provided in Section 4.2.11.8. The Waste Management PEIS RODs affecting SRS are shown in Table 4.5.11.8–1.

Table 4.5.11.8–1. Waste Management PEIS Records of Decision Affecting SRS

Waste Type	Preferred Action
TRU waste	DOE has decided to store and prepare TRU waste onsite prior to disposal at WIPP. DOE amended its decision to transfer approximately 300 m^3 (10,594 ft^3) of contact-handled TRU waste from the Mound Plant to SRS for storage, characterization, and repackaging prior to sending it to WIPP for disposal (66 FR 38646).[a]
LLW	DOE has decided to treat SRS's LLW onsite and continue onsite disposal.[b]
Mixed LLW	DOE has decided to regionalize treatment of mixed LLW at the Hanford Site, INEEL, the ORR, and the SRS. DOE has decided to ship SRS's mixed LLW to either the Hanford Site or NTS for disposal. [b]
Hazardous waste	DOE has decided to continue to use commercial facilities for treatment of most of SRS's non-wastewater hazardous waste.[c]

[a] From the ROD for TRU waste (63 FR 3629) and the ROD for the WIPP Disposal Phase Supplemental EIS (63 FR 3624).
[b] From the ROD for LLW and mixed LLW (65 FR 10061).
[c] From the ROD for hazardous waste (63 FR 41810).

4.6 THE CARLSBAD SITE

The following sections describe the affected environment at the Carlsbad Site for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, and socioeconomics. In addition, radiation and hazardous chemical environment, transportation, and waste management are described.

4.6.1 Land Use and Visual Resources

4.6.1.1 Land Use

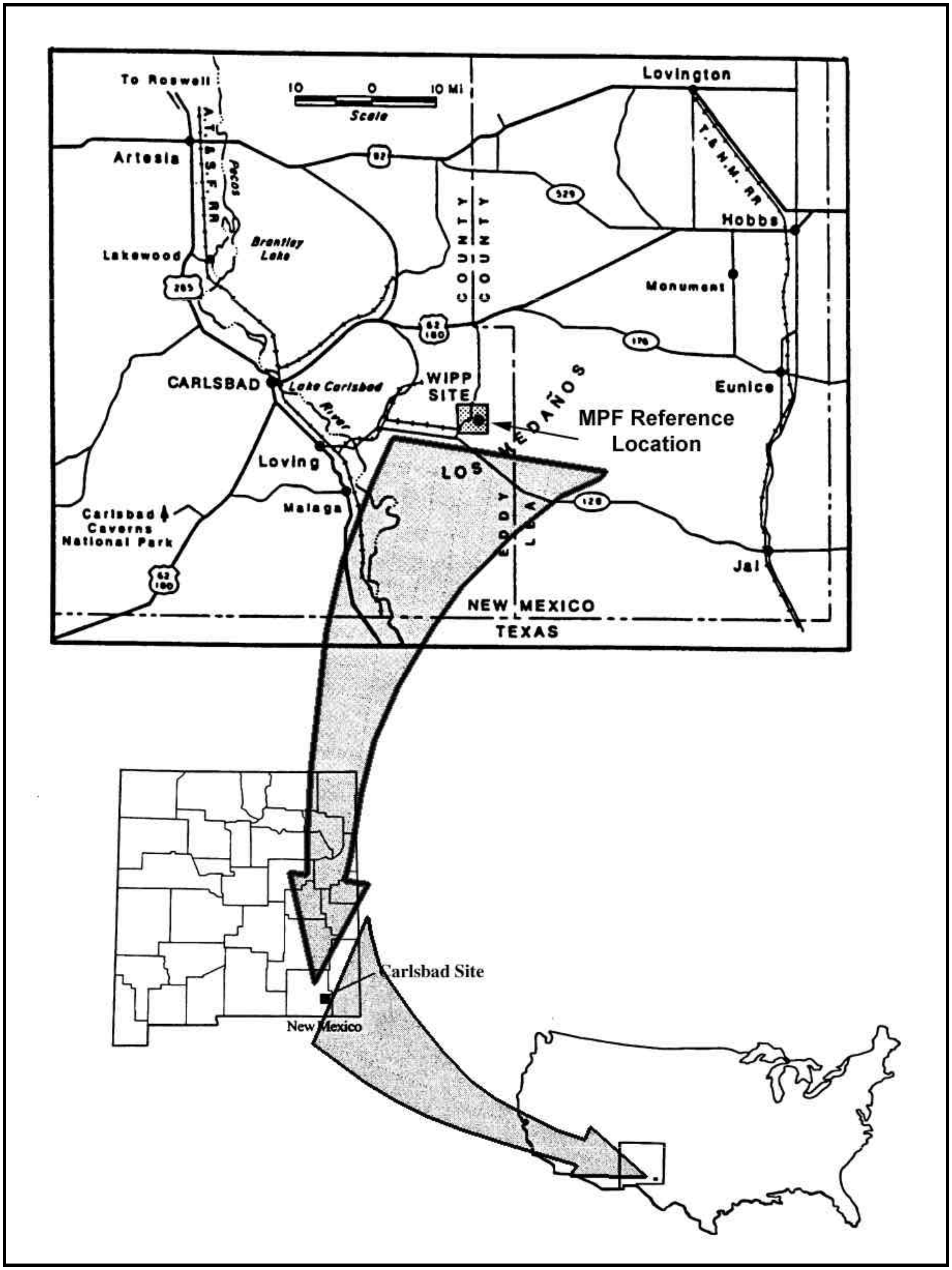
The Carlsbad Site is in Eddy County in southeastern New Mexico, 42 km (26 mi) east of Carlsbad, New Mexico (see Figure 4.6.1.1–1). Carlsbad Site and the surrounding land is a relatively flat, sparsely inhabited plateau with little surface water. The land for operation of the Waste Isolation Pilot Plant (WIPP) at Carlsbad was provided by the *WIPP Land Withdrawal Act* (Public Law 102-579, as amended by Public Law 104-201), which transferred the land from the U.S. Department of the Interior (DOI) to DOE and effectively withdrew the land from entry, sale, or disposition, appropriation under mining laws, and operation of the mineral and geothermal leasing laws. The Act also directed DOE to produce a management plan for grazing, hunting and trapping, wildlife habitat, the disposition of salt, and tailings and mining.

The Carlsbad Site includes WIPP, which is a square, 6.4 km (4 mi) on each side, comprising a total of 4,144 ha (10,240 ac). The WIPP Site is divided into four areas, with increasing levels of DOE control toward the center of the site. The innermost area is the Property Protection Area (see Figure 4.6.1.1–2), which is 14 ha (35 ac) surrounded by a chain link fence. Most of the WIPP facilities are within this area. These facilities include the Waste Handling Building where radioactive waste is received and prepared for underground disposal, four shafts to the underground area, a Support Building, an Exhaust Filter Building, and a water supply system.

Beyond the Property Protection Area is the Exclusive Use Area, which is 112 ha (277 ac) surrounded by barbed wire and fencing. Public access to the Exclusive Use Area is controlled by the WIPP security force. Within this area, DOE operates collection ponds for managing site runoff, some auxiliary buildings, and two-mined-rock (salt) piles. Just outside the barbed wire fence, but well within the WIPP property boundary is the Off-Limits Area. The Off-Limits Area is 575 ha (1,421 ac) that is unfenced to allow cattle grazing, but is posted for no trespassing.

However, this area contains sewage stabilization ponds that are fenced. The remaining land between the WIPP site boundary and the Off-Limits Area is 3,443 ha (8,507 ac) designated as multiple use. All the land in this area, as well as that in the Off-Limits Area, has been leased for grazing.

The reference location for the MPF is in the southern half of Section 21 of Township 22 South and Range 31 East, within the Off-Limits Area just east of the DOE Exclusive Use Area. There are approximately 130 ha (321 ac) available for development in this location. As stated above, the primary land usage in this area is grazing.



Source: DOE 1997b.

Figure 4.6.1.1–1. Location of the Carlsbad Site

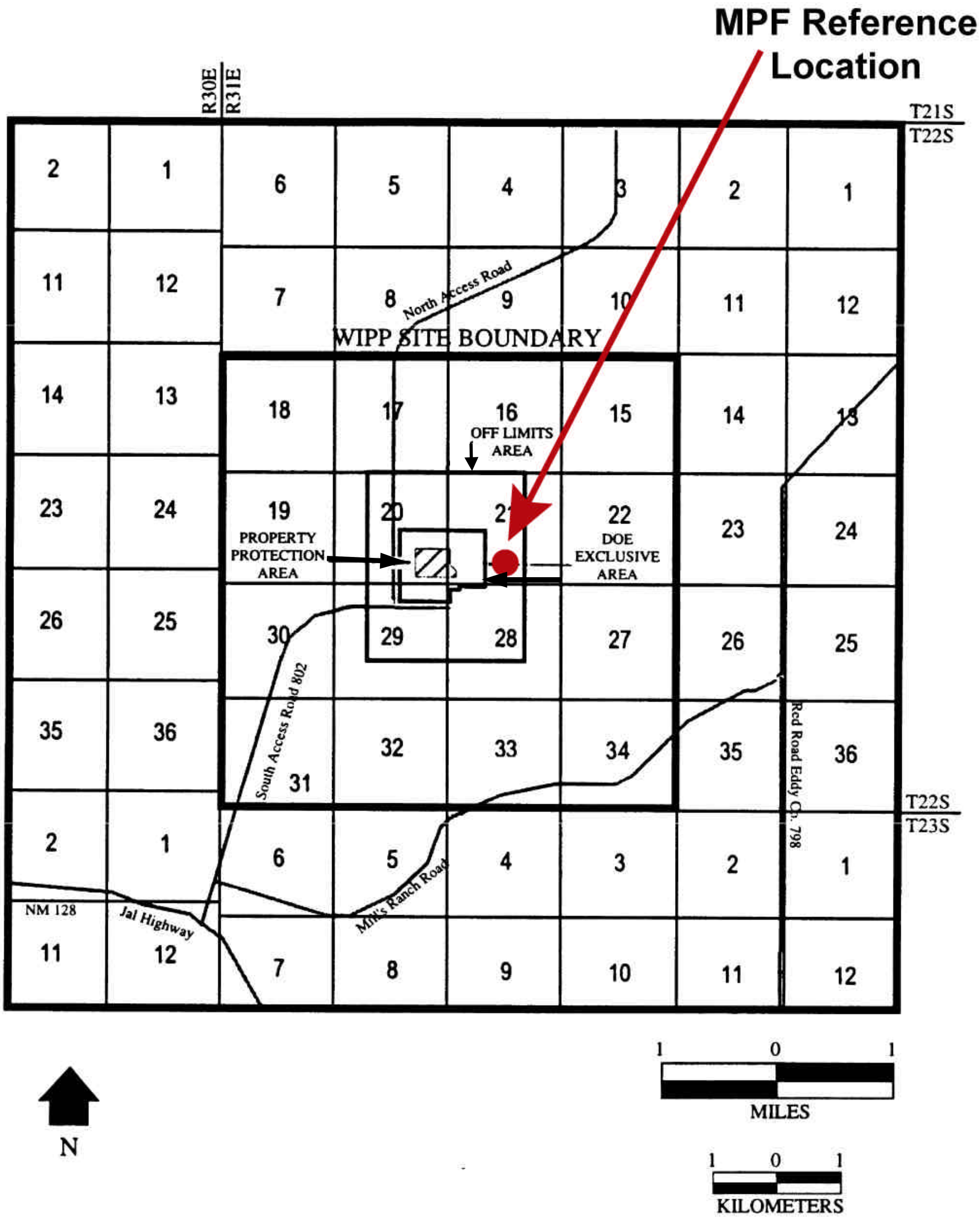


Figure 4.6.1.1–2. The Carlsbad Site

In accordance with the *WIPP Land Withdrawal Act*, DOE prepared a Land Management Plan (DOE 2002a). The Plan, prepared in cooperation with the State of New Mexico and the U.S. DOI's BLM, identifies resource values, promotes multiple-use management, and identifies long-term goals for the WIPP lands. It also provides opportunities for the public as well as local, state, and Federal agencies to participate in the land use planning process.

The land within 16 km (10 mi) of WIPP is predominantly owned by BLM, with interspersed parcels of state trust and privately owned lands, including two private ranches. It is used for grazing cattle, with lesser amounts used for oil and gas wells and potash mining. Recreation is another popular use of the land with hunting, camping, hiking, and bird watching being the major activities. In nearly all respects, surface land characteristics within a 16-km (10-mi) radius are similar to those on the WIPP site itself (see Section 4.6.1.2). The nearest community is Loving, New Mexico, 29 km (18 mi) west-southwest of WIPP with a population of approximately 1,300. The nearest major population center is Carlsbad.

4.6.1.2 Visual Resources

The Carlsbad Site is situated in the Los Medaños region of the Chihuahuan Desert. Los Medaños is located in an area of intergradation between the northern region of the Chihuahuan Desert and the Llano Estacado or Staked Plains (DOE 2002a). The region is characterized by aeolian and alluvial sedimentation on upland plains that form hummocks, dunes, sand ridges, and swales with the presence of Harvard Shin Oak as a prominent foliar factor (DOE 2002a). Additional foliage includes honey mesquite and an assortment of prairie grasses. Topographically, this high desert area contains few natural visual obstructions.

From viewpoints to the west, WIPP facilities and the site tailings pile are visible. From a northern viewpoint, a ridge obstructs the view of the Off-Limits Area and beyond. From the east, the same ridge obstructs the view of the innermost areas of the site and road access is restricted. From the southern viewpoint, the majority of the site is visible to the public. BLM has assigned a Class IV Visual Resource Management rating to the entire WIPP site (Lynn 2002b). For a description of the BLM classification system, see Table 4.2.1.2–1. Management activities within this class require major modifications of the existing character of the landscape.

4.6.2 Site Infrastructure

An extensive network of existing infrastructure provides services to WIPP activities and facilities as shown in Table 4.6.2–1. These services are discussed in detail in the following sections. Two categories of infrastructure—transportation access and utilities—are described below for the Carlsbad Site. Transportation access includes roads, railroads, and airports while utilities include electricity and fuel (e.g., natural gas, gasoline, and coal).

4.6.2.1 Transportation

The site can be reached from the north access road, which intersects U.S. 62/180, 21 km (13 mi) north of the Carlsbad Site and south access road which intersects NM 128 at a distance of 6.5 km (4 mi) southwest of the Carlsbad Site. There are approximately 5-8 km (3-5 mi) of unimproved (dirt) roads onsite. There is a DOE constructed rail spur to the site from the

Burlington Northern and Santa Fe Railroad at a distance of 10 km (6 mi) west of the site (DOE 1997b).

Table 4.6.2–1. Carlsbad Site Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	24	NA
Railroads (km)	10	NA
Electricity		
Energy consumption (MWh/yr)	19,759	175,200
Peak load (MWe)	3.8	20
Fuel		
Natural gas (m^3/yr)	0	NA[a]
Liquid fuel (L/yr)	113,600	NA[b]
Coal (t/yr)	0	0

NA = not available.
[a] 12-inch natural gas line is about 1.6 km (1 mi) north of the site.
[b] Capacity – 2 pump fueling stations with 30,283 L (8,000 gal) of fuel storage.
Source: Johnson 2002a.

Portions of two Federal airways are within 8 km (5 mi) of the Carlsbad Site. The nearest commercial airport is in Cavern City, 45.1 km (28 mi) west of the Carlsbad Site near Carlsbad, New Mexico. Other airports in the area are Eunice (51.5 km [32 mi] east), Carlsbad Caverns (67.6 km [42 mi] southwest), Hobbs Airport (67.6 km [42 mi] northeast), Jal (64.4 km [40 mi] southeast), Lovington (80.5 km [50 mi] northeast), and Artesia (82.1 km [51 mi] northwest) (DOE 2002a).

4.6.2.2 Electrical Power

The Carlsbad Site is serviced by an overhead electrical transmission line that traverses the 4,146 ha (10,240 acre) site for 3.2 km (2 mi) to the north and an additional 3.2 km (2 mi) to the south (DOE 1996a). In 2001, annual site consumption of electricity was approximately 19,759 MWh (Johnson 2002a).

4.6.2.3 Fuel

There is currently no natural gas being used at the site; however, capacity is available from a 30-cm (12-in) natural gas line owned by El Paso Natural Gas, approximately 1.6 km (1 mi) north of the site. Approximately 113,600 L/yr (30,000 gal/yr) of liquid fuel is consumed at the site. Additional capacity is available from two pump fuel stations with 30,283 L (8,000 gal) of fuel storage. There is no coal consumption at the Carlsbad Site (Johnson 2002a).

4.6.3 Air Quality and Noise

4.6.3.1 Climate and Meteorology

The regional climate at the Carlsbad Site is semi-arid, with generally mild temperatures, low precipitation and humidity, and a high rate of evaporation. Temperatures are moderate throughout the year, although seasonal changes are distinct. The mean annual temperature in southeastern New Mexico is 17.2°C (63°F). In the winter (December through February), nighttime lows average near -5°C (23°F), and average maxima average near 10°C (50°F). The lowest recorded temperature at the nearest Class-A weather station in Roswell was -33.8°C (-29°F) in February 1905. In the summer (June through August), the daytime temperature exceeds 32.2°C (90°F) approximately 75 percent of the time. On June 27, 1994, the National Weather Service documented a measurement of 50°C (122°F) at WIPP as the record high temperature for New Mexico (DOE 2002a).

Precipitation is light and unevenly distributed throughout the year, averaging 33 cm (13 in) for the past 5 years. Winter is the season of least precipitation, averaging less than 1.5 cm (0.6 in) of rainfall per month. Snow averages about 13 cm (5 in) per year at the site and seldom remains on the ground for more than a day at a time because of the typically above-freezing temperatures in the afternoon. Approximately half the annual precipitation comes from frequent thunderstorms during June through September. Rains are usually brief but occasionally intense and can result in flash flooding in arroyos and along floodplains (DOE 2002a).

Prevailing winds are from the southeast approximately 13 percent of the time, and the dominant wind speed ranges from 8-11 km/hr (5-7 mph) with an occurrence of 38 percent. Wind speeds categorized as calm (less than 3 km/hr [2 mph]) occur about 4 percent of the time (DOE 2002h). These conditions are consistent with long-term averages for the region. High winds associated with thunderstorms are frequently a source of localized blowing dust. Dust storms covering an extensive area are rare, and those that reduce visibility to less than 1.6 km (1.1 mi) occur only with the strongest pressure gradients such as those associated with intense extratropical cyclones that occasionally form in the region during winter and early spring. Winds of 80-97 km/hr (50-60 mph) and higher may persist for several days if these pressure systems become stationary. Ten windstorms of 93 km/hr (58 mph) and greater were reported during 1955-1967 within the area in which the WIPP facility is located.

Tornadoes are common throughout the region. From 1955-1967, 15 tornadoes were reported in the WIPP site area covered by one degree of latitude and longitude. Tornado statistics indicate that the average frequency of a tornado striking WIPP is 8.1×10^{-4} times per year, or about once every 1,235 years (DOE 2002a).

4.6.3.2 Nonradiological Releases

WIPP operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. WIPP is located within Pecos-Permian Basin Intrastate AQCR. The area encompassing WIPP and Eddy County is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) (40 CFR 81.332). In addition to the NAAQS established by EPA, the State of

New Mexico has established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates, hydrogen sulfide, and total reduced sulfur. The PSD Class I areas nearest to WIPP are Carlsbad Caverns National Park, which is approximately 61 km (38 mi) southwest of WIPP, and Guadalupe Mountains National Park, which is approximately 100 km (62 mi) southwest of WIPP.

WIPP has completed inventories of potential pollutants and emissions in accordance with EPA and New Mexico Air Quality Control Regulations (NMAQCR). Based on these inventories, WIPP has no permitting or reporting requirements at this time except for those applying to two primary backup diesel generators. A NMAQCR operating permit was issued for the two diesel generators in 1993. The diesel generators are assumed to emit four pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, and PM_{10}) and have strict limits on those emissions.

Based on the initial 1993 air emissions inventory, WIPP is not required to obtain Federal *Clean Air Act* permits. WIPP, in consultation with the NMED Air Quality Bureau, working in concert with data provided in the first air emissions inventory, was required to obtain a NMAQCR 702, Operating Permit (recodified in 1997 as 20.2.72 NMAC, "Construction Permits") for two primary backup diesel generators at the site. The only emission points where WIPP exceeds state threshold criteria requiring a permit are the backup diesel generators. WIPP completed all necessary requirements for emissions monitoring and sampling required by New Mexico Air Quality Permit 310-M-2. During 2001, backup diesel generators were operated for approximately 28 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operation that would cause a violation of the permit. Proposed facility modifications are reviewed to determine if they caused new air emissions and require permit applications.

Prior to October 1994, ambient monitoring of sulfur dioxide, hydrogen sulfide, nitrogen dioxide, TSP, carbon monoxide, and VOCs was conducted at WIPP. The results of this monitoring program indicated that air quality in the area of WIPP usually met state and Federal standards. TSP standards were occasionally exceeded during periods of high wind and blowing sands, and the ambient air quality standard for sulfur dioxide had been infrequently exceeded. Because there is no regulatory requirement to conduct air quality monitoring at WIPP, the ambient air monitoring stations at WIPP have been decommissioned. TSP monitoring continues weekly at offsite locations. Estimated concentrations at maximally impacted points of unrestricted public access are summarized in Table 4.6.3.2–1.

The existing ambient air concentrations attributable to sources at WIPP are expected to represent a small percentage of the ambient air quality standards.

Table 4.6.3.2–1. WIPP Estimated Nonradiological Ambient Air Emissions

Pollutant	Averaging Period	Most Stringent Standard[a] (micrograms per m^3)	Estimated Ambient Concentration (micrograms per m^3)
Carbon monoxide	8-hour	8,900 [b]	110
	1-hour	13,400 [b]	410
Nitrogen dioxide	Annual	84 [b]	0.28
	24-hour	168 [b]	110
Sulfur dioxide	Annual	47 [b]	0.02
	24-hour	234 [b]	8.5
	3-hour	1,170 [c]	77
PM_{10}	Annual	50 [a]	0.67
	24-hour	150 [a]	85

[a] National Primary Ambient Air Quality Standard (40 CFR 50)
[b] New Mexico Ambient Air Quality Standard (Air Quality Criteria Regulation 201) corrected for altitude.
[c] National Secondary Ambient Air Quality Standard (40 CFR 50) corrected for altitude.
Source: DOE 1997b.

4.6.3.3 Radiological Releases

In the Carlsbad Site region, airborne radionuclides originate from natural sources (i.e., terrestrial and cosmic), worldwide fallout, and WIPP operations. DOE maintains a network of seven air sampling stations on and around WIPP to determine concentrations of radioactive particulates and aerosols in the air. DOE provides detailed summaries of radiological releases to the atmosphere from WIPP operations, along with resulting concentrations and doses, in a series of annual environmental data reports. Table 4.6.3.3–1 lists minimum, maximum, and average radionuclide concentrations obtained from composite air sampling locations surrounding WIPP. Since radioactive materials remain in the waste containers, there are no emissions of radionuclides to the ambient air from DOE facilities during normal WIPP waste handling, and the public is not subjected to radioactivity from the WIPP facility. The WIPP 2001 National Emissions Standards for Hazardous Air Pollutants (NESHAP) Report concluded that WIPP operated in compliance with the release standards of 40 CFR 191, Subpart A, and 40 CFR 61, Subpart H (WTRU 2002).

4.6.3.4 Noise

The Carlsbad Site is located in a sparsely populated area of southeastern New Mexico. The dominant use of the land within 16 km (10 mi) of the site is grazing, with lesser amounts used for oil and gas extraction and potash mining. BLM owns most of this land. Two ranches are located within 16 km (10 mi) of WIPP. The nearest prominent man-made features are the city of Loving (with a 1990 population of 1,243), which is 29 km (18 mi) west-southwest, and the city of Carlsbad (with a 1990 population of 24,896), which is 42 km (26 mi) west. The area of land that lies within the WIPP Site Boundary and committed to the WIPP facility is a square. Each side of the square is 6.4 km (4 mi), or 4,146 ha (10,240 ac) or 41.4 km^2 (16 mi^2). The main operations structures consist of the Waste Handling Building, the Support Building and the Exhaust Filter Building. Noise generated by topside operations is limited and potential public receptors are sufficiently removed from noise exposure as a result of the facility's geographical location, site boundary demarcation, and access control requirements (DOE 2002h).

Table 4.6.3.3–1. Minimum, Maximum, and Average Radionuclide Concentrations (Bq/m^3) in Air Filter Composites from Stations Surrounding the WIPP Site

Radionuclide		RN	2xTPU	MDC
Americium-241	Minimum	-4.26×10^{-8}	6.40×10^{-8}	3.81×10^{-8}
	Maximum	6.03×10^{-8}	6.11×10^{-8}	2.17×10^{-7}
	Average	1.87×10^{-8}	4.88×10^{-8}	8.58×10^{-8}
Plutonium-238	Minimum	-3.36×10^{-8}	6.73×10^{-8}	3.92×10^{-8}
	Maximum	2.07×10^{-7}	2.23×10^{-7}	3.05×10^{-7}
	Average	2.23×10^{-8}	9.37×10^{-8}	1.43×10^{-7}
Plutonium-239+240	Minimum	-2.96×10^{-8}	5.96×10^{-8}	3.52×10^{-8}
	Maximum	1.08×10^{-7}	1.34×10^{-7}	2.18×10^{-7}
	Average	1.62×10^{-8}	5.36×10^{-8}	7.84×10^{-8}
Uranium-234	Minimum	2.01×10^{-8}	4.48×10^{-7}	3.52×10^{-8}
	Maximum	4.59×10^{-8}	8.51×10^{-7}	1.29×10^{-7}
	Average	2.96×10^{-8}	1.66×10^{-8}	5.80×10^{-8}
Uranium-235	Minimum	0.00×10^{0}	0.00×10^{0}	4.44×10^{-8}
	Maximum	8.18×10^{-7}	9.29×10^{-8}	2.10×10^{-7}
	Average	1.69×10^{-7}	2.82×10^{-7}	7.74×10^{-8}
Uranium-238	Minimum	1.75×10^{-8}	4.18×10^{-7}	3.51×10^{-8}
	Maximum	4.81×10^{-8}	9.55×10^{-7}	1.82×10^{-7}
	Average	2.90×10^{-8}	1.63×10^{-8}	6.42×10^{-8}
Potassium-40	Minimum	-5.29×10^{-6}	2.37×10^{-4}	1.27×10^{-4}
	Maximum	6.44×10^{-3}	2.46×10^{-4}	8.84×10^{-4}
	Average	6.90×10^{-4}	3.11×10^{-3}	3.31×10^{-4}
Cobalt-60	Minimum	-1.32×10^{-5}	2.94×10^{-5}	1.98×10^{-5}
	Maximum	3.96×10^{-5}	4.00×10^{-5}	5.07×10^{-8}
	Average	6.32×10^{-6}	2.72×10^{-5}	2.89×10^{-5}
Strontium-90	Minimum	-7.47×10^{-6}	5.66×10^{-6}	6.99×10^{-6}
	Maximum	6.33×10^{-8}	4.40×10^{-6}	1.44×10^{-5}
	Average	2.01×10^{-7}	7.08×10^{-8}	8.77×10^{-8}
Cesium-137	Minimum	-3.81×10^{-5}	3.28×10^{-5}	1.69×10^{-5}
	Maximum	3.70×10^{-5}	3.70×10^{-5}	4.88×10^{-5}
	Average	-7.71×10^{-7}	3.35×10^{-5}	2.62×10^{-5}

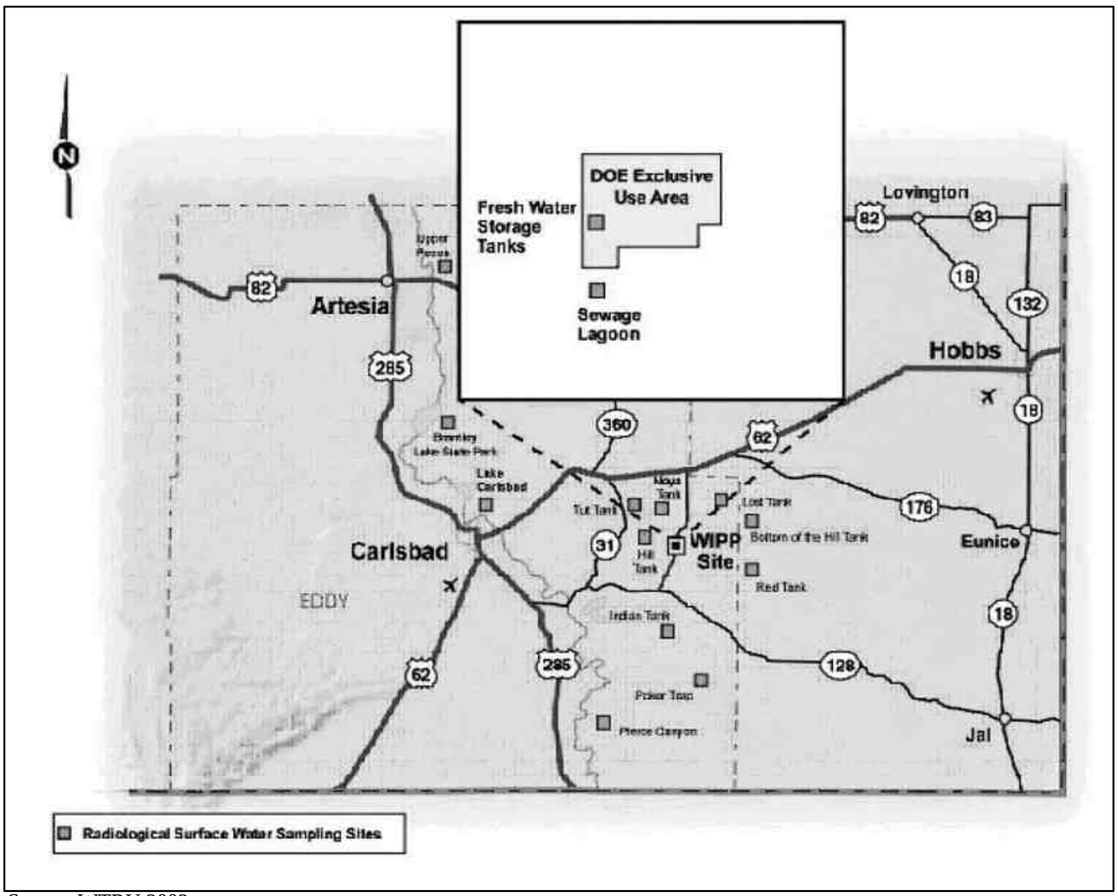
RN = Radionuclide concentration
TPU = Total Propagated Uncertainty (Standard Deviation, in the case of the mean)
MDC = Minimum Detectable Concentration
Source: DOE 1997b.

The ambient noise level in the WIPP area prior to construction was 26 to 28 dB. DOE requires its facilities to comply with OSHA standards as promulgated in 29 CFR 1910.95. Any WIPP noise sources with the potential to exceed these standards have been mitigated (for example, noise dampers have been installed in the underground air exhausts) and are now in compliance with 29 CFR 1910.95. The ambient noise level around WIPP has been estimated to be about 50 dB at a distance of 120 m (400 ft) from the Waste Handling Building due to normal operations. This qualitative estimate was determined to be accurate for *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b) and remains accurate for the current WIPP operations. DOE requires its facilities to comply with OSHA standards as promulgated in 29 CFR 1910.95 for protection of workers (DOE 2001b).

4.6.4 Water Resources

4.6.4.1 Surface Water

The Carlsbad Site is located 19 km (12 mi) east of the Pecos River and within the Pecos River Basin, which represents about one-half of the drainage area of the Rio Grande Water Resources Region. The drainage area of the Pecos River at this location is 49,200 km^2 (19,000 mi^2). WIPP has a few small intermittent creeks, the only westward-flowing tributaries of the Pecos River within 32 km (20 mi) north or south of the site (Figure 4.6.4.1–1).



Source: WTRU 2002.

Figure 4.6.4.1–1. Surface Water at the Waste Isolation Pilot Plant

The Pecos River is the main surface water resource in the Carlsbad Site vicinity. Due to inflow from brine springs and slight exceedance of water quality levels of certain heavy metals, river water is not used for human consumption (DOE 1997b). Irrigation and livestock watering are the primary uses of the water from the Pecos River.

More than 90 percent of the mean annual precipitation at the site is lost by evapotranspiration. On an average monthly basis, evapotranspiration at the site greatly exceeds the available rainfall; however, intense local thunderstorms produce runoff and percolation. The maximum recorded flood on the Pecos River occurred on August 23, 1966, near Malaga, about 25 km (15 mi) from the Carlsbad Site. The maximum elevation of the flood was 90 m (300 ft) below the elevation of the WIPP surface facility.

WIPP does not lie within the 100-year floodplain. The general ground elevation in the vicinity of the surface facility is about 152 m (500 ft) above the riverbed and 122 m (400 ft) above the 100-year floodplain. No information on the 500-year floodplain is available. Protection from flooding is provided by the diversion of water away from WIPP by a system of peripheral interceptor diversions.

Surface Water Quality

Samples were collected once in 2001 from 10 sampling locations and analyzed for radionuclides (WTRU 2002). See Figure 4.6.4.1–1 for sampling locations. Isotopes of natural uranium were detected in surface water at every sampling location. Uranium-234 ranged from 1.12×10^{-2} picocuries per liter (pCi/L) to 5.89 pCi/L. The MCL for uranium-234 is 500 pCi/L. Uranium-235 was detected in 54 percent of the samples, with concentration ranging from 3.46×10^{-3} pCi/L to 1.76×10^{-1} pCi/L. The MCL for uranium-235 is 600 pCi/L. Results for uranium concentrations in 2001 samples were compared with the uranium concentrations in 2000 samples. There was no significant difference in the concentration of any uranium isotope between the years. The results for plutonium-238, plutonium-239+240 and americium-241 samples showed levels below the Minimum Detection Concentration in every sample. The results of selected radionuclides are summarized in Table 4.6.4.1–1.

4.6.4.2 Groundwater

The WIPP repository is situated in the thick, relatively impermeable Salado Formation salt beds 655 m (2,150 ft) below the ground surface. The hydrologic and mechanical properties of the salt beds surrounding WIPP are better understood than the regional hydrology. Generally, however, groundwater in the Rustler and Dewey Lake Formations and the units overlying them are essentially isolated from the hydrology of the Salado Formation.

The Rustler Formation includes the Culebra and Magenta Dolomites, two units containing water of low quality (brine to brackish) (DOE 1997b). The Culebra Dolomite, which is the first notable water-bearing unit above the Salado Formation, has been investigated for its potential to transport radionuclides released from the repository resulting from a borehole intrusion. Groundwater flow in the units overlying the Salado Formation has been assumed to occur primarily in the Culebra Dolomite, although it is recognized that regional flow in the Rustler Formation is three-dimensional and occurs to some degree in all Rustler units (DOE 1997a).

Flow in the Culebra is generally from north to south. The Dewey Lake Formation overlies the Rustler Formation and in some areas is relatively transmissive, particularly in the south-central and southwestern part of the WIPP site (DOE 1997b). The location of the water table is generally considered to be within the Dewey Lake Formation.

Table 4.6.4.1–1. Selected Radionuclide Concentration (pCi/L) in Surface Water Near WIPP

Location	Results	MCL or DCG	Result	MCL or DCG
	Cesium-137		**Cobalt-60**	
BRA	3.27	200	12.59	100
CBD	8.73	200	-0.27	100
FWT	-22.5	200	0.82	100
HIL	5.54	200	1.94	100
IDN	5.49	200	2.04	100
NOY	0.54	200	0.58	100
PCN	6.86	200	-3.97	100
SWL	-1.16	200	-3.97	100
TUT	-12.40	200	8.11	100
UPR	2.00	200	4.70	100
	Strontium-90		**Potassium-40**	
BRA	-0.51	1,000	198.90	15
CBD	0.080	1,000	115.94	15
FWT	0.31	1,000	129.99	15
HIL	0.62	1,000	105.94	15
IDN	0.497	1,000	-33.51	15
NOY	0.96	1,000	-77.57	15
PCN	0.38	1,000	2756.75	15
SWL	-0.72	1,000	591.89	15
TUT	0.13	1,000	152.97	15
UPR	-0.44	1,000	86.49	15
	Uranium-234		**Uranium-235**	
BRA	2.89	500	0.086	600
CBD	3.57	500	0.098	600
FWT	1.43	500	0.038	600
HIL	0.59	500	0.027	600
IDN	0.33	500	0.025	600
NOY	0.30	500	0.015	600
PCN	5.89	500	0.18	600
SWL	1.21	500	0.0052	600
TUT	0.26	500	0.014	600
UPR	2.20	500	0.097	600

Source: WTRU 2002.

Only a few locations of groundwater recharge and discharge to and from the Rustler Formation are known. The only documented areas of naturally occurring groundwater discharge within 24 km (15 mi) of WIPP are the Pecos River near Malaga Bend and, to a lesser extent, the saline lakes in Nash Draw, a shallow drainage course about 8 km (5 mi) wide (DOE 1997b). This local flow associated with Nash Draw is unrelated to groundwater flow at WIPP. The only documented area of groundwater recharge is also near Malaga Bend (DOE 1997b). This location is hydraulically downgradient from the repository, and recharge here has little relevance to flow near WIPP. Recent regional groundwater modeling has suggested that groundwater in the Culebra, Magenta, and Dewey Lake and Triassic units originates in areas that are north and northeast of WIPP (DOE 1997b).

Water service for WIPP is provided by a water line that originates 50 km (31 mi) north of the site. This water line provides all water required for operations of WIPP as well as untreated water to the city of Carlsbad (DOE 1996a). However, the city of Carlsbad owns rights to a total of 8.6 billion L/yr (2.3 billion gal/yr) of groundwater in the wellfield that currently supplies WIPP and an additional 12.6 billion L (3.3 billion gal) in an undeveloped wellfield nearby. Water consumption in 2001 was approximately 25,963,000 L (6,858,646 gal). The current maximum water limit provided by the city of Carlsbad is at 75.7 million L/yr (20 million gal/yr) but WIPP has water capacity of approximately 2.4 billion L/yr (650 million gal/yr). Wells for this supply line are located near Maljamar, New Mexico, and tap the Ogallala Aquifer (Johnson 2002a).

Nonpotable water, used primarily for irrigation and livestock watering, comes from the Pecos River (DOE 1997b).

Groundwater Quality

Groundwater samples were collected twice in 2001 from seven different wells around the WIPP site. The water samples were collected from depths ranging from 180-270 m (600-900 ft) from six wells (WQSP-1 to WQSP-6), and from a depth of 69 m (225 ft) from WQSP-6A (WTRU 2002). Isotopes of naturally occurring uranium were detected in every well in 2001. The mean concentrations of Uranium-234 ranged from 6.84 pCi/L to 3.49×10^{1} pCi/L. Uranium-235 ranged from 1.59×10^{-1} pCi/L to 3.34×10^{-2} pCi/L. The concentrations of uranium isotopes in water samples collected from these wells were compared between 2000 and 2001. There was a significant difference in the concentration of uranium isotopes. The average concentration for both nuclides was approximately two times higher in 2001. This may be due to two different laboratories performing the analysis, employing two different methods in 2000 and 2001. The groundwater had a high total dissolved solids content, which caused the average chemical recovery of the samples to be less in 2001. The results of groundwater sampling are summarized in Table 4.6.4.2–1.

Table 4.6.4.2-1. Average Annual Radionuclide Concentration (pCi/L) in Groundwater from Wells at the WIPP Site

Location	Mean (pCi/L)		
	Americium-241	**Plutonium-238**	**Plutonium-239+240**
MCL or DCG	NS	40	30
WQSP-1	0.011	0.0079	0.0016
WQSP-2	0.00	0.0059	-0.15
WQSP-3	0.014	0.0059	0.00
WQSP-4	0.0081	0.0058	0.00039
WQSP-5	-0.0056	0.0029	0.0015
WQSP-6	-0.0056	0.0029	-0.0025
WQSP-6A	0.0057	0.0092	-0.0016
	Uranium-234	**Uranium-235**	**Uranium-238**
MCL or DCG	500	600	40
WQSP-1	3.49	0.90	5.70
WQSP-2	31.08	0.48	5.08
WQSP-3	7.32	0.16	1.12
WQSP-4	14.35	0.22	2.41
WQSP-5	15.54	0.22	2.25
WQSP-6	14.81	0.33	2.02
WQSP-6A	6.83	0.25	3.59
	Cesium-137	**Cobalt-60**	**Potassium-40**
MCL or DCG	200	100	15
WQSP-1	-0.31	0.90	5.70
WQSP-2	-6.81	14.11	424.32
WQSP-3	-0.13	2.95	140.54
WQSP-4	-3.43	1.68	694.60
WQSP-5	-2.32	0.99	2756.75
WQSP-6	-10.43	4.68	165.95
WQSP-6A	2.24	3.89	164.32
	Strontium-90	**Radium-226**	**Radium-228**
MCL or DCG	8	5*	5*
WQSP-1	-0.31	149.19	28.11
WQSP-2	-0.14	104.86	13.89
WQSP-3	-0.25	182.43	29.73
WQSP-4	1.60×10^{-2}	0.43	239.46
36.76	9.84×10^{-3}	0.27	73.24
10.35	0.045	24.05	4.59
WQSP-6A	0.33	10999.99	0.18

* Denotes combined Radium-226 and Radium-228 MCL standard
NS = No Standard.
pCi/L = picocuries/Liter.
Source: WTRU 2002.

4.6.5 Geology and Soils

4.6.5.1 Geology

The Carlsbad Site is located in southeastern New Mexico, in the northern portion of the Delaware Basin in the Pecos Valley Section of the Great Plains Physiographic Province. The Delaware Basin is a structural basin underlying present-day southeastern New Mexico and western Texas and containing a thick sequence of sandstones, shales, carbonates, and evaporites.

The terrain throughout the Great Plains Physiographic Province varies from plains and lowlands to rugged canyons. In the immediate vicinity of WIPP, numerous small mounds formed by wind-blown sand characterize the land surface. The representative site being evaluated for the MPF is located east of the WIPP project location (see Figure 4.6.1.1–2).

Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of the ground and infrastructure at WIPP and includes potential volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

Volcanism

While there is a layer of volcanic ash that dates back to 600,000 years ago, volcanic activity is considered unlikely over the next 10,000 years (EPA 1996).

Seismic Activity

No surface displacement or faulting younger than early Permian (Wolfcampian) has been reported, indicating that tectonic movement since then, if any, has not been noteworthy. No mapped Quaternary (last 1.9 million years) or Holocene (last 10,000 years) faults exist closer to the site than the western escarpment of the Guadalupe Mountains, about 100 km (60 mi) west-southwest (DOE 1997b).

The strongest earthquake on record in the region occurred within 290 km (180 mi) of the WIPP site. The August 16, 1931, Valentine, Texas, earthquake had an estimated Richter magnitude of 6.4. The estimated ground shaking from this earthquake that would have been felt at WIPP is a Modified Mercalli Intensity V, which is defined to be shaking that is felt by nearly everyone, with some dishes breaking and shutters and pictures moving (see Table 4.2.5.1–2) (DOE 1997b).

Since 1990, at least two seismic events have occurred that were recorded at WIPP. The Richter magnitude 5.0 Rattlesnake Canyon Earthquake occurred approximately 100 km (60 mi) east-southeast of WIPP in January 1992. This event had no effect on any of the structures at WIPP. The most recent earthquake recorded at WIPP occurred April 14, 1995, at a distance of 32 km (20 mi) east-southeast of Alpine, Texas (approximately 240 km [150 mi] south of the site) with a Richter magnitude of 5.3 (DOE 1997b). These events had no effect on any structures at WIPP.

Slope Stability, Subsidence, and Soil Liquefaction

The site slopes gently from east to west, from an elevation of 1,088 m (3,570 ft) above sea level at its eastern boundary to 990 m (3,250 ft) above sea level along its western boundary. Landslides are not considered a threat in the area.

Subsidence (lowering of the ground surface) is known to occur in areas overlying layers of carbonates and evaporates. However, there is no field evidence of surface subsidence features at WIPP (63 FR 273.54).

4.6.5.2 Soils

The soils in the immediate vicinity of WIPP are made mostly of wind-blown sand and dust. The Mescalero caliche, a layer enriched in calcium carbonate material ranging in age from about 510,000 to about 410,000 years, is typically present beneath the surface layer of sand (DOE 1997b).

Soil Erosion

Intense local thunderstorms can produce significant localized runoff and associated localized erosion.

Mineral Resources

Resources such as oil, natural gas, and potash are in the region of WIPP. Mining and drilling activities other than those supporting the WIPP project are restricted within Section 16 area of the WIPP site (see Figure 4.6.1.1–2) (DOE 1997b).

4.6.6 Biological Resources

4.6.6.1 Terrestrial Resources

The Carlsbad Site is located in Eddy County, New Mexico, and encompasses approximately 41 km^2 (16 mi^2) within the remote Chihuahuan Desert of southeastern New Mexico. The site is 42 km (26 mi) east of Carlsbad, New Mexico. Geographically, the region is a relatively flat, sparsely inhabited plateau with little surface water (DOE 2002a). The *WIPP Land Withdrawal Act* was signed into law on October 30, 1992, transferring the land from DOI to DOE. With the exception of facilities within the boundaries of the posted 6 km^2 (2 mi^2) Off-Limits Area, the surface land uses remain largely unchanged from pre-1992 uses, and are managed in accordance with accepted practices for multiple land use (WTRU 2002). The WIPP withdrawal area includes portions of two grazing allotments administered by the DOI's BLM. DOE is responsible for range management decisions within the WIPP withdrawal area, including those affecting the two grazing allotments. However, as stipulated in the Memorandum of Understanding between DOE and DOI, BLM will provide for management of the grazing allotments within the WIPP withdrawal area in accordance with applicable grazing laws. DOE manages all habitat within the WIPP withdrawal area for ungulates, raptors, upland game, and any state- and/or federally-listed species of plants or animals occupying the WIPP withdrawal area (JPA 1997).

The Chihuahuan Desert has long been regarded for its extraordinary diversity of plant and animal communities. The location of WIPP, situated in the Los Medaños region of the Chihuahuan Desert, exemplifies this unusual array of biotic factors. The Los Medaños is located in an area of intergradation between the northern region of the Chihuahuan Desert and the Llano Estacado (Staked Plains). The region is characterized by aeolian (wind borne) and alluvial (water borne) sedimentation on upland plains that form hummocks, dunes, sand ridges, and swales with the presence of shinnery oak (or shin oak) (*Quercus havardii*) as a prominent woody species. Shrubs and grasses are the most prominent components of the local flora. Dominant trees include shinnery oak, honey mesquite (*Prosopis glandulosa*), and western soapberry (*Sapindus drummondii*). Much of the area is composed of combined dune and grassland habitats that include perennial grasses and shrubs. Although the abundance of shin oak has aided in the stabilization of the dunes, a number of them remain unstable and exhibit distinct signs of shifting. An additional predominant shrub is honey mesquite that has invaded what historically was a short-grass, shinnery oak-dominated landscape. As with many areas, the shinnery oak community has shifted from a dominant bluestem/grama *(Andropogon* spp*./Bouteloua* spp*.)* grassland with varying amounts of shinnery oak, sand sage *(Artemisia filifolia)*, and yucca *(Yucca* spp*.)* to a composition dominated by dropseeds *(Sporobolus* spp*.)*, three-awns *(Aristida* spp*.)*, and gramas, with high densities of plains yucca *(Yucca glauca)*, annual forbs, and honey mesquite.

The subtle blend of plant communities with shin oak/dune habitat that somewhat dominates the grassland affords a composition of factors that results in the diverse wildlife population of the Los Medaños. Wildlife in the vicinity of WIPP is characterized by a wide variety of insects, amphibians, reptiles, mammals, and birds. Wildlife populations are characterized by numerous species of arthropods, amphibians, reptiles, birds, and mammals.

Reptiles and amphibians are found in great numbers in southeastern New Mexico. Representative of the no fewer than 10 native amphibians are the tiger salamander (*Ambystoma tigrinum*), green toad (*Bufo debilis*), plain's spadefoot toad (*Spea bombifrons*), red-spotted toad (*Bufo punctatus*), and New Mexico spadefoot toad (*Spea muliplicata*). Their significance is seldom recognized until spring or summer rains, at which time they appear in extraordinary numbers. Reptiles comprise more conspicuous inhabitants due to the diurnal nature of numerous species. Characteristic of the approximately 35 distinct species of indigenous reptiles in the region include the ornate box turtles (*Terrapene ornata*), side-blotched lizards (*Uta stansburiana*), western whiptails (*Cnemidophorus tigris*), bullsnakes (*Pituophis melanoleucus*), prairie rattlesnakes (*Crotalus viridis*), and Texas horned lizards *(Phrynosoma cornutum*).

This portion of New Mexico supports an abundant and diverse population of mammals. As is common in desert biomes, black-tailed jackrabbits (*Lepus californicus)* and desert cottontails (*Sylvilagus audoboni*) are the most conspicuous mammals. Three species of ground squirrel (*Spermophilus* spp.) and numerous other rodents such as kangaroo rats (*Dipodomys* spp.) and cactus mice (*Peromyscus eremicus*) also occupy the area. Large piles of debris, which may consist of aluminum cans, cow dung, and other rubbish (sometimes to a height of nearly 1.5 m [5 ft]), clustered at the base of cactus or large mesquites characterize the houses (or "middens") of the Southern Plains woodrat (*Neotoma micropus*). Big-game species, such as desert mule deer (*Odocoileus hemionus*) and carnivores such as badgers (*Taxidea taxis*), coyotes (*Canis latrans*), gray foxes (*Urocyon cinereoargenteus*), and striped skunks (*Mephitis mephitis*) also frequent the area. According to the BLM's Resource Management Plan, 15 percent of the wildlife species identified in the Resource Area utilize the Shin Oak habitat with 30 percent occupying areas consisting primarily of grass compositions with greater than 75 percent grasses.

Bird densities vary according to preferable food and habitat availability. The habitat heterogeneity of Los Medaños accounts for a wide assortment of bird species that inhabit the area either as seasonal transients or permanent residents. Scaled quail (*Callipepla squamata*), mourning doves (*Zenaida macroura*), loggerhead shrikes (*Lanius ludovicianus*), black-throated sparrows (*Amphispiza bilineata*), Chihuahuan ravens *(Corvus cryptoleucus*), and a unique desert subspecies of the northern bobwhite (*Colinus virginianus*) are but a few examples of the array of avian inhabitants. Due to a scarcity of surface waters in the immediate vicinity of WIPP, migrating or breeding waterfowl are not common. In addition, this area supports a particularly abundant and diverse population of raptors, or birds of prey. The density of large avian-predator nests has been documented as high as 16 nests per 10 km^2 (4 mi^2), one of the predominant raptor breeding populations in recorded scientific literature. Harris' hawks (*Parabuteo unicinctus*), Swainson's hawks (*Buteo swainsoni*), and great horned owls *(Bubo virginianus*) are species commonly found nesting in the area. Northern harriers (*Cicus cyaneus*), burrowing owls (*Athene cunicularia*), barn owls (*Tyto alba*), and American kestrels (*Falco sparverius*) are also found around the site.

Birds and mammals compose the upper levels of the food chain in the natural ecosystem around WIPP. These organisms may be affected by noise and human presence as well as by changes in habitat structure due to salt impacts. Population densities are monitored annually to define normal cycles of abundance and to detect major changes in populations or communities that may be due to activities at WIPP. It is the policy and practice of DOE to conduct effluent monitoring and environmental surveillance programs that are appropriate for determining adequate protection of the public and the environment during WIPP operations. The goal of the WIPP Environmental Monitoring Program is to determine if the local ecosystem has been impacted by WIPP activities and, if so, to evaluate the severity, geographic extent, and environmental significance of those impacts. The Environmental Monitoring Program monitors pathways by which WIPP-related radionuclides and other contaminants could reach the environment surrounding the WIPP site. The pathways measured include air, surface water, groundwater, sediments, soils, and biota (e.g., vegetation, game birds, and fish) (WTRU 2002). Site personnel manage several wildlife research projects and conduct a number of general wildlife management activities. Specific wildlife populations are monitored and researched in accordance with applicable laws, agreements, and regulations. Each activity is mandated and/or supported by state and Federal guidelines or by way of commitments created through interagency agreements and Memorandums of Understanding. Beginning in 1985, population density measurements of birds and small nocturnal mammals were performed annually to assess the effects of WIPP surface activities (e.g., construction, salt piles) on wildlife populations. Customary protocol involved comparative data analyses between two outlying or "control" plots and two experimental plots near WIPP operations. No consistent differences were found between the control and experimental plots. WIPP, and the region surrounding it, is widely recognized for its concentration and diversity of raptors. The area is home to several raptor species of special concern, including Harris' hawks, Swainson's hawks, burrowing owls, and barn owls, as well as other species. DOE, BLM, and other government agencies are keenly aware of the value and importance of protecting and monitoring raptor populations. To assist in this effort at WIPP, BLM and DOE established a program in the early 1990s to monitor, protect, and educate site workers and the public about raptors on the WIPP site.

4.6.6.2 Wetlands

There are no jurisdictional wetlands present within the WIPP site that are regulated under Section 404 of the CWA.

4.6.6.3 Aquatic Resources

The Carlsbad Site is located east of the Pecos River. The Pecos River within this region drains an area of 49,200 km^2 (19,000 mi^2). WIPP has a few small intermittent creeks that are the only westward-flowing tributaries of the Pecos River within 32 km (20 mi) north or south of the site. Native amphibians are noticeable during puddle creation from the spring or summer rains. They may appear in extraordinary numbers after rainfall events. Perennial aquatic habitats near WIPP are limited to stock watering ponds and tanks, which may be frequented by yellow mud turtles (*Kinosternon flarescens*) and tiger salamanders. Similarly, various species of aquatic mollusks, inhabitants of local stock ponds and livestock drinking units, are observed on occasion.

4.6.6.4 Threatened and Endangered Species

In the first WIPP SEIS, DOE concluded that there was no critical habitat at the site for terrestrial species identified as endangered, threatened, or candidate species by either the USFWS or the New Mexico Department of Game and Fish (DOE 1997a). In 1996, DOE conducted a survey on the WIPP Land Withdrawal Area and associated lands to investigate the potential for impacts to rare, threatened, endangered, or sensitive plant or animal species as a result of the potential actions presented a second SEIS. The 1996 survey included an assessment of suitable habitats for these species. No state- or federally-listed species were found on the WIPP Land Withdrawal Area during the survey. The data reported in the survey, which support the conclusions of other studies, remain valid and indicate that permanent populations of these species are not established on WIPP lands. Currently, for Eddy County, the USFWS lists six federally endangered, six federally threatened, one proposed for listing, and five candidate species. The New Mexico Department of Game and Fish lists 10 endangered and 21 threatened animal species, while the New Mexico Energy, Minerals, and Natural Resources Department lists 6 endangered plant species for Eddy County. Neither the New Mexico Game and Fish's BISON-M (Biota Information System of New Mexico) database nor the New Mexico Council's database contains a record of occurrence at WIPP for any listed species found in Table 4.6.6.4–1. Ongoing wildlife research projects and general wildlife management programs are conducted by personnel at Westinghouse TRU Solutions, LLC, the management and operations contractor at WIPP, to ensure disturbance and encroachment on wildlife habitat are minimized. The protection of threatened and endangered species is taken into consideration when planning and administering projects on WIPP lands (DOE 2001b, DOE 2002a, and DOE 2002h).

Table 4.6.6.4–1. Listed Federal- and State-Threatened and Endangered Species and other Special Interest Species that Occur in Eddy County, New Mexico

Species	Federal Classification	State Classification	Occurrence in Eddy County/WIPP
Mammals			
Black-tailed Prairie Dog *Cynomys ludovicianus arizonensis*	Candidate	Sensitive taxa (informal)	Eddy County Occurrence No Record at WIPP
Least Shrew *Cryptotis parva*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Swift Fox Vulpes velox velox	Removed from Candidate listing October 30, 2001	Sensitive taxa (informal)	Eddy County Occurrence No Record at WIPP
Birds			
American Peregrine Falcon *Falco peregrinus anatum*	Delisted	Threatened	Eddy County Occurrence No Record at WIPP
Aplomado Falcon, *Falco femoralis septentrionalis*	Endangered	Endangered	Eddy County Occurrence No Record at WIPP
Baird's Sparrow *Ammodramus bairdii*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Bald eagle *Haliaeetus leucocephalus*	Threatened—Proposed for Delisting	Threatened	Eddy County Occurrence No Record at WIPP
Bell's Vireo *Vireo bellii*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Broad-billed Hummingbird *Cynanthus latirostris magicus*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Brown Pelican *Pelecanus occidentalis carolinensis*	Endangered	Endangered	Eddy County Occurrence No Record at WIPP
Common Ground-dove *Columbina passerina pallescens*	Unlisted	Endangered	Eddy County Occurrence No Record at WIPP
Gray Vireo *Vireo vicinior*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Interior Least Tern *Sterna antillarum athalassos*	Endangered	Endangered	Eddy County Occurrence No Record at WIPP
Lesser Prairie-chicken *Tympanuchus pallidicinctus*	Candidate	Sensitive taxa (informal)	Eddy County Occurrence No Record at WIPP
Mexican Spotted Owl *Strix occidentalis lucida*	Threatened	Sensitive taxa (informal)	Eddy County Occurrence No Record at WIPP

Table 4.6.6.4–1. Listed Federal- and State-Threatened and Endangered Species and other Special Interest Species that Occur in Eddy County, New Mexico (*continued*)

Species	Federal Classification	State Classification	Occurrence in Eddy County/WIPP
Birds *(continued)*			
Mountain Plover *Charadrius montanus*	Proposed Threatened	Sensitive taxa (informal)	Eddy County Occurrence No Record at WIPP
Neotropic Cormorant *Phalacrocorax brasilianus*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Piping Plover *Charadrius melodus circumcinctus*	Threatened	Endangered	Eddy County Occurrence No Record at WIPP
Southwest Willow Flycatcher *Empidonax traillii extimus*	Endangered	Endangered	Eddy County Occurrence No Record at WIPP
Varied Bunting *Passerina versicolor*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Reptiles			
Arid Land Ribbon Snake *Thamnophis proximus diabolicus*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Blotched Water Snake *Nerodia erythrogaster transversa*	Unlisted	Endangered	Eddy County Occurrence No Record at WIPP
Mottled Rock Rattlesnake *Crotalus lepidus lepidus*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Sand Dune Lizard *Sceloporus arenicolus*	Candidate	Threatened	Eddy County Occurrence No Record at WIPP
Western River Cooter *Pseudemys gorzugi*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Fish			
Bigscale Logperch *Percina macrolepida*	Unlisted	Threatened	Eddy County Occurrence Not present at WIPP
Blue Sucker *Cycleptus elongatus*	Unlisted	Endangered	Eddy County Occurrence Not present at WIPP
Gray Redhorse, *Moxostoma congestum*	Unlisted	Threatened	Eddy County Occurrence Not present at WIPP
Greenthroat Darter *Etheostoma lepidum*	Unlisted	Threatened	Eddy County Occurrence Not present at WIPP
Mexican Tetra *Astyanax mexicanus*	Unlisted	Threatened	Eddy County Occurrence Not present at WIPP

Table 4.6.6.4–1. Listed Federal- and State-Threatened and Endangered Species and other Special Interest Species that Occur in Eddy County, New Mexico (*continued*)

Species	Federal Classification	State Classification	Occurrence in Eddy County/WIPP
Fish *(continued)*			
Pecos Bluntnose Shiner *Notropis simus pecosensis*	Threatened	Threatened	Eddy County Occurrence Not present at WIPP
Pecos Gambusia *Gambusia nobilis*	Endangered	Endangered	Eddy County Occurrence Not present at WIPP
Pecos Pupfish *Cyprinodon pecosensis*	Unlisted	Threatened	Eddy County Occurrence Not present at WIPP
Molluscs			
Ovate Vertigo Snail *Vertigo ovata*	Unlisted	Threatened	Eddy County Occurrence No Record at WIPP
Pecos Pyrg Snail *Pyrgulopsis pecosensis*	Candidate	Threatened	Eddy County Occurrence No Record at WIPP
Texas Hornshell *Popenaias popeii*	Candidate	Endangered	Eddy County Occurrence No Record at WIPP
Plants			
Gypsum wild buckwheat *Eriogonum gypsophilum*	Threatened	Endangered	Eddy County Occurrence No Record at WIPP
Kuenzler's hedgehog cactus/Kuenzler's strawberry cactus/ pitayita *Echinocereus fendleri var. kuenzleri*	Unlisted	Endangered	Eddy County Occurrence No Record at WIPP
Lee's pincushion cactus *Escobaria sneedii var. leei*	Threatened	Endangered	Eddy County Occurrence No Record at WIPP
Mulee/needle mulee/beehive cactus/pineapple cactus/Scheer pincushion *Coryphantha scheeri var. scheeri*	Endangered	Endangered	Eddy County Occurrence No Record at WIPP
Shining coralroot/shining cock’s comb *Hexalectris nitida*	Unlisted	Endangered	Eddy County Occurrence No Record at WIPP
Tharp's blue-star *Amsonia tharpii*	Unlisted	Endangered	Eddy County Occurrence No Record at WIPP

Sources: NMG&F 2002, NMRPTC 1999.

4.6.7 Cultural and Paleontological Resources

4.6.7.1 Cultural Resources

All undertakings at WIPP are conducted in compliance with relevant cultural resource Federal legislation, particularly Sections 110 and 106 of the NHPA, and DOE orders and policies that address cultural resource protection and management. Prior to passage of the *WIPP Land Withdrawal Act* in 1992, BLM managed the cultural resources in this area. Management responsibility was transferred from DOI to DOE in 1994 through a Memorandum of Understanding. Cultural resources are currently managed according to guidelines set forth in the WIPP Land Management Plan (DOE 2002a). DOE and the State of New Mexico signed a Joint Powers Agreement that includes provisions specifying how DOE will satisfy its obligations regarding cultural resources under NHPA. The ROI for cultural resources is the entire WIPP site.

Cultural resource investigations at WIPP started in 1976 and have continued to the present for any new undertakings at the site. Initially, the central 10 km^2 (4 mi^2) of the WIPP Land Withdrawal Area was surveyed, resulting in the identification of 33 sites and 64 isolated occurrences (DOE 1980). Over 25 separate investigations have been conducted at the site since then, resulting in approximately 37 percent of the Land Withdrawal Area 1,368 ha (3,380 ac) being inventoried (DOE 1997b, DOE 2002a). Fifty-nine archaeological sites and 91 isolated occurrences (single or few artifacts, or isolated features) comprise the total resources recorded in the Land Withdrawal Area (DOE 2002a). Based on site inventory data and assuming fairly even distribution of resources across the landscape, DOE estimates that the remaining unsurveyed acreage in WIPP may contain 99 sites and 153 isolated occurrences. The resources are almost exclusively prehistoric, with only one of the 59 sites having both prehistoric and historic components. There are no known Native American traditional cultural properties, sacred sites, or burials in the Land Withdrawal Area.

Management of cultural resources, particularly archaeological sites, in this part of New Mexico is difficult due to the geomorphology. Dune fields, which are common in the region within and surrounding WIPP, often move rapidly, covering and uncovering archaeological sites. A survey conducted in a previously surveyed location a few years later will record different sites. Thus, previously surveyed project areas often require resurveying for new undertakings.

The isolated occurrences at WIPP are not likely to yield information beyond that already documented, and thus are considered not eligible for inclusion in the NRHP. Many of the sites are considered eligible or potentially eligible for listing on the NRHP. All of the 33 sites recorded in the central 10 km^2 (4 mi^2) are considered eligible to the NRHP as a district (DOE 1980).

Cultural Resources on the Reference Location

The reference location at WIPP is located in the central 10 km^2 (4 mi^2) of the Land Withdrawal Area. This location was previously surveyed for archaeological sites in the late 1970s and archaeological sites were found throughout this area. In addition, because of the movement of dune fields, it is likely that resurvey of the area would discover previously unrecorded archaeological sites. Finally, this is a location that has not undergone construction disturbance, therefore, it is likely that cultural resources are located at the reference location or in the area immediately surrounding it.

4.6.7.2 Paleontological Resources

Near the end of the Pleistocene, approximately 20,000-15,000 years ago, the region surrounding WIPP enjoyed a water table higher than today's. Although the specific location of WIPP remained dry on the surface, the higher water table was evidenced by nearby lakes, with springs and seeps present along the Oglala Caprock. The Mescalero sands and dunes which cover WIPP now were also present, and the general paleo-environment at this time was one of sagebrush and grasslands. The sources of water near WIPP contained fresh water snails and other mollusks, and were an attraction for Late Pleistocene vertebrates, including the giant ground sloth, camel, horse, bison, short-faced bear, and Columbian mammoth. Discoveries of fossils from these invertebrates and vertebrates in the region generally have been found in locations exhibiting Late Pleistocene lacustrine or spring/seep deposits (McGee 2002). However, because these water sources were located around WIPP, it is possible that some fossil deposits of vertebrates could be located on the WIPP site from animals migrating between water sources. The only recorded discovery of fossilized remains at WIPP is the metacarpal of a *Bison antiquus*, which was an isolated find with no other remains in the area. The bone was found in 1996 during trenching for electrical conduit in the Property Protection Area (Lynn 2002a).

4.6.8 Socioeconomics

Socioeconomic characteristics addressed at the Carlsbad Site include employment, income, population, housing, and community services. These characteristics are analyzed for a two-county ROI consisting of Eddy and Lea Counties in New Mexico, where the majority of site employees reside.

4.6.8.1 Employment and Income

The service sector employs the greatest number of workers in the ROI with more than 26 percent of the workforce. Other important sectors of employment include retail trade (17 percent); mining (15.5 percent); and government (13.6 percent) (BEA 2002).

The labor force in the ROI increased 7.8 percent from 1990 to 2001, an average of 0.7 percent each year. In comparison, the State of New Mexico labor force increased at a much greater rate, a total of 18.4 percent over the same time period. Total employment in the ROI increased at a faster pace than the labor force, a total of 9.5 percent. Unemployment fell from 5.6 percent in 1990 to 4.1 percent in 2001. In comparison, the state-wide average unemployment rate fell from 6.5 percent in 1990 to 4.8 percent in 2001 (BLS 2002a).

In 2000, per capita income in the ROI ranged from a high of $21,007 in Eddy County to a low of $20,229 in Lea County. The average per capita income in the ROI was approximately $20,600, compared to the New Mexico average of $21,931. Per capita income increased by almost 49 percent from 1990 to 2000, compared to a state-wide increase of 46.8 percent (BEA 2002).

4.6.8.2 Population and Housing

Between 1990 and 2000, the ROI population grew from 104,370 to 107,169, an increase of 2.7 percent. This was a much slower rate of growth than for New Mexico, which grew at a rate of 47 percent during the same time period. All of the population growth was in Eddy County, where the population increased by 6.3 percent. Lea County's population decreased by 0.5 percent (Census 2002).

In 2000, the total number of housing units in the ROI was 45,654 with 39,078 occupied. There were 28,692 owner-occupied housing units and 10,386 occupied rental units. In 2000, the homeowner vacancy rate in the ROI ranged from a high of 3.6 percent in Lea County to a low of 2.9 percent in Eddy County. The rental vacancy rate ranged from 18.7 percent in Lea County to 18.1 percent in Eddy County. The homeowner vacancy rates for the ROI are comparable to the New Mexico state average of 2.2 percent, but the ROI rental vacancy rate was much higher than the New Mexico state average rate of 11.6 percent. The number of housing units in the ROI is fairly evenly divided between the two counties with 49 percent in Eddy County and 51 percent in Lea County (Census 2002).

4.6.8.3 Community Services

There are a total of 8 school districts in the ROI with 66 schools serving over 22,000 students. The student-to-teacher ratio in these districts ranges from a high of 16.8 in the Carlsbad Municipal Schools in Eddy County to a low of 12.9 in Tatum Municipal Schools in Lea County. The average student-to-teacher ratio in the ROI is 16.0 (NCES 2002).

The ROI is served by four hospitals with a capacity of over 400 beds. The largest hospital in the ROI is Lea Regional Medical Center in Hobbs, New Mexico. The closest hospital to WIPP is the Guadalupe Medical Center in Carlsbad, New Mexico (AHA 1995). There are approximately 100 doctors in the ROI.

4.6.9 Radiation and Hazardous Chemical Environment

4.6.9.1 Radiation Exposure and Risk

An individual's radiation exposure in the vicinity of WIPP amounts to approximately 360 mrem/yr as shown in Table 4.6.9.1–1 and is comprised of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; weapons test fallout; consumer and industrial products, and nuclear facilities. All radiation doses mentioned in this EIS are effective dose equivalents. Effective dose equivalents include the dose from internal deposition of radionuclides and the dose attributable to sources external to the body.

Table 4.6.9.1–1. Sources of Radiation Exposure to Individuals in the WIPP Vicinity Unrelated to WIPP Operations

Source	Radiation Dose (mrem/yr)
Natural Background Radiation	
Total external (cosmic and terrestrial)	55
Internal terrestrial and global cosmogenic	40[a]
Radon in homes (inhaled)	200[a]
Other Background Radiation[a]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	**360**

[a] An average for the United States.
Source: Derived from data in NCRP 1987.

Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to WIPP operations.

Releases of radionuclides to the environment from WIPP operations provide another source of radiation exposure to individuals in the vicinity of WIPP. Types and quantities of radionuclides released from WIPP operations in 2001 are listed in *WIPP 2001 Site Environmental Report* (WTRU 2002). The doses to the public resulting from these releases are presented in Table 4.6.9.1–2. The radionuclide emissions contributing the majority of the dose to the offsite MEI were americium-241, plutonium-238, plutonium-239, and plutonium-240. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

Table 4.6.9.1–2. Radiation Doses to the Public From Normal WIPP Operations in 2001 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Offsite MEI (millirem)	10	4.96×10^{-6}	4	0	100	4.96×10^{-6}
Population within 80 km person-rem)	None	NR	None	NR	None	NR

NR = Not Reported.
[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the *Clean Air Act* (40 CFR 61) and the 4-mrem/yr limit is required by the *Safe Drinking Water Act* (40 CFR 141). For this EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. If the potential collective dose to the offsite population exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.
Source: WTRU 2002.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the offsite MEI due to radiological releases from WIPP operations are estimated to be 2.5×10^{-12}, or 2.5 cancer deaths in a population of 1 trillion. The estimated probability of this maximally exposed person dying of cancer at some point in the future from radiation exposure associated with one year of WIPP operations is less than one in 1 million (it takes several to many years from the time of radiation exposure for a cancer to potentially manifest itself).

WIPP workers receive the same dose as the general public from background radiation, but they also may receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at WIPP from operations in 2001 are presented in Table 4.6.9.1–3. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among WIPP workers from normal operations in 2001 is 4.4×10^{-4}. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 4.6.9.1–3. Radiation Doses to Workers from Normal WIPP Operations in 2001 (Total Effective Dose Equivalent)

Occupational Personnel	Standard	Actual
Average radiation worker dose (millirem)	5,000[a]	2.9
Collective radiation worker dose[b] (person-rem)	None	1.103

[a] DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 mrem/yr (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] There were 75 workers with measurable doses in 2001.
Source: Goff 2003.

4.6.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. WIPP workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals.

Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at WIPP via inhalation of air containing hazardous chemicals released to the atmosphere by WIPP operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

VOC monitoring underground at WIPP was implemented in 1997 as a requirement of the Hazardous Waste Facility Permit and is intended to demonstrate that regulated VOCs are not being emitted by the waste at concentrations in excess of concentrations of concern as prescribed in the permit. Nine target compounds, which contribute approximately 99 percent of the calculated human health risks from RCRA constituents, were chosen for monitoring. These target compounds are 1,1-dichloroethylene, methylene chloride, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, 1,2-dichloroethane, toluene, chlorobenzene, and 1,1,2,2-tetrachloroethane.

Sampling for target compounds is done at two air monitoring stations. The stations are identified as VOC-A, located downstream from hazardous waste disposal unit Panel 1 in Drift E300, and VOC-B, located upstream from Panel 1. In 2001, VOC-B was located in Drift S1950. As waste is placed in new panels, VOC-B will be relocated to ensure that it samples underground air before it passes the waste panels. The location of VOC-A is not anticipated to change.

4.6.10 Traffic and Transportation

4.6.10.1 Regional Transportation Infrastructure

WIPP is located approximately 42 km (26 mi) east of Carlsbad, New Mexico (Figure 4.6.10.1–1). Major highways in the region include U.S. 285 that runs north and south through Carlsbad and U.S. 62/U.S. 180 that runs roughly east and west through Carlsbad. These highways are both four-lane highways. Access to WIPP from all locations of interest for this EIS is from the north on U.S. 285 to U.S. 62/U.S. 180. A 21-km (13-mi) access road connects WIPP to U.S. 62/U.S. 180. A 6-km (4-mi) long south access road connects the southern WIPP boundary with NM 128. All hazardous and radioactive shipments to and from WIPP use the north access road.

4.6.10.2 Local Traffic Conditions

Given the low population in Carlsbad, especially in the vicinity of WIPP, and the relatively low employment for WIPP, traffic in the region is light and free flowing except for short durations during shift change. Traffic data for roads in the vicinity of WIPP are provided in Table 4.6.10.2–1.

Table 4.6.10.2–1. Traffic Conditions on Principal Roads Near WIPP

Access Road	Annual Average Daily Traffic	Peak Hourly Traffic
North access road	310	NA
South access road	750	NA
U.S. 62/U.S. 180 between north access road and Carlsbad	3,300	570
NM 128 between south access road and intersection with NM 31	1,200	180
U.S. 62 just east of Carlsbad	18,900	1,100

Source: NMSH&TD 2002, Johnson 2002b.

Figure 4.6.10.1–1. Highways in the Region of the Carlsbad Site

4.6.11 Waste Management

This section describes the DOE waste generation baseline that will be used to gauge the relative impact of MPF construction and operations on the overall waste generation at the Carlsbad Site and on DOE's capability to manage such waste. WIPP manages LLW, mixed LLW, hazardous waste, and sanitary waste. Except for "derived waste" (discussed below), TRU waste and mixed TRU waste are not normally generated. Table 4.6.11–1 provides the routine waste generation rates at WIPP. Table 4.6.11–2 summarizes the waste management capabilities at WIPP.

Table 4.6.11–1. Annual Routine Waste Generation From WIPP Operations (m^3)

Waste Type	1996	1997	1998	1999	2000	2001
Transuranic	0	0	0	0	0	0
Low-level	0	0	0	0	0	0.40
Mixed	0	0	0	0	0	0.05
Hazardous[a]	2.00	84.0	80.0	30.4	15.8	14.2
Sanitary[b]	1,000	821	821	751	9.18	82.2

[a] Includes state-regulated waste. Hazardous waste reported in metric tons.
[b] From DOE 2002o (1996 data) and DOE's Central Internet Database (available at http://cid.em.doe.gov). Sanitary waste reported in metric tons.
Source: DOE 2002o.

Table 4.6.11–2. Waste Management Facilities at WIPP

Facility/ Description	Capacity	Status	Applicable Waste Types				
			LLW	Mixed LLW	TRU Waste	Hazardous Waste	Nonhazardous Waste
Storage Facility (m^3)							
Waste Handling Building Unit [a]	77				X		
Parking Area Unit	45				X		
Disposal Facility (m^3)							
10 underground HWDUs	54,000 [b]				X		

[a] Includes derived waste storage area. Derived waste from TRU waste operations is managed as TRU waste.
[b] Capacity authorized by current RCRA permit, which includes 3 of 10 panels planned for the WIPP facility. Under the *WIPP Land Withdrawal Act*, the repository capacity is limited to 175,600 m^3 (6,201,314 ft^3), including up to 7,080 m^3 (250,000 ft^3) of remote-handled (RH) TRU waste.
Source: NMED 2001.

WIPP is a geologic repository designed for the disposal of defense-generated TRU waste. Some of the TRU wastes disposed of at WIPP contain hazardous wastes as co-contaminants. During the Disposal Phase of the WIPP facility, which is expected to last 25 years, the total amount of waste received from offsite generators and any derived waste will be limited to 175,600 m^3 (6,201,314 ft^3) of TRU waste of which up to 7,080 m^3 (250,000 ft^3) may be remote-handled TRU mixed waste.

The WIPP repository has been divided into 10 discrete underground hazardous waste disposal units (HWDUs) or panels, which are being permitted under 40 CFR 264, Subpart X. The process design capacity for the miscellaneous unit is for the maximum amount of waste that may be received from offsite generators plus the maximum expected amount of derived wastes that may be generated at the WIPP facility. During the 10-year period of the current RCRA permit (issued in October 1999), up to 52,110 m^3 (1,840,264 ft^3) of contact-handled waste and 1,954 m^3 (69,005 ft^3) of remote-handled waste could be emplaced in Panels 1 to 3. A fourth HWDU (Panel 4) and disposal area access drifts (designated as Panels 9 and 10) will be constructed, but will not receive waste for disposal, under the current RCRA permit.

WIPP operates two container storage units. One is inside the Waste Handling Building and consists of the contact-handled bay, conveyance loading room, waste hoist entry room, remote-handled bay, cask unloading room, hot cell, transfer cell, and facility cask loading room. This storage unit will be used for waste receipt, handling, and storage (including storage of derived waste) prior to emplacement in the underground repository. The capacity of this storage unit is 77 m^3 (2,719 ft^3). The second storage unit is the parking area outside the Waste Handling Building where the TRUPACT-II trailers and the road cask trailers will be parked awaiting waste handling operations. The capacity of this unit is 12 TRUPACT-IIs and three road casks or four rail casks with a combined volume of 45 m^3 (1,589 ft^3). The railroad side tracks are included in this area to accommodate rail shipments of remote-handled TRU mixed waste.

Wastes may be generated at the WIPP facility as a direct result of managing the TRU wastes received from the offsite generators. Such waste may be generated in either the Waste Handling Building or the underground. This waste is referred to as "derived waste." All such derived waste will be placed in the rooms in HWDUs along with the TRU waste for disposal. Non-mixed hazardous wastes generated at WIPP, through activities where contact with TRU mixed waste does not occur, are characterized, placed in containers, and accumulated until they are transported offsite for treatment and/or disposal at a permitted facility.

The WIPP operational philosophy is to introduce no new hazardous components into TRU mixed waste to avoid generating TRU mixed waste that is compositionally different than the TRU mixed waste shipped to the repository for disposal. Some additional TRU mixed wastes, such as personal protective equipment, swipes, and tools, may result from decontamination operations and off-normal events. Such waste will be assumed to be contaminated with the RCRA-regulated constituents in the TRU waste containers from which it was derived. Derived waste may be generated as a result of decontamination during the waste handling process. Derived waste is assumed to be acceptable for management at WIPP because any TRU waste shipped to the facility will have already been determined to be acceptable and no new constituents will be added. Derived waste will be packaged in standard Department of Transportation-approved Type A containers. Containers of derived waste will be moved to the underground HWDU using the same equipment used for handling TRU mixed waste.

4.6.11.1 Low-Level Radioactive Waste

The solid radioactive waste system provides for the collection and packaging of site-derived radioactive waste for the disposal in the underground HWDU. This waste is collected in standard Type A containers equipped with filter vents and managed as TRU waste. All site-derived waste is anticipated to be contact-handled, due to its low activity and the potential sources of site-derived solid waste in the WIPP facility.

In addition to the derived waste, a small amount of LLW is generated by the WIPP radiochemistry laboratory. This waste is stored at the laboratory and shipped offsite for treatment and disposal.

4.6.11.2 Mixed Low-Level Waste

WIPP site-derived waste could originate in both the surface and underground facilities. These wastes will be packaged for disposal in the underground HWDUs. Because derived wastes can contain only those materials present in the waste from which they were derived, no additional characterization of the derived waste is proposed for disposal purposes. Characterization of derived waste will primarily be based on process knowledge.

In addition to the derived waste, a small amount of mixed LLW is generated by the WIPP radiochemistry laboratory. This waste is stored at the laboratory and shipped offsite for treatment and disposal.

4.6.11.3 Transuranic and Alpha Waste

Except for site-derived waste, WIPP operations have not generated TRU wastes to date.

4.6.11.4 Hazardous Waste

WIPP hazardous wastes typically include absorbed liquids from spills and routine usage of maintenance products, including oils, coolants, and solvents. The waste is managed in satellite accumulation areas and a less-than-90-day storage area (Section 474) pending shipment to offsite treatment or disposal facilities (WTRU 2002).

Storage of these materials is administered by the Site Generated Nonradioactive Hazardous Waste Management Program, the Industrial Safety Program, and the WIPP Emergency Management Program. A Hazardous Waste/Material Storage Facility is provided for storage of various types of incoming and outgoing hazardous materials prior to shipment to a treatment, storage, and disposal facility (DOE 2002m).

4.6.11.5 Sanitary Waste

WIPP operates a construction debris landfill in Section 6. This landfill is restricted to the disposal of unused construction materials and construction debris (e.g., timbers, piping, uncontaminated excavation soil, concrete, packing materials, sheet metal, glass, and wood). Refuse and paper are disposed of at a local landfill or recycled off site, as appropriate for the waste.

4.6.11.6 Wastewater

Water used as a fire suppressant is the largest potential source of liquid radioactive waste at WIPP. Another source would be liquid used for decontamination. In an unlikely fire event, suspect liquids would be sampled and tested for radioactivity. If the liquid exceeds the uncontrolled release limit of DOE Order 5400.5, it would be made acceptable for disposal at WIPP. All nonfire water radioactive waste is collected in portable tanks or drums and handled in accordance with procedure in WP 05-WH1036, *Site-Derived Mixed Waste Handling* (DOE 2002a).

WIPP operates a sewage treatment facility to collect and treat sanitary wastewater and nonradioactive liquids from the repository's surface facility operations. Provisions also exist for the sewage treatment facility to receive nonhazardous effluents typically resulting from observation wells and the dewatering of mine shafts (DOE 2002h). The lagoon system is a zero discharge treatment facility consisting of two primary settling lagoons, two polishing lagoons, a chlorination system, and three evaporation basins. The sewage system was expanded in June 1993 to add two lined evaporation basins, doubling the system capacity.

WIPP has a NMED Discharge Permit for a wastewater lagoon facility. The daily discharge limit to the lagoon is 87,064 L/day (23,000 gal/day) of domestic wastewater, 7,571 L/day (2,000 gal/day) of miscellaneous nonhazardous water, and 30,283 L/day (8,000 gal/day) of miscellaneous nonhazardous brine and water. WIPP is preparing to amend its existing discharge permit to cover discharges from the active salt tailings pile. Currently, WIPP does not require NPDES permitting. There are no point source discharges to waters of the United States associated with the repository (DOE 2001b).

4.6.11.7 Pollution Prevention

The total waste (routine waste as well as environmental restoration and D&D waste) generated by WIPP was 96 m^3 (3,390 ft^3) in FY2001, accounting for 0.015 percent of DOE's overall waste generation. Implementing pollution prevention projects reduced the total amount of waste generated at WIPP in 2001 by approximately 169 m^3 (5,968 ft^3). Examples of WIPP pollution prevention projects completed in 2001 include the reduction of sanitary waste by 5 metric tons (5.5 tons) by recycling computer equipment through donations to local schools (DOE 2002g).

4.6.11.8 Waste Management PEIS Records of Decision

A discussion of DOE's hazardous waste, LLW, mixed LLW, and TRU waste decisions based on the Waste Management PEIS is provided in Section 4.2.11.8. The Waste Management PEIS RODs affecting WIPP are shown in Table 4.6.11.8–1.

Table 4.6.11.8–1. Waste Management PEIS Records of Decision Affecting WIPP

Waste Type	Preferred Action
TRU waste	DOE decided (with one exception) that each DOE site would prepare its own TRU waste for disposal and store it onsite until it could be shipped to WIPP for disposal. DOE amended its decision to establish the capability at WIPP to prepare for disposal up to 1,250 m^3 (44,143 ft^3) of contact-handled TRU waste out of about 7,000 m^3 (247,205 ft^3) expected to be received annually for disposal. In addition, DOE decided to increase the time that CH-TRU waste may be stored above ground at WIPP to one year and to increase the total aboveground storage capacity at WIPP by 25 percent, for a total of 152 m^3 (5,368 ft^3) (65 FR 82985).[a]
LLW	DOE has decided to treat WIPP's LLW onsite and to ship the waste to either the Hanford Site or NTS for disposal.[b]
Mixed LLW	DOE has decided to regionalize treatment of mixed LLW at the Hanford Site, INEEL, ORR, and SRS. DOE has decided to ship WIPP's mixed LLW to either the Hanford Site or NTS for disposal.[b]
Hazardous waste	DOE has decided to continue to use commercial facilities for treatment of WIPP's non-wastewater hazardous waste.[c]

[a] From the ROD for TRU waste (63 FR 3629) and the ROD for the WIPP Disposal Phase SEIS (63 FR 3624).
[b] From the ROD for LLW and mixed LLW (65 FR 10061).
[c] From the ROD for hazardous waste (63 FR 41810).

5.0 ENVIRONMENTAL IMPACTS

Chapter 5 describes the environmental consequences of the Proposed Action to construct and operate the Modern Pit Facility at the Los Alamos Site, Nevada Test Site, Pantex Site, Savannah River Site, and the Carlsbad Site in addition to the Technical Area (TA)-55 Upgrade Alternative at LANL, and the No Action Alternative. Chapter 5 also describes the impacts common to all alternatives, cumulative impacts, and resource commitments.

5.1 INTRODUCTION

The environmental impacts analysis addresses all potentially affected areas in a manner commensurate with the importance of the effects on each area. The methodologies used for preparing the assessments for the resource areas are discussed in Appendix F of this Modern Pit Facility (MPF) Environmental Impact Statement (EIS). The specific methodologies used to assess human health, accidents, and transportation are presented in Appendices B, C, and D, respectively.

Chapter 5 is organized by major sections devoted to each site. Section 5.2 discusses the environmental consequences at the Los Alamos National Laboratory (LANL). LANL is involved in the No Action Alternative, MPF Alternative and the TA-55 Upgrade Alternative. The TA-55 Upgrade Alternative occurs only at LANL. Sections 5.3, 5.4, 5.5, and 5.6 discuss the environmental impacts of the No Action Alternative and the impacts of the MPF Alternative at the Nevada Test Site (NTS), Pantex Site (Pantex), Savannah River Site (SRS), and the Carlsbad Site, respectively.

The MPF Alternative at each site includes a discussion of the construction impacts for three plant sizes producing 125 pits per year (ppy), 250 ppy, and 450 ppy. The MPF Alternative at each site also includes a discussion of the operations impacts for the three different production capacities 125 ppy, 250 ppy, and 450 ppy.

A contingency or surge use of two-shift operations for emergencies is also analyzed. This would raise the output levels of the three sized plants to almost twice their single-shift capacities. The surge output of the 125 ppy plant would be approximately the same and have the same environmental impacts as the 250 ppy single-shift scenario. Likewise, the surge output of the 250 ppy plant would be approximately the same and have the same environmental impacts as the 450 ppy single-shift scenario. The impacts of the surge output of the 450 ppy plant are provided qualitatively in a sensitivity analysis at the end of each resource discussion.

Additional sections in Chapter 5 present issues common to all or some of the alternatives. These sections include:

Section 5.7, Common Impacts—Discusses impacts of a Beryllium Facility, decontamination and decommissioning of the MPF, and the impacts due to the reduction in the current production of pits at LANL due to the construction and operations of the MPF.

Section 5.8, Cumulative Impacts—Discusses the potential cumulative impacts that could result at each site as a result of the construction and operations of the MPF.

Sections 5.9, 510, and 5.11—Discusses the resources commitments required for the Proposed Action including unavoidable adverse impacts, the relationship between short-term and long-term use, and irreversible/irretrievable commitment of resources.

5.2 LOS ALAMOS SITE

The following sections discuss the environmental impacts associated with the No Action Alternative, the MPF Alternative, and the TA-55 Upgrade Alternative at LANL. The environmental impacts are presented below for each of the following environmental resource areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, and waste management.

5.2.1 Land Use and Visual Resources

5.2.1.1 Land Use

This section presents a discussion of the environmental impacts associated with the No Action Alternative, the MPF Alternative, and the TA-55 Upgrade Alternative.

The proposed concept for MPF is a multibuilding aboveground configuration. There would be three separate process buildings: Material Receipt, Unpacking, and Storage; Feed Preparation; and Manufacturing. They would be flanked by a number of smaller support facilities which would include: the Analytical Support Building, Production Support Building, Process Building Entry Control Facilities, Operations Support Facilities, Engineering Support Facility, Perimeter Intrusion Detection and Assessment System (PIDAS), Safe Havens, Standby Diesel Generator Buildings, Diesel Fuel Storage Tank, Chillers/Chemical Feed and Chilled Water Pump Buildings, Cooling Towers, Alternate Power Electrical Transformers, Truck Loading Docks, Liquid Nitrogen/Argon Storage Tanks, Chemical Storage Tanks, Bottled Gas Storage and Metering Buildings, Heating Ventilation, and Air Conditioning (HVAC) Exhaust Stacks, Waste Staging/Transuranic (TRU) Packaging Building, Commodities Warehouse, Roads and Parking Areas, and a Runoff Detention Area. In addition to these structures, a Construction Laydown Area and a Concrete Batch Plant would be built for the construction phase only. Upon construction completion, they would be removed and the area would be returned to its original state.

All buildings would be either one or two stories. The site would require two HVAC exhaust stacks; the tallest, standing 30 m (100 ft), would be located inside the PIDAS. Facility exhausts would be HEPA-filtered prior to discharge through the stacks.

Under the multibuilding configuration, production rates would dictate the size of the facilities proposed. The three potential facility capacities are 125, 250, and 450 ppy. Required acreage for each of the facility capacities during construction and operations is presented in

Section 5.8, Cumulative Impacts—Discusses the potential cumulative impacts that could result at each site as a result of the construction and operations of the MPF.

Sections 5.9, 510, and 5.11—Discusses the resources commitments required for the Proposed Action including unavoidable adverse impacts, the relationship between short-term and long-term use, and irreversible/irretrievable commitment of resources.

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The following sections discuss the environmental impacts associated with the No Action Alternative, the MPF Alternative, and the TA-55 Upgrade Alternative at LANL. The environmental impacts are presented below for each of the following environmental resource areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, and waste management.

5.2.1 Land Use and Visual Resources

5.2.1.1 Land Use

This section presents a discussion of the environmental impacts associated with the No Action Alternative, the MPF Alternative, and the TA-55 Upgrade Alternative.

The proposed concept for MPF is a multibuilding aboveground configuration. There would be three separate process buildings: Material Receipt, Unpacking, and Storage; Feed Preparation; and Manufacturing. They would be flanked by a number of smaller support facilities which would include: the Analytical Support Building, Production Support Building, Process Building Entry Control Facilities, Operations Support Facilities, Engineering Support Facility, Perimeter Intrusion Detection and Assessment System (PIDAS), Safe Havens, Standby Diesel Generator Buildings, Diesel Fuel Storage Tank, Chillers/Chemical Feed and Chilled Water Pump Buildings, Cooling Towers, Alternate Power Electrical Transformers, Truck Loading Docks, Liquid Nitrogen/Argon Storage Tanks, Chemical Storage Tanks, Bottled Gas Storage and Metering Buildings, Heating Ventilation, and Air Conditioning (HVAC) Exhaust Stacks, Waste Staging/Transuranic (TRU) Packaging Building, Commodities Warehouse, Roads and Parking Areas, and a Runoff Detention Area. In addition to these structures, a Construction Laydown Area and a Concrete Batch Plant would be built for the construction phase only. Upon construction completion, they would be removed and the area would be returned to its original state.

All buildings would be either one or two stories. The site would require two HVAC exhaust stacks; the tallest, standing 30 m (100 ft), would be located inside the PIDAS. Facility exhausts would be HEPA-filtered prior to discharge through the stacks.

Under the multibuilding configuration, production rates would dictate the size of the facilities proposed. The three potential facility capacities are 125, 250, and 450 ppy. Required acreage for each of the facility capacities during construction and operations is presented in

Table 5.2.1.1–1. As discussed in Section 3.1.2.4, these areas are for a generic campus type layout and the actual facility footprint covers much less area.

Table 5.2.1.1–1. MPF Acreage Required for Three Facility Capacities

	Facility Capacity 125 ppy	Facility Capacity 250 ppy	Facility Capacity 450 ppy
During Construction	56 ha	58 ha	69 ha
Post Construction	44 ha	46 ha	56 ha
Total Facilities Footprint	5.5 ha	5.9 ha	7.5 ha

Source: MPF Data 2003.

The reference location for the MPF at LANL is in TA-55. Land use at TA-55 has been categorized as Research and Development (R&D) (see Figure 4.2.1.1–2). TA-55 is a 38-ha (93-ac) site that is situated 1.7 km (1.1 mi) south of the city of Los Alamos.

The TA-55 Upgrade Alternative would involve expanding the pit production capability of the Plutonium Facility, Building 4 (PF-4), the current plutonium facility at TA-55, through modifications and consolidations only, and not expanding the size of the facility. However, additional office space, change space, and a new cold laboratory would be required in TA-55, and a new small glovebox decontamination and handling facility would be required in TA-54, a designated waste management and disposal area.

No Action Alternative

Under the No Action Alternative, TA-55 operational capabilities and material storage would continue at current levels. Since no new buildings or facilities would be built and operations would not change, there would be no impact on land use at the site.

Modern Pit Facility Alternative

Construction Impacts

Depending on the facility capacity, an estimated 56-69 ha (138-171 ac) of land for buildings, walkways, building access, parking, buffer space, and construction-related workspace would be required to construct the MPF. The MPF would be located near or adjacent to previously developed areas. The land required for the proposed MPF construction would represent approximately 0.5-0.7 percent of LANL's total land area of 104 km^2 (40 mi^2), an extremely small proportion. However, with respect to the 38-ha (93-ac) TA-55, 47 percent of the site has already been developed. The remaining space within TA-55 is adequate to handle the total facilities footprint. The National Nuclear Security Administration (NNSA) believes that, should LANL be selected for the MPF site, the proposed facility design could be adapted to the space available. If the LANL site were selected to host the MPF, a tiered-EIS would serve to explore all reasonable siting options.

Should LANL be selected and the MPF be placed in the existing TA-55 location, there would be a change in land use. There might also be a modification to the current land use designation, R&D, for this area.

Operations Impacts

Depending on the facility capacity, an estimated 44-56 ha (110-138 ac) of land for buildings, walkways, building access, parking, and buffer space would be required to operate the MPF. The reduction in required acreage from construction to operations represents the removal of the Construction Laydown Area and the Concrete Batch Plant upon construction completion. The land required for the proposed MPF operations would represent approximately 0.4-0.5 percent of LANL's total land area of 104 km^2 (40 mi^2), an extremely small proportion. As detailed above, NNSA believes that, should LANL's TA-55 be selected for the MPF site, the proposed facility design could be adapted to the space available. If the LANL site were selected to host the MPF, a tiered-EIS would serve to explore all reasonable siting options.

Should LANL be selected and the MPF be placed in the existing TA-55 location, there would be a change in land use. There might also be a modification to the current land use designation, R&D, for this area.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not have any additional effect on land use for this alternative.

TA-55 Upgrade Alternative

Construction Impacts

The TA-55 Upgrade would require the modification of the PF-4 structure as well as additional new construction. New facilities within TA-55 would have to be constructed to provide additional office space, change space, and a cold laboratory. Office space at TA-55 is currently oversubscribed and increasing pit production capacity would necessitate additional space. Likewise, the increase in pit production would necessitate an increase in the ingress/egress and change room capacity for plutonium workers. A cold laboratory would be required for cold process development, staging, training, and as space for uncleared workers. Additionally, a small glovebox decontamination/handling facility designed to prepare decommissioned gloveboxes for shipment to WIPP would be required and constructed in TA-54. TA-54 contains a number of other decontamination/handling facilities. The construction of all new facilities would result in an additional footprint of approximately 2.5 ha (6.2 ac) of land area. Considering that only 47 percent of TA-55 has previously been developed, land is available for the construction of additional facilities. The land required for the construction of the additional facilities would represent approximately 0.02 percent of LANL's total land area.

Should the TA-55 Upgrade be selected, there would be a small change in land use. There might also be a modification to the current land use designation, R&D, for TA-55. The R&D/Waste Disposal land use designation for TA-54 would no change.

Operations Impacts

The operation of the TA-55 Upgrade with new facilities would result in an additional footprint of approximately 1 ha (2.5 ac) of land area. The reduction of hectares reflects construction completion and the removal of all construction-related facilities and equipment. As detailed above, TA-55 would experience an increase in office space, ingress/egress and change room capacity for plutonium workers, as well as adding a new cold laboratory. Again, considering that only 47 percent of TA-55 has previously been developed, land is available for the operation of the additional facilities. TA-54, already host to a number of other decontamination/handling facilities, would gain one more small glovebox decontamination/handling facility. The land required for the operation of all additional facilities would represent approximately 0.01 percent of LANL's total land area.

Should the TA-55 Upgrade be selected, there would be a small change in land use. There might also be a modification to the current land use designation, R&D, for TA-55. The R&D/Waste Disposal land use designation for TA-54 would no change.

5.2.1.2 Visual Resources

No Action Alternative

Under the No Action Alternative, there would be no impact on visual resources at LANL or TA-55 since no new facilities would be built.

Modern Pit Facility Alternative

Construction Impacts

Activities related to the construction of new buildings required for the MPF Alternative would result in a change to the visual appearance of TA-55 due to the presence of construction equipment, new buildings in various stages of construction, and possibly increased dust. Native grasses, shrubs, trees, and pines would be cleared from the site. These changes would be temporary and, because of its interior location on the LANL site, would only be noticeable from higher elevations to the west along the upper reaches of the Parajito Plateau rim. Thus, impacts on visual resources during construction would be minimal.

Operations Impacts

The MPF, which would include one- and two-story buildings, storage tanks, and two HVAC exhaust stacks, would change the appearance of TA-55. While not visible from lower elevations, the new facilities would be visible from higher elevations beyond the LANL boundary. As a result of the Cerro Grande Fire, there would be an increased visibility of newly built structures (as well as the entire TA-55 area). However, this change would be consistent with the currently developed areas of TA-55. Thus, new construction within TA-55 boundaries would not change the current Class IV Bureau of Land Management (BLM) Visual Resource Management rating of developed areas within TA-55.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not change the layout or physical features of the MPF reference location. Therefore, there would be no additional impacts to Visual Resources.

TA-55 Upgrade Alternative

Construction Impacts

Activities related to the construction of new buildings required for the TA-55 Upgrade Alternative would result in a change to the visual appearance of TA-55 due to the presence of construction equipment, new buildings in various stages of construction, and possibly increased dust. Native grasses, shrubs, trees, and pines may be cleared for the various sites. These changes would be temporary and, because of TA-55's interior location on the LANL site, would only be noticeable from higher elevations to the west along the upper reaches of the Parajito Plateau rim. Thus, impacts on visual resources during construction at TA-55 would be minimal.

Activities related to the construction of a new glovebox decontamination/handling facility at TA-54 would result in a change to the visual appearance of the TA-54 due to the presence of construction equipment, the new building in various stages of construction, and possibly increased dust. Native grasses, shrubs, trees, and pines may be cleared for the site. At lower elevations, at a distance of several miles away from LANL, TA-54 is primarily distinguishable in the daytime by views of its water storage towers and white domes. TA-54's 5-km (3-mi) northern border forms the boundary between LANL and San Ildefonso Pueblo, and its southeastern boundary borders the town of White Rock in Los Alamos County. Although construction activities would be visible offsite, these changes would be temporary and the resulting structure would be placed among other structures of similar appearance and function. Thus, impacts on visual resources during construction at TA-55 would be minimal.

Operations Impacts

The new office, ingress/egress, change room, and cold laboratory facilities would change the appearance of TA-55. While not visible from lower elevations, the new buildings would be visible from higher elevations beyond the LANL boundary. As a result of the Cerro Grande Fire, there would be an increased visibility of newly built structures (as well as the entire TA-55 area). However, this change would be consistent with the currently developed areas of TA-55. Thus, new construction within TA-55 boundaries would not change the current Class IV BLM Visual Resource Management rating of developed areas within TA-55.

The new glovebox decontamination/handling facility would slightly change the appearance of TA-54. However, this change would be consistent with current development in the area. Thus, a new facility at TA-54 would not change the current Class IV BLM Visual Resource Management rating of the developed areas within TA-54.

5.2.2 Site Infrastructure

This section describes the impact on site infrastructure at LANL for the No Action Alternative and the modifications that would be needed for the construction and operations of the MPF Alternative and the TA-55 Upgrade Alternative. These impacts are evaluated by comparing current site infrastructure to key facility resource needs for the No Action, MPF, and TA-55 Upgrade Alternatives.

5.2.2.1 No Action Alternative

Under the No Action Alternative, there would be no change to the site infrastructure at LANL. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

5.2.2.2 Modern Pit Facility Alternative

Construction Impacts

The projected demand on key site infrastructure resources associated with construction activities of the three proposed plant sizes (125, 250, or 450 ppy) for the MPF Alternative on an annual basis are shown in Table 5.2.2.2–1. Existing infrastructure at LANL would be adequate to support annual construction requirements for the proposed plant sizes for the projected 6-year construction period. Infrastructure requirements for construction activities would have a minor impact on current site infrastructure.

Table 5.2.2.2–1. Annual Site Infrastructure Requirements for Construction of MPF at LANL

Proposed Alternatives	Electrical		Fuel		Process Gases
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Gases (m^3/yr)
Site capacity	963,600	107[a]	Not limited[b]	229,400,000[c]	Not limited[b]
Available site capacity	472,414	24	Not limited	159,400,000	Not limited
No Action Alternative[d]					
Total site requirement	491,186[a]	83[a]	Negligible	70,000,000[e]	Not limited
Percent of site capacity	51%	78%	Not limited	31%	Not limited
MPF Alternative					
125 ppy					
Total site requirement	492,000	86	Negligible	70,000,000	Not limited
Percent of site capacity	51%	80%	Not limited	31%	Not limited
Change from No Action	1,000	3	1,520,000	0	2,200
Percent of available capacity	0.21%	13%	Not limited	0	Not limited
Peak requirement	NA	NA	2,600,000	0	4,000
250 ppy					
Total site requirement	492,000	86.5	Negligible	70,000,000	Not limited
Percent of site capacity	51%	81%	Not limited	31%	Not limited
Change from No Action	1,125	3.5	1,700,000	0	2,502
Percent of available capacity	0.24%	15%	Not limited	0%	Not limited
Peak requirement	NA	NA	2,900,000	0	4,248

Table 5.2.2.2–1. Annual Site Infrastructure Requirements for Construction of MPF at LANL *(continued)*

Proposed Alternatives	Electrical		Fuel		Process Gases
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Gases (m^3/yr)
`450 ppy					
Total site requirement	492,000	87	Negligible	70,000,000	Not limited
Percent of site capacity	51%	81%	Not limited	31%	Not limited
Change from No Action	1,333	4.0	2,170,000	0	3,200
Percent of available capacity	0.28%	17%	Not limited	0	Not limited
Peak requirement	NA	NA	3,700,000	0	5,700

[a] Electrical site capacity and current requirements are for the entire Los Alamos Power Pool, which include LANL and other Los Alamos County users.
[b] Not limited due to offsite procurement.
[c] Entire service area capacity which includes LANL and other Los Alamos area users.
[d] Projected requirements over 25 years under the LANL SWEIS Expanded Operations Alternative (DOE 1999a). Revised projections for electrical energy, peak load, and natural gas also include usage for other Los Alamos County users that rely upon the same utility system (DOE 1999i).
[e] Usage value for LANL plus baseline usage for other Los Alamos County users.
NA = Not Applicable.
Source: MPF Data 2003.

Operations Impacts

The estimated annual site infrastructure requirements for the pit production capacities of 125, 250, or 450 ppy are presented in Table 5.2.2.2–2. Existing site infrastructure would be adequate to support pit production capacities of 125 and 250 ppy. For the production of 450 ppy, peak electrical load would be exceeded and LANL would have to procure additional power. Impacts to fuel and process gases would be negligible.

Table 5.2.2.2–2. Annual Site Infrastructure Requirements for Facility Operations Under the MPF Alternative

Proposed Alternatives	Electrical		Fuel		Process Gases	
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Nitrogen (m^3/yr)	Argon (m^3/yr)
Site Capacity	963,600	107	Not limited[c]	229,400,000[d]	Not limited[c]	Not limited[c]
Available site capacity	472,414	24	Not limited	159,400,000	Not limited	Not limited
No Action Alternative						
Total site requirement	491,186	83	Negligible	70,000,000[e]	Not limited	Not limited
Percent of site capacity	51%	78%	Not limited	31%	Not limited	Not limited
MPF Alternative						
125 ppy[a,b]						
Total site requirement	571,000	103.5	Negligible	74,400,000	Not limited	Not limited
Percent of site capacity	59%	97%	Not limited	32%	Not limited	Not limited
Change from No Action	79,800	20.5	259,650	4,400,000[f]	223,900	4,200
Percent of available capacity	17%	85%	Not limited	3%	Not limited	Not limited

Table 5.2.2.2–2. Annual Site Infrastructure Requirements for Facility Operations Under the MPF Alternative *(continued)*

Proposed Alternatives	Electrical		Fuel		Process Gases	
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Nitrogen (m^3/yr)	Argon (m^3/yr)
250 ppy[a,b]						
Total site requirement	605,000	106.5	Negligible	75,000,000	Not limited	Not limited
Percent of site capacity	63%	100%	Not limited	33%	Not limited	Not limited
Change from No Action	114,000	23.5	360,000	4,990,000[f]	245,000	7,300
Percent of available capacity	24%	98%	Not limited	3%	Not limited	Not limited
450 ppy[a,b]						
Total site requirement	670,000	119.5	Negligible	77,700,000	Not limited	Not limited
Percent of site capacity	69%	112%	Not limited	34%	Not limited	Not limited
Change from No Action	176,000	36.5	580,000	7,730,000[f]	303,000	11,800
Percent of available capacity	37%	152%	Not limited	5%	Not limited	Not limited

[a] Peak load is based on electrical demands of HVAC, lighting, and miscellaneous electrical systems. Peak load and annual electrical consumption estimates for the three pit production capacities are based on ratioing SRS FY99 Pit Manufacturing data (MPF Data 2003) to the multiple facility sizes. Estimates based on 24 hrs/day, 365 days per year.
[b] Diesel fuel estimates based on vendor fuel consumption data ratioed for expected diesel generator size. Diesel generator testing of 1 hour per week.
[c] Not limited due to offsite procurement.
[d] Entire service area capacity which includes LANL and other Los Alamos area users.
[e] Usage value for LANL plus baseline usage for other Los Alamos County users.
[f] Used to make steam.
Source: MPF Data 2003.

Sensitivity Analysis

There would be negligible impacts to liquid fuel or process gases from surge production capacity. Additional electrical power would have to be procured to meet surge operation demands.

5.2.2.3 TA-55 Upgrade Alternative

Construction Impacts

The projected demand for key site infrastructure resources associated with the TA-55 Upgrade Alternative at PF-4 to produce 80 ppy is shown in Table 5.2.2.3–1. The TA-55 Upgrade Alternative would have a negligible impact on site infrastructure resources at LANL.

Operations Impacts

The estimated annual electrical power capacity requirements for the production of 80 ppy are shown in Table 5.2.2.3–2. Existing site electrical energy would be adequate to support the production of 80 ppy. There would be no impacts to other site infrastructure resources.

Table 5.2.2.3–1. Annual Site Infrastructure Requirements for Construction of the TA-55 Upgrade Alternative

Proposed Alternative	Electrical Energy (MWh/yr)	Process Gases (m^3/yr)
Site Capacity	963,600	Not limited
Available Site Capacity	472,414	Not limited
No Action Alternative		
Total site requirement	491,186	Not limited
Percent of site capacity	51%	Not limited
80 ppy		
Total site requirement	491,000	Not limited
Percent of site capacity	51%	Not limited
Change from No Action	2	3,000
Percent of available capacity	Negligible	Not limited

Source: MPF Data 2003.

Table 5.2.2.3–2. Annual Site Infrastructure Requirements for the Operation of the TA-55 Upgrade Alternative

Proposed Alternative	Electrical	
	Energy (MWh/yr)	Peak Load (MWe)
Site Capacity	963,600	107
Available Site Capacity	472,414	24
No Action Alternative		
Total site requirement	491,186	83
Percent of site capacity	51%	78
80 ppy		
Total site requirement	497,000	93
Percent of site capacity	52%	87
Change from No Action	5,480	10
Percent of available capacity	1.2%	42

Source: DOE 2002k, MPF Data 2003.

5.2.3 Air Quality and Noise

5.2.3.1 Nonradiological Releases

No Action Alternative

Construction Impacts

There would be no nonradiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of criteria and toxic pollutants would continue to be generated. These emissions are part of the baseline described in Chapter 4. No increases in emissions or air pollutant concentrations are expected under the No Action Alternative. Therefore, a Prevention of Significant Deterioration (PSD) increment analysis is not required.

As part of its evaluation of the impact of air emissions, the U.S. Department of Energy (DOE) consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because LANL is located in an attainment area for all criteria pollutants; therefore, no conformity analysis is required.

Modern Pit Facility Alternative

Construction Impacts

Construction of new structures would result in temporary increases in air quality impacts from construction equipment, trucks, and employee vehicles. Exhaust emissions from these sources would result in releases of sulfur dioxide, nitrogen oxides, particulate matter (particulate matter less that 10 microns in diameter [PM_{10}] and total suspended particulates), and carbon monoxide. The calculation of emissions from construction equipment was based on emission factors provided in the U.S. Environmental Protection Agency (EPA) document AP-42, "Compilation of Air Pollutant Emission Factors" (EPA 1995). For highway vehicles (worker commuting vehicles and delivery vehicles) emission factors were obtained from the EPA Mobile Source Emission Factor Model, MOBILE6.2 (EPA 2002).

Fugitive dust generated during the clearing, grading, and other earth-moving operations is dependent on a number of factors including silt and moisture content of the soil, wind speed, and area disturbed. A common procedure to estimate fugitive emissions from an entire construction site is to use the EPA emission factor of 2.69 metric tons per hectare (120 tons per acre) per month of activity (EPA 1995). This emission factor represents total suspended particulates (i.e., particles less than 30 microns in diameter). A multiplication factor of 0.75 was used to correct the emission rate to one for PM_{10} (EPA 1995). Also, it was assumed that water would be applied to disturbed areas. This would reduce emission rates by about 50 percent. Facility construction would necessitate a Concrete Batch Plant at the building site. Particulate matter, consisting primarily of cement dust, would be the only regulated pollutant emitted in the concrete mixing process. Emission factors for the Concrete Batch Plant were obtained from AP-42 (EPA 1995).

The estimated maximum annual pollutant emissions resulting from construction activities are presented in Table 5.2.3.1–1. Actual construction emissions are expected to be less, since conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The temporary increases in pollutant emissions due to construction activities are too small to result in violations of the National Ambient Air Quality Standards (NAAQS) beyond the LANL site boundary. Therefore, air quality impacts resulting from construction would be small.

Table 5.2.3.1–1. Estimated Peak Nonradiological Air Emissions for the MPF—Construction

Pollutant	Estimated Annual Emission Rate (metric tons/yr)		
	125 ppy	250 ppy	450 ppy
Carbon monoxide	409.6	451.4	582.7
Carbon dioxide	7,084.2	7,802.9	10,062.5
Nitrogen dioxide	177.7	195.7	252.4
Sulfur dioxide	11.6	12.8	16.5
Volatile organic compounds	28.7	31.6	40.8
PM_{10}	694.4	720.3	857.0
Total Suspended Particulates	926.3	960.9	1,143.5

Source: MPF Data 2003.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.2.9, Human Health and Safety.

Operations Impacts

Pit manufacturing activities would result in the release of criteria and toxic pollutants into the surrounding air. The primary volume contributors are nitrogen and argon, used to maintain inert atmospheres for glovebox operations. Carbon dioxide would be used as a cleaning agent and helium would be used for leak testing operations. Hydrogen and nitrogen dioxide are reaction products from aqueous purification operations (pyrochemical purification would produce lower amounts of hydrogen and nitrogen dioxide). The chemicals used for dye-penetrant testing of welds are assumed to be volatilized and released to the atmosphere. Organic solvents used for cleaning and chemicals used in the Analytical Laboratory for various analyses would not be expected to contribute any appreciable quantities of any other chemicals to the annual nonradioactive air emissions. Air emissions from periodic functional testing support systems (primarily standby diesel generators) would include carbon monoxide, nitrogen dioxide, PM_{10}, sulfur dioxide, volatile organic compounds (VOCs), and total suspended particulates (WSRC 2002e). The estimated emission rates (kg/yr) for nonradiological pollutants emitted under each of the three new facility scenarios are presented in Table 5.2.3.1–2. Although a portion of these emissions would be offset by the transfer of current pit manufacturing activities to the new facilities, the emissions would be incremental to the LANL baseline. If LANL is selected as the preferred site, a PSD increment analysis would be performed under a project-specific tiered EIS to determine whether the pit manufacturing activities would cause a significant pollutant emission increase.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because LANL is located in an attainment area for all criteria pollutants. Therefore, although each alternative would emit criteria pollutants, a conformity review is not necessary.

Table 5.2.3.1–2. Annual Nonradiological Air Emissions for the MPF—Operations

Chemical Released	Quantity Released (kg/yr)		
	125 ppy	250 ppy	450 ppy
Acetone	2.5	5	8.5
Argon	1.4×10^4	2.6×10^4	4.4×10^4
Carbon dioxide	5.5×10^5	1.03×10^6	1.86×10^6
Carbon monoxide	3,180	4,380	7,150
1,2-Dicarboxylic acid	2.5	5	8.5
Helium	0.6	1.2	2.1
Hydrogen	22	43	77
Isobutane	7	14	25
Isopropanol	6	12	21
Mineral oil	6	12	21
Naptha	22	44	84
Nitrogen	2.6×10^5	2.8×10^5	3.5×10^5
Nitrogen dioxide	15,580	22,040	36,340
PM_{10}	390	530	870
Sulfur dioxide	975	1,340	2,190
Total suspended particulates	1,045	1,440	2,350
Trichloroethane	1	1.5	2
Volatile organic compounds	975	1,340	2,190

Source: WSRC 2002e.

The maximum concentrations (microgram per cubic meter [$\mu g/m^3$]) at the LANL site boundary that would be associated with the release of criteria pollutants under each of the three plant capacity scenarios (i.e., 125, 250, and 450 ppy) were modeled and are presented in Table 5.2.3.1–3. These concentrations were compared to the most stringent (Federal or state) ambient air quality standards. For each of the three capacity scenarios, incremental concentration increases would be small. For most pollutants, there would be an incremental increase of less than 1 percent of the baseline. The greatest increase would occur for the 24-hour nitrogen dioxide concentration under the 450 ppy scenario, but the ambient concentration would remain below the 24-hour ambient air quality standard. Since estimated emissions are maximum potential emissions and all emergency generators would not operate at the same time, the estimated emissions and resulting concentrations are conservative.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.2.9, Human Health and Safety.

Table 5.2.3.1–3. Criteria Pollutant Concentrations at the LANL Site Boundary for the MPF—Operations

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (μg/m³)	Maximum Incremental Concentration (μg/m³)			
			Baseline[b]	MPF Alternative		
				125 ppy	250 ppy	450 ppy
Carbon monoxide	8-hour	7,800	1,440	5.4	7.4	12
	1-hour	11,700	2,710	7.7	11	17
Nitrogen dioxide	Annual	73.7	9	2.8	3.8	5.7
	24-hour	147	90	14	19	28.7
Sulfur dioxide	Annual	41	18	0.19	0.26	0.42
	24-hour	205	130	0.95	1.3	2.1
	3-hour	1,030	254	2.1	2.9	4.8
PM_{10}	Annual	50	1	0.075	0.10	0.17
	24-hour	150	9	0.38	0.51	0.84
Total Suspended Particulates	Annual	60	2	0.20	0.28	0.46
	24-hour	150	18	1.0	1.4	2.3

[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] The No Action Alternative is represented by the baseline.
Source: MPF Data 2003, 20 NMAC 2.3.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased releases of criteria pollutants. The increase in releases of criteria pollutants from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility releases. Similarly, the increase of criteria pollutants from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.2.3.1–3). A review of the maximum incremental concentrations in Table 5.2.3.1–3 indicates that if the maximum incremental concentration of most criteria pollutants for the 450 ppy facility were conservatively doubled for surge capacity, concentrations would still not approach the most stringent standards or guideline concentrations. The only exception would be the 24-hour nitrogen dioxide concentration, which would exceed the corresponding standard by 4.7 percent. As noted above, estimated emissions are maximum potential emissions; actual emissions would be less.

TA-55 Upgrade Alternative

Construction Impacts

As discussed above, construction of new structures and modifications to existing structures would result in temporary increases in air quality impacts from construction equipment, trucks, and employee vehicles. Fugitive dust would be generated during the clearing, grading, and other earth moving operations, and particulate matter, consisting primarily of cement dust, would be emitted from the Concrete Batch Plant.

The estimated maximum annual pollutant emissions resulting from construction activities are presented in Table 5.2.3.1–4. Actual construction emissions are expected to be less, since conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the LANL site boundary. Therefore, air quality impacts resulting from construction would be small.

Table 5.2.3.1–4. Estimated Peak Nonradiological Air Emissions Under the LANL TA-55 Upgrade Alternative—Construction

Pollutant	Estimated Annual Emission Rate (metric tons per year)
Carbon monoxide	57.060
Carbon dioxide	52.015
Nitrogen dioxide	0.119
Sulfur dioxide	0.035
Volatile organic compounds	3.199
PM_{10}	0.345
Total Suspended Particulates	0.561

Source: MPF Data 2003.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.2.9, Human Health and Safety.

Operations Impacts

As discussed above, pit-manufacturing activities would result in the release of criteria and toxic pollutants into the surrounding air. These emissions would be incremental to the LANL baseline. If the TA-55 Upgrade Alternative is selected as the Preferred Alternative, a PSD increment analysis would be performed under a project-specific tiered EIS to determine whether the pit manufacturing activities would cause a significant pollutant emission increase.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because LANL is located in an attainment area for all criteria pollutants. Therefore, although each alternative would emit criteria pollutants, a conformity review is not necessary.

The maximum concentrations ($\mu g/m^3$) at the LANL site boundary that would be associated with the release of criteria pollutants under the TA-55 Upgrade Alternative are presented in Table 5.2.3.1–5. These concentrations were compared to the most stringent (Federal or state) ambient air quality standards. Incremental concentration increases would be small. For most pollutants, there would be an incremental increase of less than 1 percent of the baseline. The greatest increase would occur for the annual PM_{10} concentration, but the ambient concentration would remain below the ambient air quality standard. Since estimated emissions are maximum potential emissions and all emergency generators would not operate at the same time, the estimated emissions and resulting concentrations are conservative.

Table 5.2.3.1–5. Criteria Pollutant Concentrations at the LANL Site Boundary for the TA-55 Upgrade Alternative—Operations

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (mg/m^3)	Maximum Incremental Concentration (mg/m^3)	
			Baseline [b]	TA-55 Upgrade
Carbon monoxide	8-hour	7,800	1,440	1.81
	1-hour	11,700	2,710	NA
Nitrogen dioxide	Annual	73.7	9	NA
	24-hour	147	90	7.64
Sulfur dioxide	Annual	41	18	1.3
	24-hour	205	130	NA
	3-hour	1,030	254	NA
PM_{10}	Annual	50	1	8
	24-hour	150	9	NA
Total Suspended Particulates	Annual	60	2	0.06[b]
	24-hour	150	18	NA

[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] The No Action Alternative is represented by the baseline.
NA = not available.
Source: MPF Data 2003.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.2.9, Human Health and Safety.

5.2.3.2 Radiological Releases

No Action Alternative

Construction Impacts

There would be no radiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of radionuclides would continue to be emitted. These emissions are part of the baseline described in Chapter 4. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.2.9, Human Health and Safety.

Modern Pit Facility Alternative

Construction Impacts

No radiological releases to the environment are expected in association with construction activities. However, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site preparation activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the nature and extent of any contamination and would be required to remediate any contamination in accordance with established site procedures.

Operations Impacts

Radioactive air emissions from pit manufacturing activities would involve plutonium, americium and enriched uranium. The pit manufacturing activities would be performed within gloveboxes or vaults for radiological containment and would include plutonium recovery using aqueous or pyrochemical processes, foundry, machining, assembly, post assembly operations, inspection and certification, waste handling, and preparing the final product (pits) for shipment. Analytical operations would normally be conducted in laboratories consisting of rooms with gloveboxes and hoods for radiological containment. Each module would be separated from occupied areas of the laboratory facility by airlocks. Sample transfers would occur using a vacuum tube transfer system from the Feed Preparation and Manufacturing Facilities to the Analytical Support Facility. The ventilation exhaust from process and laboratory facilities would be filtered through double banks of HEPA filters before being released to the air via a 30-m (100-ft) tall stack. HEPA filters are the best available control technology for particulate emissions and are capable of removing more than 99.99 percent of entrained particles from the exhaust air.

DOE estimated routine radionuclide air emissions for three different plant capacities: 125, 250, and 450 ppy (see Table 5.2.3.2–1). While releases under each of the three capacity scenarios would be small, the total radionuclide emissions at LANL would increase by a factor of 10. This is primarily due to increased emissions of plutonium isotopes. To ensure that total emissions are not underestimated, DOE's method for estimating emissions was conservative. Therefore, actual emissions from pit manufacturing operations would be smaller.

Table 5.2.3.2–1. Annual Radiological Air Emissions for the MPF at LANL—Operations

Isotope	Annual Emissions (Ci/yr)			
	Baseline[a]	125 ppy	250 ppy	450 ppy
Americium-241	2.6×10^{-7}	2.08×10^{-7}	3.81×10^{-7}	7.61×10^{-7}
Plutonium-239		7.72×10^{-6}	1.19×10^{-5}	2.05×10^{-5}
Plutonium-240		2.01×10^{-6}	3.10×10^{-6}	5.35×10^{-6}
Plutonium-241		1.48×10^{-4}	2.28×10^{-4}	3.94×10^{-4}
Total Plutonium	$\mathbf{9.3 \times 10^{-6}}$	$\mathbf{1.58 \times 10^{-4}}$	$\mathbf{2.43 \times 10^{-4}}$	$\mathbf{4.20 \times 10^{-4}}$
Uranium-234		4.19×10^{-9}	5.58×10^{-9}	8.38×10^{-9}
Uranium-235		1.32×10^{-10}	1.76×10^{-10}	2.64×10^{-10}
Uranium-236		2.13×10^{-11}	2.84×10^{-11}	4.26×10^{-11}
Uranium-238		1.18×10^{-12}	1.58×10^{-12}	2.36×10^{-12}
Total Uranium	$\mathbf{7.3 \times 10^{-6}}$	$\mathbf{4.34 \times 10^{-9}}$	$\mathbf{5.79 \times 10^{-9}}$	$\mathbf{8.69 \times 10^{-9}}$
Total	$\mathbf{1.69 \times 10^{-5}}$	$\mathbf{1.58 \times 10^{-4}}$	$\mathbf{2.43 \times 10^{-4}}$	$\mathbf{4.21 \times 10^{-4}}$

[a] The No Action Alternative is represented by the baseline.
Source: WSRC 2002f.

DOE estimated the radiation doses to the maximally exposed offsite individual (offsite MEI) and to the offsite population surrounding LANL. As shown in Table 5.2.3.2–2, the expected annual radiation dose to the maximally exposed offsite individual would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The maximum estimated dose to the offsite population residing within an 80-km (50-mi) radius would also be very low. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.2.9, Human Health and Safety.

Table 5.2.3.2–2. Annual Doses Due to Radiological Air Emissions from MPF Operations at LANL

Receptor	125 ppy	250 ppy	450 ppy
Offsite MEI[a] (mrem/yr)	4.1×10^{-8}	6.6×10^{-8}	1.2×10^{-7}
Population within 80 km (person-rem per year)	3.4×10^{-7}	5.5×10^{-7}	1.0×10^{-6}

[a] The offsite MEI is assumed to reside at the site boundary.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased radiological air emissions. The increase in radiological air emissions from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility emissions. Similarly, the increase in radiological air emissions from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.2.3.2–1). A review of the annual radiological emissions in Table 5.2.3.2–2 indicates that if the emissions for the 450 ppy facility were conservatively doubled for surge capacity, concentrations remain very low. The additional dose represented by these emissions would be well below regulatory limits.

TA-55 Upgrade Alternative

Construction Impacts

No radiological releases to the environment are expected in association with the construction of new buildings at TA-54 and TA-55. However, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site preparation activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the nature and extent of any contamination and would be required to remediate any contamination in accordance with established site procedures.

Modifications to the facility would include a major upgrade of the residue recovery/metal feed area (the 400 Area) of PF-4. Various manufacturing equipment would be added to or replaced in the fabrication areas of PF-4 to enhance capacity and reliability. There would also be significant glovebox decontamination/decommissioning/disposal operations as new process development and certification operations are moved into other areas of PF-4. These activities have the potential to release small quantities of radionuclides to the environment. Release of airborne radioactivity would be controlled by conducting all operations with such potential in an existing process facility having an appropriate HEPA-filtered ventilation system or in the glovebox decontamination/handling facility that would be constructed in TA-54.

Operations Impacts

Radioactive air emissions from pit manufacturing activities would involve plutonium, americium and enriched uranium. The pit manufacturing activities would be performed within gloveboxes or vaults for radiological containment and would include plutonium recovery using aqueous or pyrochemical processes, foundry, machining, assembly, post assembly operations, inspection and certification, and waste handling. Analytical operations would normally be conducted in laboratories consisting of rooms with gloveboxes and hoods for radiological containment. The ventilation exhaust from process and laboratory facilities would be filtered through double banks of HEPA filters before being released to the air via a 30-m (100-ft) tall stack. HEPA filters are the best available control technology for particulate emissions and are capable of removing more than 99.99 percent of entrained particles from the exhaust air.

DOE estimated routine radionuclide air emissions for the TA-55 Upgrade Alternative are shown in Table 5.2.3.2–3. While releases under each of the three capacity scenarios would be small, the total radionuclide emissions at LANL would nearly double. This is primarily due to increased emissions of plutonium isotopes. To ensure that total emissions are not underestimated, DOE's method for estimating emissions was conservative. Therefore, actual emissions from pit manufacturing operations would be smaller.

Table 5.2.3.2–3. Annual Radiological Air Emissions from Operations Under the TA-55 Upgrade Alternative

Isotope	Annual Emissions (Curies per year)	
	Baseline[a]	TA-55 Upgrade Alternative[b]
Americium-241	2.6×10^{-7}	1.72×10^{-8}
Plutonium-239		5.38×10^{-7}
Plutonium-239		1.40×10^{-7}
Plutonium-241		1.03×10^{-5}
Total Plutonium	**9.3×10^{-6}**	**1.1×10^{-5}**
Uranium-234		2.52×10^{-10}
Uranium-235		7.95×10^{-12}
Uranium-236		1.28×10^{-12}
Uranium-238		7.14×10^{-14}
Total Uranium	**7.3 × 10-6**	**2.62 × 10-10**
Total	**1.69×10^{-5}**	**1.1×10^{-5}**

[a] The No Action Alternative is represented by the baseline.
[b] Assumed same isotopic distribution as that used for the Modern Pit Facility Alternative.
Source: MPF Data 2003.

DOE estimated the radiation doses to the offsite MEI and the offsite population surrounding LANL. As shown in Table 5.2.3.2–4, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 millirems per year (mrem/yr) set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The maximum estimated dose to the offsite population residing within an 80-km (50-mi) radius would also be very low. The impacts on the public and on a hypothetical noninvolved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.2.9, Human Health and Safety.

Table 5.2.3.2–4. Annual Doses Due to Radiological Air Emissions from Operations Under the TA-55 Upgrade Alternative

Receptor	Dose
Offsite MEI[a] (mrem/yr)	3.0×10^{-9}
Population within 80 km (person-rem per year)	2.5×10^{-8}

[a] The offsite MEI is assumed to reside at the site boundary.

5.2.3.3 Noise

No Action Alternative

Construction Impacts

Under the No Action Alternative, continuing operations at LANL would not involve any new construction. Thus, there would be no impacts from construction noise on wildlife or the public.

Operations Impacts

The noise-generating activities described in Section 4.2.3.4 would continue. These noise-generating activities are included in the LANL baseline and are not expected to change under the No Action Alternative.

Modern Pit Facility Alternative

Construction Impacts

Construction of new buildings at TA-55 would involve the movement of workers and construction equipment and would result in some temporary increase in noise levels near the area. Noise sources associated with construction at TA-55 would not include loud impulsive sources such as blasting. Although noise levels in construction areas could be as high as 110 A-weighted decibels (dBA), these high local noise levels would not extend far beyond the boundaries of the construction site. Table 5.2.3.3–1 shows the attenuation of construction noise over relatively short distances. At 122 m (400 ft) from the construction sites, construction noises would range from approximately 55-85 dBA. The *Environmental Impact Data Book* (Golden et al. 1980) suggests that noise levels higher than 80-85 dBA are sufficient to startle or frighten birds and small mammals. Thus, there would be little potential for disturbing wildlife outside a 122-m (400-ft) radius of the construction site. Given the distance to the site boundary (1.9 km [1.2 mi]) there would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Table 5.2.3.3–1. Peak and Attenuated Noise Levels Expected from Operation of Construction Equipment

Source	Noise level (dBA)				
	Peak	Distance from source			
		15 m	30 m	61 m	122 m
Heavy trucks	95	84-89	78-83	72-77	66-71
Dump trucks	108	88	82	76	70
Concrete mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80-89	74-82	68-77	60-71
Dozer	107	87-102	81-96	75-90	69-84
Generator	96	76	70	64	58
Crane	104	75-88	69-82	63-76	55-70
Loader	104	73-86	67-80	61-74	55-68
Grader	108	88-91	82-85	76-79	70-73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Fork lift	100	95	89	83	77

Source: Golden et al. 1980.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by the Occupational Safety and Health Administration (OSHA) in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Operations Impacts

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise impacts from pit manufacturing operations at the new buildings would be expected to be similar to those from existing operations at TA-55. There would be an increase in equipment noise (e.g., heating and cooling systems, generators, vents, motors, material-handling equipment) from pit manufacturing activities. However, given the distance to the site boundary (about 1.9 km [1.2 mi]), noise emissions from equipment would not likely disturb the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources (e.g., public address systems and testing of radiation and fire alarms) could have onsite impacts, such as the disturbance of wildlife. But these noise sources would be intermittent and would not be expected to disturb wildlife outside of facility boundaries. Traffic noise associated with the operation of these facilities would occur onsite and along offsite local and regional transportation routes used to bring materials and workers to the site. Noise from traffic associated with the operation of these facilities would likely produce less than a 1-dBA increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance to the public. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Sensitivity Analysis

If any of the three facilities operated at surge capacity, a second shift would be added. However, because of the distance of the facilities to the site boundary, noise from second-shift operations would not be noticeable offsite. Second-shift worker traffic would slightly increase noise levels on local roads. However, most material deliveries would likely occur during normal business hours, so there would be no increase in noise from truck traffic during the second shift. Impacts would be similar for each of the three plant capacities analyzed. Second-shift workers would be exposed to the same level of noise as first-shift workers. DOE would implement the same hearing protection programs for the second shift as used for the first. The second shift would not affect worker hearing.

TA-55 Upgrade Alternative

Construction Impacts

Construction of new facilities and modifications to PF-4 would involve the movement of workers and construction equipment and would result in some temporary increase in noise levels near the area. As discussed above, there would be little potential for disturbing wildlife outside a 122-m (400-ft) radius of the construction sites. Given the distance to the site boundary (about 1.9 km [1.2 mi]) there would be no change in noise impacts on the public as a result of construction activities at TA-55. The glovebox decontamination/handling facility construction site in TA-54 is located adjacent to Native American lands and approximately 2.1 km (1.3 mi) from the nearest residential community of White Rock. A small increase in noise levels may be observed at the site boundary, but there would be no change in noise impacts at the nearest residential area as a result of construction activities at TA-54. A small increase in traffic noise levels from construction employees and material shipments would be expected, but the noise level would likely increase by less than 1 dBA and would not result in any increased annoyance to the public.

Operations Impacts

Noise impacts from operations under the TA-55 Upgrade Alternative are expected to be similar to those from existing operations at TA-54 and TA-55. There may be a small increase in equipment noise (e.g., heating and cooling systems, generators, vents, motors, and material-handling equipment) due to the increased output from pit manufacturing activities. However, the small increase in noise emissions is not expected to disturb wildlife or the public. Traffic noise associated with operation of these facilities would occur onsite and along offsite local and regional transportation routes used to bring materials and workers to the site. Noise from traffic associated with additional employment at these facilities would likely produce less than a 1-dBA increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance to the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

5.2.4 Water Resources

Environmental impacts associated with the proposed alternatives at LANL could affect groundwater resources. No impacts to surface water are expected. At LANL, groundwater resources would be used to meet all construction and operations water requirements. Table 5.2.4–1 summarizes existing surface water and groundwater resources at LANL, the total LANL site-wide water resource requirements for each alternative, and the potential changes to water resources at LANL resulting from the proposed alternatives.

Table 5.2.4–1. Potential Changes to Water Resources from the MPF at LANL

Affected Resource Indicator	No Action[a]	MPF Alternative			TA-55 Upgrade Alternative
		125 ppy Single-Shift Operation	250 ppy Single-Shift Operation	450 ppy Single-Shift Operation	
Construction – *Water Availability and Use*					
Water source	Ground	Ground	Ground	Ground	Ground
Total site-wide water construction requirement (million L/yr)	1,710	1,720.7	1,721.8	1,726.3	1,710.005
Percent change from No Action water use (1,710 million L/yr)	NA	0.6%	0.7%	1.0%	0.00031%
Water Quality					
Wastewater discharge into NPDES permitted outfalls	693	695	695	696	696
Percent change from No Action wastewater discharge	NA	0.29%	0.29%	0.43%	0.43%
Operations – *Water Availability and Use*					
Water source	Ground	Ground	Ground	Ground	Ground
Total site-wide water operations requirement (million L/yr)	1,710	1,987.4	2,039.5	2,214.5	1,740.2
Percent change from No Action water use	NA	16.2%	19.3%	29.5%	1.8%
Water Quality					
Wastewater discharge into NPDES permitted outfalls (million L/yr)	693	738.0	754.9	774.8	705.3

Table 5.2.4–1. Potential Changes to Water Resources from the MPF at LANL *(continued)*

Affected Resource Indicator	No Action[a]	MPF Alternative			TA-55 Upgrade Alternative
		125 ppy Single-Shift Operation	250 ppy Single-Shift Operation	450 ppy Single-Shift Operation	
Water Quality (continued)					
Percent change from No Action wastewater discharge (693 million L/yr)	NA	6.5%	8.9%	11.8%	1.8%
Floodplain					
Actions in 100-year floodplain	NA	None	None	None	None
Actions in 500-year floodplain	NA	None	None	None	None

All discharges to natural drainages require National Pollutant Discharge Elimination System (NPDES) permits.
NA = not applicable.
million L/yr = million liters per year.
[a] Source: DOE 2002k.
Source: MPF Data 2003.

5.2.4.1 Surface Water

No Action Alternative

No additional impacts on surface water resources are anticipated at LANL under the No Action Alternative beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Surface water would not be used to support the construction of the MPF at LANL as groundwater is the source of water at LANL. Therefore, there would be no impact to surface water availability from construction. Sanitary wastewater would be generated by construction personnel. As plans include use of portable toilets, no onsite discharge of sanitary wastewater would be minimized.

During construction, an estimated total of 37.5 million L (9.9 million gal), 41.26 million L (10.9 million gal), and 54.13 million L (14.3 million gal) of liquid wastes would be generated for the 125, 250, and 450 ppy facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal generation of liquid waste over that timeframe, it is estimated that approximately 6.25 million L/yr (1.65 million gal/yr), 6.88 million L/yr (1.82 million gal/yr), and 9.02 million L/yr (2.38 million gal/yr) of liquid waste would be generated for the 125, 250, and 450 ppy facilities, respectively. It is estimated that one-third of the liquid wastes generated during construction would be from sanitary wastewater, with the remaining amount attributed to concrete construction activities. Water runoff from construction would be handled according to LANL's National Pollutant Discharge Elimination System (NPDES) permit for stormwater involving construction activities.

Stormwater runoff from construction areas could potentially impact downstream surface water quality, although any effects on runoff quality would likely be localized around immediate points of disturbance or construction laydown areas. However, appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) would be employed during construction to minimize suspended sediment and material transport, as well as potential water quality impacts. LANL would comply with Federal and state regulations to prevent, control, and handle potential spills from construction activities. However, the MPF reference location is not located near any surface water; therefore, no impacts to surface water from potential construction-related spills would be expected.

The MPF reference location at LANL is not within the 100- or 500-year floodplains. Therefore, no impacts to floodplains are anticipated. New and existing DOE facilities are subject to numerous safety analyses, including threats posed by Natural Phenomena Hazards such as earthquakes, high winds/tornadoes, and flooding. Once the exact location of the MPF is determined, detailed flood hazard analyses would be performed.

Operations Impacts

No impacts on surface water resources are expected as a result of MPF operations at LANL. No surface water would be used to support facility activities and there would be no direct discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of facility operations stemming from staff use of lavatory, shower, and breakroom facilities and from miscellaneous potable and sanitary uses. It is estimated that 45.0 million L/yr (11.9 million gal/yr), 61.9 million L/yr (16.4 million gal/yr), and 81.8 million L/yr (21.6 million gal/yr) of sanitary wastewater would be generated for the 125, 250, and 450 ppy facilities, respectively. These quantities would represent 6.5 percent, 8.9 percent, and 11.8 percent increases in sanitary wastewater discharges, respectively. LANL's current NPDES permit would require modification and approval concerning the increase in wastewater discharges. The sanitary wastewater would be treated, monitored, and discharged through NPDES outfall 135.

The MPF would not generate any radioactive liquid waste. However, there is a potential for generating radioactive contaminated water from the operations and maintenance of safety showers in contaminated areas, the operation of decontamination stations, the mopping of floors in contaminated areas, and the testing of fire sprinkler systems located in contaminated areas. Wastewater that has the potential for being radioactively contaminated would be collected, sampled, and analyzed prior to discharge. Radioactive wastewater would be treated and disposed of in accordance with DOE procedures.

Sensitivity Analysis

For a 450 ppy facility working a double shift, more wastewater would be generated by the increased number of workers. The sanitary wastewater treatment system would require appropriate modifications to handle the increase in flow.

TA-55 Upgrade Alternative

Construction Impacts

Surface water would not be used to support the construction of the TA-55 Upgrade Alternative, as groundwater is the source of drinking water at LANL. Therefore, there would be no impact to surface water availability from construction. During construction, sanitary liquid waste would be generated. As plans include use of portable toilets, no onsite discharge of sanitary wastewater would be minimized.

During construction, an estimated total of 18.5 million L (4.9 million gal) of liquid wastes would be generated for the TA-55 Upgrade Alternative. Liquid wastes generated during construction would mostly be from sanitary wastewater that would be disposed of using the existing wastewater system.

Stormwater runoff from construction areas could potentially impact downstream surface water quality, although any effects on runoff quality would likely be localized around immediate points of disturbance or construction laydown areas. However, appropriate soil erosion and sediment control measure (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. LANL would comply with Federal and state regulations to prevent, control, and handle potential spills from construction activities. However, TA-55 is not located near any surface water; therefore, no impacts to surface water from potential construction-related spills would be expected.

TA-55 is not located within the 100- or 500-year floodplains. Therefore, no impacts to floodplains are anticipated.

Operations Impacts

No impacts on surface water resources are expected as a result of TA-55 Upgrade Alternative operations at LANL. No surface water would be used to support facility activities and there would be no direct discharge of sanitary or industrial effluent to surface waters from TA-55; sanitary wastewater would be discharged to LANL's existing system. Sanitary wastewater would be generated as a result of facility operations stemming from staff use of lavatory, shower, and breakroom facilities and from miscellaneous potable and sanitary uses. It is estimated that 12.3 million L (3.25 million gal) of sanitary wastewater would be generated for the 80 ppy. This quantity would represent a 1.8 percent increase in sanitary wastewater discharge. LANL's current NPDES permit would require modification and approval concerning the increase in wastewater discharge. The sanitary wastewater would be treated, monitored, and discharged into dry arroyos according to NPDES requirements.

The TA-55 Upgrade Alternative would not generate any radioactive liquid waste. However, there is a potential for generating radioactive contaminated water from the operation and maintenance of safety showers, the operation of decontamination stations, the mopping of floors in contaminated areas, and the testing of sprinkler systems located in contaminated areas. Wastewater produced that has the potential for being radioactively contaminated would be collected, sampled, and analyzed prior to discharge. Radioactive wastewater would be treated and disposed of in accordance with DOE procedures.

5.2.4.2 Groundwater

No Action Alternative

Under the No Action Alternative, additional impacts on groundwater availability or quality are anticipated at LANL beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and meeting the potable and sanitary needs of construction employees. The proposed use of portable toilets by the construction personnel would greatly reduce water use over that normally required during construction. In addition, water required for concrete mixing would likely be procured offsite. As a result, it is estimated that construction activities would require a total of approximately 71.92 million L (19 million gal), 79.49 million L (21 million gal), and 109.79 million L (29 million gal) of groundwater for the 125, 250, and 450 ppy capacity facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal usage over that timeframe, it is estimated that approximately 10.7 million L/yr (2.83 million gal/yr), 11.8 million L/yr (3.12 million gal/yr), and 16.3 million L/yr (4.31 million gal/yr) would be needed for the 125, 250, and 450 ppy facilities, respectively. The total site water requirement including these quantities would be within LANL's current maximum water allotment. It is currently anticipated that this water would be derived from LANL groundwater supply sources via a temporary service connection or trucked to the point of use, especially during the early stages of construction.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls and countermeasure plans would be employed to minimize the chance of petroleum, oils, lubricants, and other materials used during construction being released to the subsurface and to ensure that waste materials are properly disposed. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts

Groundwater would continue to be used at LANL primarily to meet the potable and sanitary needs of facility personnel and for cooling tower water makeup. A summary of water needs for the MPF by category and total is listed in Table 5.2.4.2–1. The percent change in water consumption for the No Action Alternative ranges from 4.8-8.8 percent. LANL has a maximum water allotment of 2.05 billion L/yr (541.6 million gal/yr) and the maximum additional quantity of water needed for MPF represents 93 percent of the maximum water allotment. The maximum water requirement for site operations with the 125 ppy MPF Alternative does not exceed the maximum water allotment at LANL. Site water requirements for the 250 ppy and 450 ppy facilities exceed LANL's maximum water allotment. However, under the current lease agreement, LANL may purchase water in excess of the 30 percent allotment if available as discussed in Section 4.2.4.2.

Table 5.2.4.2–1. Summary of Water Consumption During MPF Operations at LANL (million L)

	125 ppy	250 ppy	450 ppy
Domestic Water	44.9	61.7	81.6
Cooling Tower Makeup	232.5	267.8	422.7
Total	**277.4**	**329.5**	**504.3**
Total needed for site operation	1,987.4	2,039.5	2,214.5
Percent Change from No Action Alternative	16.2%	19.3%	29.5%

Source: MPF Data 2003.

No sanitary or industrial effluent would be discharged to the surface or subsurface. Thus, no operational impacts on groundwater quality would be expected.

Routine chemical additives would be added to the domestic water to control bacteria and pH, as well as to cooling tower water makeup for bacteria and corrosion control. Table 5.2.4.2–2 summarizes the chemicals added. Use of these types of chemicals is standard and no adverse impacts would be expected.

Table 5.2.4.2–2. Summary of Chemical Additives to Domestic Water and Cooling Tower Water Makeup (kg)

Chemical	125 ppy	250 ppy	450 ppy
Water Chemicals			
Sodium hypochlorite	90	124	164
Sodium hydroxide	58	80	106
Polyphosphate	180	247	327
Cooling Tower Makeup			
Betz Slimicide	120	130	210
Betz 25K series (corrosion inhibitor)	7,000	8,000	12,700

Source: MPF Data 2003.

Sensitivity Analysis

The double shift for 450 ppy would cause a significant increase in water use over the 450 ppy single shift, which would already exceed LANL's maximum water allotment. Therefore, DOE would need to purchase additional water.

TA-55 Upgrade Alternative

Construction Impacts

Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and meeting the potable and sanitary needs of construction employees. The proposed use of portable toilets by the construction personnel would greatly reduce water use over that normally required during construction. In addition, water required for concrete mixing would likely be procured offsite. As a result, it is estimated that construction activities would require a total of 21,000 L (5,548 gal) for construction of an 80 ppy facility. It is expected that construction would take approximately 4 years. Assuming an equal usage over that timeframe, it is estimated that approximately 5,250 L/yr (1,387 gal/yr) would be needed. The annual requirement for the TA-55 Upgrade Alternative represents a very small fraction of the total site water requirement and would be within LANL's current maximum water allotment. It is anticipated that this water would be derived from LANL groundwater supply sources.

There would be no onsite discharge of wastewater to the subsurface and appropriate spill prevention controls, and countermeasure plans would be employed to minimize the chance of petroleum, oils, lubricants, and other materials used during construction being released to the subsurface and to ensure that waste materials are properly disposed. Overall, no impact on groundwater availability or quality is anticipated.

Operations Impacts

Groundwater would continue to be used at LANL primarily to meet the potable and sanitary needs of facility personnel. During operations, 30.2 million L/yr (8 million gal/yr) of domestic water would be required, and the total annual site operation groundwater requirement is 1,740.2 million L (459.7 million gal), which includes TA-55 Upgrade Alternative. The percent change in water consumption from the No Action Alternative is 1.8 percent. LANL has a maximum water allotment of 2.05 billion L/yr (541.6 million gal/yr) and the overall water requirement including the 80 ppy TA-55 Upgrade Alternative represents 85 percent of the maximum water allotment.

5.2.5 Geology and Soils

5.2.5.1 No Action Alternative

Under the No Action Alternative, no additional impacts on geology and soils are anticipated at LANL. The environmental impacts and operations (current and planned) described in Chapter 4 would continue. Hazards from large-scale geologic conditions, such as earthquakes, and from other site geologic conditions with the potential to affect existing LANL facilities are summarized in Section 4.2.5 and further detailed in the *Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory* (DOE 1999a).

5.2.5.2 Modern Pit Facility Alternative

Construction Impacts

The construction of the MPF is expected to disturb land adjacent to existing facilities at TA-55. Table 5.2.5.2–1 shows the amount of disturbance for the three different plant sizes. The major differences in the three facility layouts are in the sizes of the detention basin, Construction Laydown Area, and the roads and parking. The area of disturbance was calculated by extending the MPF area 9 m (30 ft) from the surrounding roads and the borders of the construction area and Concrete Batch Plant.

Table 5.2.5.2–1. Area Required for the MPF by Capacity Size

Facility Size	Disturbed Area (ha)
125 ppy	61.6
250 ppy	63.3
450 ppy	73.9

Source: MPF Data 2003.

Aggregate and other geologic resources (e.g., sand) would be required to support construction activities at TA-55, but these resources are abundant in Los Alamos County. In addition to new facility construction and upgrades, excavation to remove and replace some existing utility systems would also be conducted. The land area to be disturbed is relatively small; the impact on geologic and soil resources would be relatively minor. The potential exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the site's environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit. Construction of the MPF would require a stormwater permit that would address erosion control measures to minimize the impacts of erosion.

As discussed in Section 4.2.5, faults located in the vicinity of TA-55 have the potential for earthquakes. While the risk for a large earthquake exists in association with the Pajarito Fault, the smaller potential earthquakes on the closer faults would result in the same or greater ground motion at the MPF site. Ground shaking affecting primarily the integrity of inadequately designed or nonreinforced structures, but not damaging or slightly damaging properly or specially designed or upgraded facilities (Modified Mercalli Intensity VII to VIII), could be associated with the largest postulated earthquakes along these faults.

Operations Impacts

The operations of MPF at any of the three capacities would not be expected to result in impacts on geologic and soil resources. New, upgraded, and modified facilities would be evaluated, designed, and constructed in accordance with DOE Order 420.1 which requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Sensitivity Analysis

Utilizing the 450 ppy facility for two-shift operations, would not impact geologic or soil resources. A second shift of workers would use the same parking lot as the first shift. No increase in the size of the parking lot is foreseen.

5.2.5.3 TA-55 Upgrade Alternative

Construction Impacts

Under the TA-55 Upgrade Alternative, new facilities within TA-55 would have to be constructed to provide additional office space, change space, and cold laboratory space. Additionally, a small glovebox decontamination/handling facility designed to prepare decommissioned gloveboxes for shipment to WIPP would be required and constructed in TA-54. The construction associated with the new facilities and upgrade of existing TA-55 facilities is expected to disturb land adjacent to existing facilities at the TA-55 and TA-54 sites. The construction would result in 2.5 ha (6.2 ac) of land disturbed by the construction.

Aggregate and other geologic resources (e.g., sand) would be required to support the construction activities, but these resources are abundant in Los Alamos County. In addition to new facility construction and upgrades, excavation to remove and replace some existing utility systems would also be conducted. The land area to be disturbed is relatively small, and the impact on geologic and soil resources would be relatively minor. The potential exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the site's environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit. Construction of the TA-55 Upgrade would require a stormwater permit that would address erosion control measures to minimize the impacts of erosion.

As discussed in Section 4.2.5, faults located in the vicinity of LANL have the potential for earthquakes. While the risk for the largest earthquake exists in associated with the Pajarito Fault, the smaller potential earthquakes on the closer faults would result in the same or greater ground motion at the TA-55 Upgrade site. Ground shaking affecting primarily the integrity of inadequately designed or nonreinforced structures, but not damaging or slightly damaging properly or specially designed or upgraded facilities (Modified Mercalli Intensity VII to VIII) could be associated with the largest postulated earthquakes along these faults.

Operations Impacts

The operation of the TA-55 Upgrade Alternative would not be expected to result in impacts on geologic and soil resources. New, upgraded, and modified facilities would be evaluated, designed, and constructed in accordance with DOE Order 420.1, which requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

5.2.6 Biological Resources

5.2.6.1 Terrestrial Resources

No Action Alternative

Under the No Action Alternative, impacts on terrestrial resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing LANL environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

Construction would take place within the TA-55 built environment. Wildlife and vegetation present are characteristic of species adapted to built environments with open settings, i.e., nonforested. Vegetation is comprised primarily of grasses, weeds, and plants used for landscaping. Wildlife is common to the region and primarily small mammals, lizards, and birds. Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of low value vegetation and habitat would be affected during MPF construction. During site clearing activities, highly mobile wildlife species such as some small mammals and birds would be able to relocate to adjacent less developed areas. However, successful relocation may not occur due to competition for resources to support the increased population and the carrying capacity limitations of areas outside the proposed development. For less mobile species (reptiles and small mammals), direct mortality could occur during the actual construction event or ultimately result from habitat alteration. Acreage used for the development also would be lost as potential hunting habitat for raptors and other predators.

Operations Impacts

Impacts to terrestrial resources are very similar regardless of the level of pit production operations (potential pit production capacities of 125, 250, and 450 ppy including surge capacities). The major difference is the size of the modification or loss of low value plant communities and wildlife habitat. The acreage modified or lost would range from 44-56 ha (110-138 ac) depending upon pit production capacity. It is important to note that the impacts would be within a previously and substantially developed location. There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect terrestrial resources. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential for any adverse effects to plant and animal communities (terrestrial resources) surrounding TA-55.

Sensitivity Analysis

There would be minimal impacts to terrestrial resources during the two-shift operations for the 450 ppy. Wildlife road strikes (vehicle and wildlife collisions) may increase during morning and evening shift changes due to more vehicle traffic coupled with decreased visibility and higher wildlife activity.

TA-55 Upgrade Alternative

Construction/Operations Impacts

Construction impacts associated with the upgrade of TA-55 and TA-54 facilities would have minimal effect to terrestrial resources. Existing facilities would be modified to accommodate operational requirements. These improvements would occur with minimal expansion of facilities. Construction would take place within the TA-55 and TA-54 built environments. There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect terrestrial resources. Within implementation and adherence to administrative procedures, along with facility design and engineering controls, operations at the modified facilities are not expected to adversely affect plant and wildlife communities adjacent to TA-55.

5.2.6.2 Wetlands

No Action Alternative

Under the No Action Alternative, there would be no impacts to wetlands because no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

There would be no direct impacts to wetlands as there are no wetlands within the area proposed for the construction of the MPF or any of the associated construction staging and laydown areas. Implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan would avoid the indirect degradation of any adjacent wetland areas.

Operations Impacts

There are no adverse impacts predicted to any adjacent wetland area from implementation of any of the MPF production capacities. There would be no direct untreated effluent discharges to the environment. With implementation and adherence to administrative procedures, along with facility design and engineering controls, MPF operations are not expected to adversely affect wetlands downstream of the TA-55 watershed.

Sensitivity Analysis

There would be no impacts to wetlands during the two-shift operations for the surge production of 450 ppy.

TA-55 Upgrade Alternative

Construction/Operations Impacts

There are no wetlands present within the immediate area of the proposed facility upgrades. During operations there would be no direct untreated effluent discharges to the environment. Within implementation and adherence to administrative procedures, along with facility design and engineering controls, operations at the new and modified facilities would avoid adversely affecting any wetlands downstream of the TA-55 and TA-54 watersheds.

5.2.6.3 Aquatic Resources

No Action Alternative

Under the No Action Alternative, impacts on aquatic resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and LANL operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

There are no perennial or seasonal aquatic habitats within the TA-55 location proposed for the MPF. Thus there would be no direct impacts to aquatic resources. Indirect effects to aquatic resources downstream and within the TA-55 watershed would be avoided by implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan.

Operations Impacts

There would be no direct discharge of untreated operational effluent from MPF operations. Stormwater runoff from new facilities, roadways, parking lots, and other impervious areas is not predicted to result in any indirect adverse impacts on area aquatic resources. The quality of runoff waters would be similar to runoff from other LANL built environments and the quantity would represent a minor downstream contribution into the TA-55 watershed.

Sensitivity Analysis

There would be no impacts to aquatic resources during the two-shift operations for the surge production of 450 ppy.

TA-55 Upgrade Alternative

Construction/Operations Impacts

Construction impacts associated with the upgrade of TA-55 and TA-54 facilities would have little, if any, effect on aquatic resources. Existing facilities would be modified to accommodate operational requirements. These improvements would occur with minimal expansion of facilities. During MPF operations there would be no direct discharge of untreated operational effluent into the environment. Operations at the modified facilities are not predicted to adversely affect aquatic communities adjacent to TA-55 and TA-54 with implementation and adherence to administrative procedures along with facility design and engineering controls.

5.2.6.4 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, impacts to threatened and endangered species and other special interest species would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not associated with the MPF.

Modern Pit Facility Alternative

Section 7 of the *Endangered Species Act* requires all Federal agencies to ensure that actions they authorize, fund, or carry out do not jeopardize the continued existence of endangered or threatened species. Agencies must assess potential impacts and determine if proposed projects may affect federally listed or proposed-for-listing species. No species identified in Table 4.2.6.4–1, a list of Federal- and state-threatened and endangered species and other species of special interest that occur or may occur at LANL, are known to be present within the proposed site location. However, TA-55 does contain core and buffer Areas of Environmental Interest for the Mexican spotted owl (*strix occidentalis lucida*), a federally listed threatened species, and other special interest avian species may use the habitat for foraging and hunting. The proposed MPF would have minimal affect on the core and buffer area for the Mexican spotted owl as it is proposed for construction in an existing highly developed environment.

Construction Impacts

Construction would take place within the TA-55 built environment. Depending upon the MPF pit production capacity, approximately 62-74 ha (152-182 ac) of low value vegetation and habitat would be affected during MPF construction. During site clearing activities, no special interest species would be killed or dislocated as no special interest species are known to inhabit the area. However, should LANL be selected for construction and operations of the MPF, then the DOE, prior to any habitat modifying activities, would conduct site-specific surveys at the appropriate time and assess, in concert with the U.S. Fish and Wildlife Service (USFWS), the potential impacts to special interest species. Acreage temporarily modified from construction would be lost as potential foraging areas or hunting habitat for special interest avian species until the area revegetates. Revegetation would probably occur within a 1-3 year timeframe depending upon site maintenance and climate conditions.

Operations Impacts

Depending upon pit production capacity, acreage permanently modified or lost as foraging or prey base habitat for species of special interest would range from 44-56 ha (110-138 ac). It is important to note that the impacts would be to highly developed areas. There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect special interest species. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations result in a prediction of no adverse impacts to any individual within a special interest species population.

Sensitivity Analysis

There would be no impacts to threatened and endangered species during the two-shift operations for the surge production of 450 ppy.

TA-55 Upgrade Alternative

Construction/Operations Impacts

Construction impacts associated with the upgrade of TA-55 and TA-54 facilities would have little, if any, effect on special interest species. Existing facilities would be modified to accommodate operational requirements. These improvements would occur with minimal expansion of facilities. There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely effect special interest species. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, operations within TA-55 and TA-54 would minimize the potential of adverse impacts to any individual within a special interest species population.

5.2.7 Cultural and Paleontological Resources

5.2.7.1 Cultural Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility or upgrade of existing facilities. Operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to prehistoric, historic, or Native American cultural resources. The cultural resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Under the MPF Alternative, a block of land would be disturbed during construction of the new facility. The size of the disturbed area would vary by the output of the facility, and would include LANL buildings and structures (inside the PIDAS fence), security fencing and perimeter roads, support buildings and parking, a detention basin, a Concrete Batch Plant, a Construction Laydown Area, and a 9-m (30-ft) wide buffer zone surrounding the facility. For purposes of analyzing impacts to cultural resources, the three sizes of disturbed areas would be 62 ha (152 ac) (125 ppy), 63 ha (156 ac) (250 ppy), and 74 ha (182 ac) (450 ppy).

Almost half of TA-55 has been disturbed through development of other facilities. All of TA-55 has been inventoried for cultural resources; the results are discussed in Section 4.2.7. Due to the high density of cultural resources at LANL, relative to other DOE sites under consideration, there is a high probability that resources would be impacted during MPF construction anywhere on the LANL site, including TA-55. The number of resources that would be disturbed is unknown, but would likely increase as the number of acres disturbed increases.

Because the exact location of the MPF at LANL is not yet determined, cultural resources arising from infrastructure construction (such as water, sewer, gas, electricity, access roads) are not analyzed here. They will be analyzed in the site-specific EIS. However, like the facility itself, the greater the number of acres disturbed, the greater the possibility for impacts to cultural resources.

Prior to any ground-disturbing activity, DOE would identify and evaluate any cultural resources that could potentially be impacted by the construction of MPF. Methods for identification could include field surveys, shovel tests, archival research, and consultation with interested Native American tribes. DOE would determine the possibility for impacts to the resources and implement appropriate measures to avoid, reduce, or mitigate the impacts. Identification, evaluation, determination of impact, and implementation of measures would be conducted in consultation with the New Mexico State Historic Preservation Officer (SHPO) and in accordance with the *LANL Cultural Resource Overview and Data Inventory 1995* (LANL 1995b). If previously unknown cultural resources, such as subsurface resources, are discovered during construction, activities in the area of the discovery would stop and the discovery would be evaluated and treated appropriately, as determined by DOE in consultation with the New Mexico SHPO.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on cultural resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on cultural resources.

TA-55 Upgrade Alternative

Construction Impacts

This alternative includes internal modifications to the PF-4 in TA-55, construction of office space, change space, and a cold laboratory in TA-55, and construction of a glovebox decontamination/handling facility in TA-54. The total acreage that would be disturbed by these activities is 2.5 ha (6 ac).

Internal modification of the PF-4 would have no impact on cultural resources, as any construction staging areas or laydown areas would be located in areas that were previously disturbed during the original construction of the facility. All of TA-55 and most of TA-54 have been inventoried for cultural resources. Due to the high density of cultural resources at LANL, relative to the other DOE sites under consideration, there is a moderate probability that resources would be impacted during support facility construction. Because the probability for resource disturbance increases with the number of acres disturbed, and the acreage that would be disturbed for support facility construction is much smaller than the acreage that would be disturbed for the MPF, there is a much smaller likelihood for resource disturbance under the TA-55 Upgrade Alternative. Because the locations of the support facilities have not been decided, impacts to cultural resources arising from infrastructure construction (such as water, sewer, gas, electricity, access roads) are not analyzed here. They will be analyzed in the site-specific, tiered EIS. Like the facilities themselves, the greater the number of acres disturbed, the greater the possibility for impacts to cultural resources.

Prior to any ground-disturbing activity, DOE would identify and evaluate any cultural resources that could potentially be impacted by the construction of the support facilities. Methods for identification could include field surveys, shovel tests, archival research, and consultation with interested Native American tribes. DOE would determine the possibility for impacts to the resources and implement appropriate measures to avoid, reduce, or mitigate the impacts. Identification, evaluation, determination of impact, and implementation of measures would be conducted in consultation with the New Mexico SHPO and in accordance with the *LANL Cultural Resource Overview and Data Inventory 1995* (LANL 1995b). If previously unknown cultural resources, such as subsurface resources, are discovered during construction, activities in the area of the discovery would stop and the discovery would be evaluated and treated appropriately, as determined by the DOE in consultation with the New Mexico SHPO.

Operations Impacts

Operation of the PF-4 would have no impact on cultural resources.

5.2.7.2 Paleontological Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility or upgrade of existing facilities. Operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to paleontological resources. The paleontological resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Only one paleontological resource has been reported within the LANL boundaries, and such resources are unlikely to be found due to the volcanic formations that comprise the area. Therefore, no paleontological resources would be impacted due to construction of any of the three capacity sizes of the MPF or associated infrastructure anywhere on LANL.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on paleontological resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on paleontological resources.

TA-55 Upgrade Alternative

Construction Impacts

No paleontological resources have been reported within the LANL boundaries, and none are likely to be found due to the volcanic formations that comprise the area. Therefore, no paleontological resources would be impacted due to modification of the PF-4, construction of the PF-4 support facilities in TA-55 and TA-54, or construction of associated infrastructure.

Operations Impacts

Operation of the PF-4 would have no impact on paleontological resources.

5.2.8 Socioeconomics

5.2.8.1 Regional Economy Characteristics

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at LANL. Therefore, there would be no impacts to the region of influence (ROI) employment, income, and labor force.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. Construction of the facility to produce 125 ppy would require a total of 2,650 man-years of labor. During peak construction, 770 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 480 indirect jobs would be created, for a total of 1,250 jobs. This represents less than 1.5 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that the majority of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 640 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $30,900 for the construction industry, direct income would increase by $23.8 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $36.3 million ($23.8 million direct and $12.5 million indirect).

Facility–250 ppy. Construction of the facility to produce 250 ppy would require a total of 2,950 man-years of labor. During peak construction, 850 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 530 indirect jobs would be created, for a total of 1,390 jobs. This represents less than 1.5 percent of the ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that the majority of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 720 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $30,900 for the construction industry, direct income would increase by $26.3 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $40.1 million ($26.3 million direct and $13.8 million indirect).

Facility–450 ppy. Construction of the facility to produce 450 ppy would require a total of 3,800 man-years of labor. During peak construction, 1,100 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 690 indirect jobs would be created, for a total of 1,790 jobs. This represents less than 1.9 percent of the ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that the majority of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 970 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase approximately 1 percent as a result of the new jobs created. Based on the ROI average earnings of $30,900 for the construction industry, direct income would increase by $34 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $51.9 million ($34.0 million direct and $17.9 million indirect).

Operations Impacts

Facility–125 ppy. Operation of the facility to produce 125 ppy would require 988 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 280 indirect jobs would be created, for a total of approximately 1,270 jobs. This represents approximately 1.3 percent of the ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 430 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase approximately 1.2 percent as a result of the new jobs created. Based on the ROI average earnings of $47,200 for the government services industry, direct income would increase by $46.6 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $63.4 million ($46.6 million direct and $16.8 million indirect).

Facility–250 ppy. Operation of the facility to produce 250 ppy would require 1,358 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 390 indirect jobs would be created, for a total of approximately 1,750 jobs. This represents approximately 1.8 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 800 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase 1.7 percent as a result of the new jobs created. Based on the ROI average earnings of $47,200 for the government services industry, direct income would increase by $64.1 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $87.2 million ($64.1 million direct and $23.1 million indirect).

Facility–450 ppy. Operation of the facility to produce 450 ppy would require 1,797 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 510 indirect jobs would be created, for a total of approximately 2,310 jobs. This represents approximately 3 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 1,250 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase approximately 2.2 percent as a result of the new jobs created. Based on the ROI average earnings of $47,200 for the government services industry, direct income would increase by $84.8 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $115.3 million ($84.8 million direct and $30.5 million indirect).

Sensitivity Analysis

If the facility were to be operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income.

TA-55 Upgrade Alternative

Construction Impacts

Construction of TA-55 would require a total of 430 man-years of labor. During peak construction, 190 workers would be employed at the site. In addition to the direct jobs created by construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 120 indirect jobs would be created, for a total of approximately 310 jobs. This represents less than 0.5 percent of the ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that some direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 60 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase less than 0.5 percent as a result of the new jobs created. Based on the ROI average earnings of $30,900 for the construction industry, direct income would increase by $5.9 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $9.0 million ($5.9 million direct and $3.1 million indirect).

Operations Impacts

Operations of TA-55 would require 680 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 200 indirect jobs would be created, for a total of approximately 880 jobs. This represents less than 1 percent of the ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 130 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $47,200 for the government services industry, direct income would increase by $32.0 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $43.6 million ($32.0 million direct and $11.6 million indirect).

5.2.8.2 Population and Housing

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at LANL. Therefore, there would be no impacts to the ROI population and housing.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of approximately 1,600 new residents would be expected in the ROI, including workers and their families. This is an increase of approximately 1 percent over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–250 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,900 new residents would be expected in the ROI, including workers and their families. This is an increase of approximately 1 percent over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–450 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 2,500 new residents would be expected in the ROI, including workers and their families. This is an increase of approximately 1.3 percent over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Operations Impacts

Facility–125 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,100 new residents would be expected in the ROI, including workers and their families. This is an increase of less than 1 percent over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–250 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 2,100 new residents would be expected in the ROI, including workers and their families. This is an increase of approximately 1.1 percent over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–450 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 3,200 new residents would be expected in the ROI, including workers and their families. This is an increase of approximately 1.7 percent over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Sensitivity Analysis

If the facility were to be operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. There would be additional impacts to the ROI population and additional stress on the local housing market because most of these workers would come from outside the ROI.

TA-55 Upgrade Alternative

Construction Impacts

The influx of new workers would increase the ROI population and create new housing demand. A total of approximately 150 new residents would be expected in the ROI, including workers and their families. This is an increase of 0.1 percent over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Operations Impacts

The influx of new workers would increase the ROI population and create new housing demand. A total of approximately 335 new residents would be expected in the ROI, including workers and their families. This is an increase of approximately 0.2 percent over the current population. The current housing market would likely be sufficient to absorb this increase in ROI population.

5.2.8.3 Community Services

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at LANL. Therefore, there would be no impacts to the ROI community services.

Modern Pit Facility Alternative

Construction Impacts

Facility–125, 250, or 450 ppy. The small increase in the ROI population would not put increased demand on ROI community services. Comparable levels of service could be maintained with current staffing levels.

Operations Impacts

Facility–125, 250, or 450 ppy. The small increase in the ROI population would not put increased demand on ROI community services. Comparable levels of service could be maintained with current staffing levels.

TA-55 Upgrade Alternative

Construction Impacts

The small increase in the ROI population would not put increased demand on ROI community services. Comparable levels of service could be maintained with current staffing levels.

Operations Impacts

The small increase in the ROI population would not put increased demand on ROI community services. Comparable levels of service could be maintained with current staffing levels.

5.2.9 Human Health and Safety

Radiological Health Effects Risk Factors Used in this EIS

Health impacts of radiation exposure, whether from external or internal sources, are generally identified as “somatic” (i.e., affecting the exposed individual) or “genetic” (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects (i.e., induced cancers) than genetic effects. Except for leukemia, which can have an induction period (time between exposure to carcinogen and cancer diagnosis) of as little as 2-7 years, most cancers have an induction period of more than 20 years. Because of the delayed effect, the cancers are referred to as “latent” cancers.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues; the thyroid gland and skin demonstrate a greater sensitivity than other organs. Such cancers, however, also produce comparatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most probable serious effect of environmental and occupational radiation exposure, estimates of cancer fatalities, rather than cancer incidents, are presented in this EIS.

The number of latent cancer fatalities (LCFs) is estimated using risk factors determined by the International Commission on Radiological Protection. A risk factor is the probability that an individual would incur a LCF during his or her lifetime if the individual receives a unit of radiation dose (1 rem). The risk factor for workers would be 0.0004 (LCFs per rem) and 0.0005 (LCFs per rem) for individuals among the general public. The risk factor for the public would be slightly higher because the public includes infants and children, who are more sensitive to radiation than adults.

Examples:

- The LCF risk for an individual (nonworker) receiving a dose of 0.1 rem would be 0.00005 (0.1 rem × 0.0005 LCFs per rem). This risk can also be expressed as 0.005 percent chance or 1 chance in 20,000.
- The same concept is used to calculate the LCF risk from exposing a group of individuals to radiation. The LCF risk for individuals in a group of 100,000, each receiving a dose of 0.1 rem, would be 0.00005, as indicated above. This individual risk, multiplied by the number of individuals in the group, expresses the number of LCFs that could occur among the individuals in the group. In this example, the number would be 5 LCFs (100,000 × 0.00005). A number of LCFs less than 1 means that the radiation exposure is not sufficient to cause a single LCF among the members of the group. In this case, the risk is expressed as a probability that a single LCF would occur among the members of the group. For example, 0.05 LCFs can be stated as “there is 1 chance in 20 (1/0.05) that 1 LCF would occur among the members of the group.”

The EIS provides estimates of probability of a LCF occurring for the involved and non-involved workers, the offsite MEI, and the general population. These categories are defined as follows:

Involved worker—An individual worker participating in the operation of the facilities.

Non-involved worker—An individual worker at the site other than the involved worker.

Maximally exposed offsite individual (offsite MEI)—A hypothetical member of the public residing at the site boundary who could receive the maximum dose of radiation.

Population—Members of the public residing within an 80-km (50-mi) radius of the facility.

5.2.9.1 Radiological Impacts

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL.

Construction Impacts

Under the No Action Alternative, there would be no radiological impacts on members of the public or workers because this alternative would not involve any construction.

Operations Impacts

Under this alternative, the radiological releases to the environment from LANL would continue at the same rates described in Section 4.2.9. The associated impacts on the general public living within 80 km (50 mi) of LANL and the offsite MEI would continue at the levels shown in Table 4.2.9.1–2. As shown in that table, the expected annual radiation dose to the maximally exposed offsite individual would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The fatal cancer risk to the maximally exposed offsite member of the public due to radiological releases from LANL operations is estimated to be 9.5×10^{-7}, while 8×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of LANL from normal LANL operations.

Under this alternative, the radiation dose received by LANL workers would continue at the rates described in Section 4.2.9. These worker radiation doses at LANL in the year 2000 are presented in Table 4.2.9.1–3. The number of projected fatal cancers among LANL workers from normal operations in 2000 is 0.098.

Modern Pit Facility Alternative

Construction Impacts

No radiological risks would be incurred by members of the public from construction activities. Construction workers could be at a small radiological risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as is reasonably achievable.

Operations Impacts

Impacts to the Public. DOE expects minimal public health impacts from the radiological consequences of MPF operations. Public radiation doses would likely occur from airborne releases only (Section 5.2.3). Table 5.2.9.1–1 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental latent cancer fatalities (LCFs). To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

Table 5.2.9.1–1. Annual Radiological Impacts on the Public from MPF Operations at LANL for All Three Pit Production Rates

Receptor	125 ppy	250 ppy	450 ppy
Population within 80 km			
Collective dose (person-rem)	3.4×10^{-7}	5.5×10^{-7}	1.0×10^{-6}
Percent of natural background radiation[a]	0.00000000016%	0.00000000026%	0.00000000047%
LCFs[b]	1.7×10^{-10}	2.8×10^{-10}	5.0×10^{-10}
Offsite MEI[c]			
Dose (mrem)	4.1×10^{-8}	6.6×10^{-8}	1.2×10^{-7}
Percent of regulatory dose limit	0.00000041%	0.00000066%	0.0000012%
Percent of natural background radiation[a]	0.000000011%	0.000000018%	0.000000033%
Cancer fatality risk[b]	2.1×10^{-14}	3.3×10^{-14}	6.0×10^{-14}

[a] The average annual dose from background radiation at LANL is 360 mrem (see Section 4.2.9); the 586,335 people living within 80 km (50 mi) of LANL in the year 2043 would receive an annual dose of 211,081 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 LCFs per person-rem.
[c] The offsite MEI is assumed to reside at the site boundary, 2,000 m (6,562 ft) north-northeast from the MPF an actual residence may not currently be present at this location.

As shown in the table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a LCF to this individual from operations would be less than or equal to 6.0×10^{-14} per year (i.e., about 1 chance in 17 trillion per year of a LCF). The projected number of fatal cancers to the population within 80 km (50 mi) would be less than or equal to 5.0×10^{-10} per year (i.e., about 1 chance in 2 billion per year of a LCF).

Impacts to MPF Workers. Estimates of annual radiological doses to workers involved with MPF operations are independent of geographical location. These dose estimates are solely a function of:

The number of radiological workers, as determined in the development of the MPF staffing estimate for each throughput alternative. The current estimates were developed by application of a factor to the total workers for each workgroup based on operating experience in plutonium facilities. Approximately 60 percent of total operating staff are estimated to be radiological workers.

- The working dose rate at the glovebox surface for each unit operation or workstation. These dose rates were calculated based on the maximum mass (plutonium, americium) and form (metal, oxide) of material being handled. Standard "weapons grade" isotopic distribution, and americium content of 0.5 percent were assumed.

- The amount of time spent by direct operators/first line supervisors in the radiation area. This was determined from a time-motion estimate of direct "hands-in-gloves" labor required to perform each individual operation and the number of parts processed per year for a given pit production rate. Efficiency scaling factors were applied for various operations. For Foundry and Machining operations, this was assumed to be 50 percent; for Assembly and Post-Assembly & Testing, efficiencies were 90 percent.

As indicated above, the collective annual dose (mrem/yr) received by individual direct operators is calculated based on the number of operators required for the various production rates, the time spent in the radiation area, and the associated dose rates for each operation. The collective exposures for support group workers were added to these numbers and were calculated using empirical data that implies that exposure for these workers can be estimated as a percentage of direct operator exposure (e.g., Analytical Laboratory Technician ~25 percent of direct operator exposure). The average individual dose is calculated as the collective exposure divided by the estimated number of radiological workers for each throughput alternative.

The estimates of annual radiological doses to workers under each of the three pit production rates are provided in Table 5.2.9.1–2. As shown in the table, the annual doses to individual workers for all levels of production would be well below the DOE limit of 5,000 mrem (10 CFR 835.202) and the DOE-recommended Control Level of 1,000 mrem (10 CFR 835.1002). The projected number of fatal cancers in the workforce from annual operations involving 125 ppy would be 0.064 (or 1 chance in 16 that the worker population would experience a fatal cancer per year of operations). For annual pit production rates of 250 and 450, the projected number of fatal cancers would be 0.12 and 0.22, respectively (1 chance in 8 or 5, respectively, that the worker population would experience a fatal cancer per year of operations).

Table 5.2.9.1–2. Annual Radiological Impacts on MPF Workers at LANL from Operations for All Three Pit Production Rates

Production Rate	**125 ppy**	**250 ppy**	**450 ppy**
Number of Radiological Workers	**550**	**800**	**1,100**
Individual Workers[a]			
Average individual dose, mrem/yr	290	390	510
Average worker cancer fatality risk[b]	1.2×10^{-4}	1.6×10^{-4}	2.0×10^{-4}
Worker Population			
Collective dose (person-rem)	160	310	560
Cancer fatality risk[b]	0.064	0.12	0.22

[a] The regulatory dose limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, the maximum annual dose to a worker would be kept below the DOE Control Level of 1,000 mrem/yr, as established in 10 CFR 835.1002. Further, DOE recommends that facilities adopt a more limiting 500-mrem/yr Administrative Control Level (DOE 1999e). To reduce doses to levels that are as low as is reasonably achievable, an effective dose reduction plan would be enforced.
[b] Based on a cancer risk estimator of 0.0004 LCFs per person-rem.

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the MPF under any of the three capacities would approximately double the quantities of radioactive emissions from the MPF presented for single-shift operation at each capacity. Thus, the calculated radiation dose and LCFs to the offsite MEI and the population living within 80 km (50 mi) of LANL would approximately double.

Similarly, double-shift operation of the MPF under any of the three capacities would approximately double the radiation dose to MPF workers presented for single-shift operation at each capacity. Thus, the calculated adverse health impacts to MPF workers would be approximately double.

TA-55 Upgrade Alternative

Construction Impacts

No radiological risks would be incurred by members of the public from construction activities. Construction workers could be at a small radiological risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site, including that associated with residual contamination at the facilities being upgraded. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as reasonably achievable.

Operations Impacts

Impacts to the Public. DOE expects minimal public health impacts from the radiological consequences for an upgraded TA-55 pit production facility operation. Public radiation doses would likely occur from airborne releases only (Section 5.2.3). The airborne releases from a production rate of 80 ppy are estimated to be 1.1×10^{-5} Ci/yr. This can be compared to a MPF producing 125 ppy and releasing an estimated total of 1.5×10^{-4} Ci/yr of airborne radioactive materials, most of it plutonium-241. Thus, the incremental impacts to the public from an upgraded TA-55 facility would be approximately 14 times lower than from a MPF operating at 125 ppy. Table 5.2.9.1–3 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

As shown in the table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a LCF to this individual from operations would be 1.5×10^{-15} per year (i.e., about 1 chance in 670 trillion per year of a LCF). The projected number of fatal cancers to the population within 80 km (50 mi) would be 1.2×10^{-11} per year (i.e., about 1 chance in 81 billion per year of a LCF).

Table 5.2.9.1–3. Annual Radiological Impacts on the Public from the TA-55 Upgrade Alternative

Receptor	80 ppy
Population within 80 km	
Collective dose (person-rem)	2.5×10^{-8}
Percent of natural background radiation[a]	0.000000000012%
LCFs[b]	1.2×10^{-11}
Offsite MEI[c]	
Dose (mrem)	3.0×10^{-9}
Percent of regulatory dose limit	0.000000030%
Percent of natural background radiation[a]	0.00000000084%
Cancer fatality risk[b]	1.5×10^{-15}

[a] The average annual dose from background radiation at LANL is 360 mrem (see Section 4.2.9); the 586,335 people living within 80 km (50 mi) of LANL in the year 2043 would receive an annual dose of 211,081 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 LCFs per person-rem.
[c] The offsite MEI is assumed to reside at the site boundary, 2,000 m (6,562 ft) north-northeast from the MPF. An actual residence may not currently be present at this location.

Impacts to MPF Workers. The estimates of annual radiological doses to workers at the upgraded TA-55 pit production facility are provided in Table 5.2.9.1–4. The data for the surge operation of 80 ppy were obtained from the SSM PEIS (DOE 1996c). The dose presented for the involved workforce is only that incremental dose received from pit production. As shown in the table, the annual doses to individual workers for all levels of production would be well below the DOE limit of 5,000 mrem (10 CFR 835.202) and the DOE-recommended Control Level of 1,000 mrem (10 CFR 835.1002). For a production rate of 80 ppy, the projected number of fatal cancers would be 0.062 (1 chance in 16 that the worker population would experience a fatal cancer per year of operations).

Table 5.2.9.1–4. Annual Radiological Impacts on Workers at TA-55 Upgrade Facility from Operations

Production Rate	**80 ppy**
Number of Radiological Workers	**406**
Individual Workers[a]	
Average individual dose, mrem/year	380
Average worker cancer fatality risk[b]	1.5×10^{-4}
Worker Population	
Collective dose (person-rem)	154
Cancer fatality risk[b]	0.062

[a] The regulatory dose limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, the maximum annual dose to a worker would be kept below the DOE Control Level of 1,000 mrem/yr, as established in 10 CFR 835.1002. Further, DOE recommends that facilities adopt a more limiting 500-mrem/yr Administrative Control Level (DOE 1999e). To reduce doses to levels that are as low as reasonably achievable, an effective dose reduction plan would be enforced.
[b] Based on a cancer risk estimator of 0.0004 LCFs per person-rem.

5.2.9.2 Nonradiological Impacts

This section considers illness, injury, and fatality rates associated with the construction and operation of the MPF on the LANL workforce. Nonradiological impacts to workers were evaluated using occupational injury, illness, and fatality rates obtained from the Bureau of Labor Statistics (BLS), U.S. Department of Labor data. DOE values are historically lower than BLS values owing to the increased focus on safety fostered by complex-wide programs, including Integrated Safety Management (ISM) and the Voluntary Protection Program (VPP). Additionally, the small number of fatal accidents reported in the Computerized Accident/Incident Reporting System (CAIRS) makes associated calculated fatality rates statistically invalid.

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in injury, illness, and fatality trends currently observed at LANL. There would be no hazardous chemical impacts on members of the public or workers because no construction would be involved and no increase in chemical inventories would be required.

Modern Pit Facility Alternative

Construction Impacts

The potential risk of occupational injuries and fatalities to workers constructing the MPF would be expected to be bounded by injury and fatality rates for general industrial construction. Using BLS data from 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for both the peak workforce loading and for the duration of construction activities including site preparation (6¾ years). These values are shown below in Table 5.2.9.2–1.

Table 5.2.9.2–1. Injury, Illness, and Fatality Estimates for Construction of the MPF at LANL

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Peak Annual Employment	770	850	1,100
Total Recordable Cases	66	73	95
Total Lost Workday Cases	32	35	46
Total Fatalities	0.16	0.17	0.023
Project Duration (6¾ years)			
Total Recordable Cases	228	254	328
Total Lost Workday Cases	110	122	157
Total Fatalities	0.54	0.60	0.78

Source: MPF Data 2003, BLS 2002b.

No chemicals have been identified that would be a risk to members of the public from construction activities associated with any of the MPF operating capacities. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. Integrated Safety Management System (ISMS) programs to construction activities would also decrease the potential for worker exposures by providing hazards identification and control measures for construction activities (WSRC 2002c).

Operations Impacts

During normal (accident-free) operations, total facility staffing would range from approximately 988-1,797, depending on the operating capacity of the selected MPF. The potential risk of occupational injuries and fatalities to workers operating the MPF would be expected to be bounded by injury and fatality rates for general chemical manufacturing. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities for facility populations were estimated for each of the operating capacities. These values are shown below in Table 5.2.9.2–2.

Table 5.2.9.2–2. Injury, Illness, and Fatality Annual Estimates for Normal Operations of the MPF at LANL

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Total Recordable Cases	43	59	78
Total Lost Workday Cases	22	30	40
Total Fatalities	0.04	0.05	0.07

Source: MPF Data 2003, BLS 2002b.

No chemical-related health impacts are associated with normal (accident-free) operations of the MPF at the three identified operating capacities. Initial screens for the hazard analysis did not result in the identification of any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by facility safety programs such as ISMS, work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness (WSRC 2002c).

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the LANL illness and injury rates for facility-associated activities. No chemical-related health impacts would be associated with this increase in operations.

TA–55 Upgrade Alternative

This section considers illness, injury, and fatality rates associated with construction and operation of the upgraded TA-55 pit production facility on the LANL workforce. Nonradiological impacts to workers were evaluated using occupational injury, illness, and fatality rates obtained from BLS, U.S. Department of Labor data. DOE values are historically lower than BLS values owing to the increased focus on safety fostered by complex-wide programs, including ISM and the VPP. Additionally, the small number of fatal accidents reported in the CAIRS system makes associated calculated fatality rates statistically invalid.

Construction Impacts

The potential risk of occupational injuries and fatalities to workers constructing the TA-55 Upgrade would be expected to be bounded by injury and fatality rates for general industrial construction. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases and Fatalities were estimated for the peak workforce loading, estimated to be 190 workers (MPF Data 2003), and for the project duration. For the duration of construction activities, (4 years, including site preparation), the number of worker years is estimated to be 430 (MPF Data 2003). These values are shown in Table 5.2.9.2–3.

Table 5.2.9.2–3. Injury, Illness, and Fatality Estimates for Construction of the TA-55 Upgrade Alternative

Injury, Illness, and Fatality Categories	80 ppy
Peak Annual Employment	190
Total Recordable Cases	16
Total Lost Workday Cases	8
Total Fatalities	0.039
Project Duration (4 years)	
Total Recordable Cases	37
Total Lost Workday Cases	18
Total Fatalities	0.09

Source: MPF Data 2003, BLS 2002b.

No chemicals have been identified that would be a risk to members of the public from construction activities associated with the TA-55 Upgrade. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. Implementation of ISMS programs to construction activities would also decrease the potential for worker exposures by providing hazards identification and control measures for construction activities (WSRC 2002c).

Operations Impacts

During normal (accident-free) operations, total facility staffing would be approximately 680 workers. The potential risk of occupational injuries and fatalities to workers operating the upgraded TA-55 pit production facility would be expected to be bounded by injury and fatality rates for general chemical manufacturing. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases and Fatalities were estimated for the facility population. These values are shown below in Table 5.2.9.2–4.

Table 5.2.9.2–4. Injury, Illness, and Fatality Annual Estimates for Normal Operations of the TA-55 Upgrade Alternative

Injury, Illness, and Fatality Categories	80 ppy
Total Recordable Cases	29
Total Lost Workday Cases	15
Total Fatalities	0.025

Source: MPF Data 2003, BLS 2002b.

No chemical-related health impacts are associated with normal (accident-free) operations of the upgraded TA-55 pit production facility. Initial screens for the hazard analysis did not result in the identification of any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection would be augmented by facility safety programs such as ISMS, work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness (WSRC 2002c).

5.2.10 Facility Accidents

This section presents the potential impacts on workers (both involved and non-involved) and the public due to potential accidents associated with operation of the MPF at LANL. Additional details supporting the information presented here are provided in Appendix C, Human Health Effects from Facility Accidents.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.

- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.

- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, DOE predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident.

Emergency Preparedness

Each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

5.2.10.1 No Action Alternative

Under the No Action Alternative, plutonium pit fabrication capabilities would be maintained at existing levels. Potential accident scenarios for the No Action Alternative are addressed in existing documentation included by reference (DOE 1996c, DOE 1999a, LANL 1995a).

5.2.10.2 Modern Pit Facility Alternative

Radiological Impacts

DOE estimated radiological impacts to three receptors: (1) the offsite MEI at the LANL boundary; (2) the offsite population within 80 km (50 mi) of LANL; and (3) a non-involved worker 1,000 m (328 ft) from the accident location. DOE did not evaluate total dose to non-involved workers because of the uncertain nature of worker locations at the time of the accident.

Tables 5.2.10.2–1 through 5.2.10.2–3 show the frequencies and consequences of the postulated set of accidents for the public (maximally exposed offsite individual and the general population living within 80 km [50 mi] of the facility) and a hypothetical non-involved worker for the three pit production rates. The dose shown in the tables are calculated by the MACCS computer code based on accident data. The latent cancer fatality (LCF) values are calculated using a dose-to-LCF conversion factor. For the MEI and the population the conversion factor is 0.0005 LCFs per rem or person-rem respectively. For workers, the dose-to-risk conversion factor is 0.0004 LCFs per rem. If the dose to an MEI or worker exceeds 20 rem, the dose-to-risk conversion factor is doubled to 0.001 and 0.0008 respectively. Tables 5.2.10.2–4 through 5.2.10.2–6 show the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *Topical Report - Supporting Documentation for the Accident Impacts Presented in the Modern Pit Facility Environmental Impact Statement* (Tetra Tech 2003). The selection process, screening criteria used, and conservative estimates of material at risk and source term (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur under an alternative. Thus, in the event that any other accident that was not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5.2.10.2–1. MPF Alternative Radiological Accident Frequency and Consequences at LANL for 125 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
$1{\times}10^{-5}$	41.4	0.041	36,300	18.2	244	0.2
Fire in a Single Building						
$1{\times}10^{-4}$	32.7	0.033	21,400	10.7	301	0.24
Explosion in a Feed Casting Furnace						
$1{\times}10^{-2}$	38.3	0.038	25,100	12.5	353	0.28
Nuclear Criticality						
$1{\times}10^{-2}$	0.00012	5.8×10^{-8}	0.11	5.3×10^{-5}	0.0012	4.7×10^{-7}
Fire-induced Release in the CRT Storage Room						
$1{\times}10^{-2}$	2.4	0.0012	1,670	0.84	23.5	0.019
Radioactive Material Spill						
$1{\times}10^{-2}$	0.77	0.00036	502	0.25	7.1	0.0028

CRT = Cargo Restraint Transporter.
[a] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.2.10.2–2. MPF Alternative Radiological Accident Frequency and Consequences at LANL for 250 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	42.6	0.043	37,400	18.7	251	0.2
Fire in a Single Building						
1×10^{-4}	33.9	0.034	22,200	11.1	312	0.25
Explosion in a Feed Casting Furnace						
1×10^{-2}	38.3	0.038	25,100	12.5	353	0.28
Nuclear Criticality						
1×10^{-2}	0.00012	5.8×10^{-8}	0.11	5.3×10^{-5}	0.0012	4.7×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	2.4	0.0012	1,670	0.84	23.5	0.019
Radioactive Material Spill						
1×10^{-2}	0.77	0.00036	502	0.25	7.1	0.0028

[a] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.2.10.2–3. MPF Alternative Radiological Alternative Accident Frequency and Consequences at LANL for 450 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	82.1	0.082	72,000	36	484	0.39
Fire in a Single Building						
1×10^{-4}	65.7	0.066	43,000	21.5	605	0.48
Explosion in a Feed Casting Furnace						
1×10^{-2}	38.3	0.038	25,100	12.5	353	0.28
Nuclear criticality						
1×10^{-2}	0.00012	5.8×10^{-8}	0.11	5.3×10^{-5}	0.0012	4.7×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	5.1	0.0024	3,340	1.67	47	0.038
Radioactive Material Spill						
1×10^{-2}	0.77	0.00036	502	0.025	7.1	0.0028

[a] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs .

The results of the accident analysis indicate potential consequences that exceed the DOE exposure guidelines of 25 rem for a member of the public at the nearest site boundary. The analyses in these cases for NEPA purposes are based on unmitigated releases of radioactive material to select a site for the MPF. Following the ROD and selection of a site, additional NEPA action would be taken that would identify specific mitigating features that would be incorporated in the MPF design to ensure compliance with DOE exposure guidelines. These could include procedural and equipment safety features, HEPA filtration systems, and other design features that would protect radioactive materials from accident conditions and contain any material that might be released. Upon completion of MPF NEPA actions, DOE would prepare safety analysis documentation such as a safety analysis report to further ensure that DOE exposure guidelines would not be exceeded. The results of the safety analysis report are reflected in facility and equipment design and defines an operating envelope and procedures to ensure public and worker safety. Once specific mitigation measures are incorporated into the MPF design and operating procedures, the potential consequences will not exceed the DOE exposure guidelines of 25 rem for a member of the public at the nearest site boundary for any of the site alternatives.

The accident with the highest risk to the offsite population (see Tables 5.2.10.2-4 through 5.2.10.2-6) is the explosion in a feed casting furnace for the 125 ppy, 250 ppy, and 450 ppy production cases. The increased number of LCFs in the offsite population would be 0.125 per year (i.e., about 1 chance in 8 per year of a LCF in the total population) for all three production cases. The highest risk of a LCF to an offsite MEI individual located at a distance of 1,750 m (5,742 ft) in the north-northeast direction from the accident would be 0.00038 per year (i.e., about 1 chance in 2,630 per year of a LCF) for all three production cases. The highest risk of a LCF to a non-involved worker located at a distance of 1,000 m (3,281 ft) from the accident would be 0.0028 per year (i.e., about 1 chance in 360 per year of a LCF) for all three production cases.

Table 5.2.10.2–4. Annual Cancer Risks Due to MPF Accidents at LANL for 125 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	4.1×10^{-7}	0.00018	2.0×10^{-6}
Fire in a Single Building	3.3×10^{-6}	0.0011	2.4×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.125	0.0028
Nuclear criticality	5.8×10^{-10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	1.2×10^{-5}	0.0084	0.00019
Radioactive Spill Material	3.6×10^{-6}	0.0025	2.8×10^{-5}

a Increased likelihood of a LCF.
b Increased number of LCFs.
c Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

Table 5.2.10.2–5. Annual Cancer Risks Due to MPF Accidents at LANL for 250 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	4.3×10^{-7}	0.00019	2.0×10^{-6}
Fire in a Single Building	3.4×10^{-6}	0.0011	2.5×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.125	0.0028
Nuclear Criticality	5.8×10^{-10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	1.2×10^{-5}	0.0084	0.00019
Radioactive Spill Material	3.6×10^{-6}	0.0025	2.8×10^{-5}

a Increased likelihood of a LCF.
b Increased number of LCFs.
c Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

Table 5.2.10.2–6. Annual Cancer Risks Due to MPF Accidents at LANL for 450 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	8.2×10^{-7}	0.00036	3.9×10^{-6}
Fire in a Single Building	6.6×10^{-6}	0.0022	4.8×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.125	0.0028
Nuclear Criticality	5.8×10^{-10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	2.4×10^{-5}	0.017	0.00038
Radioactive Spill Material	3.6×10^{-6}	0.0025	2.8×10^{-5}

a Increased likelihood of a LCF.
b Increased number of LCFs.
c Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

Hazardous Chemicals Impacts

DOE estimated the impacts of the potential release of the most hazardous chemicals selected from the many chemicals used at MPF. A chemical's vapor pressure, acceptable concentration Emergency Response Planning Guideline (ERPG)-2, and quantity available for release are factors used to rank a chemical's hazard. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Additional information on the evaporation and dispersion of each chemical is provided in Appendix C. Tables 5.2.10.2–7 through 5.2.10.2–9 provide information on each chemical and the frequency and consequences of an accidental release. The source term shown represents the amount of the chemical that is accidentally released. The American

Industrial Hygiene Association defines the ERPG-2 as the maximum airborne concentration below which 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. The distances from the release point to the point where the ERPG-2 concentration is reached in relation to the site boundary reflects the consequence of the chemical's release. As the distance to the ERPG-2 concentration increases, the potential number of persons onsite and offsite that may be exposed to concentrations in excess of ERPG-2 would be expected to increase.

This distance to the site boundary is about 1.75 km (1.1 mi). Except for nitric acid for the 450 ppy case, any release would not be expected to exceed ERPG-2 limits offsite. For the nitric acid 450 ppy case, the ERPG-2 limit is 6 ppm and the concentration at the site boundary is estimated to be 7.29 ppm.

Table 5.2.10.2–7. MPF Alternative Chemical Accident Frequency and Consequences at LANL for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 1.75 km (ppm)	
Nitric acid	10,500	6	0.68	3.16	1.28	10^{-4}
Hydrofluoric acid	550	20	0.61	6.98	2.43	10^{-4}
Formic acid	1,500	10	0.19	0.51	0.202	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.

Table 5.2.10.2–8. MPF Alternative Chemical Accident Frequency and Consequences at LANL for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	Site Boundary at 1.75 km (ppm)	
Nitric acid	21,000	6	1.4	11.4	3.31	10^{-4}
Hydrofluoric acid	1,100	20	0.83	13.4	4.02	10^{-4}
Formic acid	3,000	10	0.26	0.975	0.34	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.

Table 5.2.10.2–9. MPF Alternative Chemical Accident Frequency and Consequences at LANL for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 1.75 km (ppm)	
Nitric acid	40,000	6	1.9	20.3	7.29	10^{-4}
Hydrofluoric acid	2,000	20	1.1	23.7	8.42	10^{-4}
Formic acid	5,500	10	0.36	1.73	0.694	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.

Involved Worker Impacts

For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Prediction of potential health effects becomes increasingly difficult to quantify as the distance between the accident location and the receptor decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be acutely injured or killed by physical effects of the accident.

The number of workers that would be at the MPF during operations would range from 988 (125 ppy) to 1,797 (450 ppy) (including security guards). Each process facility within the MPF would have attached safe haven structures designed in accordance with a number of life safety, fire protection, and safeguards and security requirements. These structures are required for personnel protection during various accident scenarios and are made of reinforced concrete similar in design to the process building wall construction. They would be designed to accommodate 120 percent of the building occupancy for a number of hours and would require their own independent ventilation systems (WSRC 2002b).

The facility ventilation system would control dispersal of any airborne radiological debris from the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk of injury.

5.2.10.3 TA-55 Upgrade Alternative

This section presents the potential impacts on workers (both involved and non-involved) and the public due to potential accidents associated with operations under the TA-55 Upgrade Alternative. Additional details supporting the information presented here are provided in Appendix C.

Radiological Impacts

DOE estimated the radiological impacts to three receptors: (1) the offsite MEI; (2) the offsite population within 80 km (50 mi) of LANL; and (3) a non-involved worker 1,000 m (3,281 ft) from the accident location. DOE did not evaluate total dose to the non-involved workers because of the uncertain nature of their location at the time of the accident.

Table 5.2.10.3–1 shows the frequencies and consequences of the postulated set of accidents for the public (offsite MEI and the general population living within 80 km [50 mi] of the facility) and a hypothetical non-involved worker for the three pit production rates. The dose shown in the table is calculated by the MACCS computer code based on accident data. The latent cancer fatality (LCF) values are calculated using a dose-to-LCF conversion factor. For the MEI and the population the conversion factor is 0.0005 LCFs per rem or person-rem respectively. For workers, the dose-to-risk conversion factor is 0.0004 LCFs per rem. If the dose to an MEI or worker exceeds 20 rem, the dose-to-risk conversion factor is doubled to 0.001 and 0.0008 respectively. Table 5.2.10.3–2 shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *Topical*

Report – Supporting Documentation for the Accident Impacts Presented in the Modern Pit Facility Environmental Impact Statement (Tetra Tech 2003). The selection process and screening criteria used (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur under the TA-55 Upgrade Alternative. Thus, in the event that any other accident that was not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5.2.10.3–1. TA-55 Upgrade Alternative Radiological Accident Frequency and Consequences for 80 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	26.4	0.026	23,200	11.6	156	0.13
Fire in a Single Building						
1×10^{-4}	20.9	0.021	13,700	6.85	193	0.15
Explosion in a Feed Casting Furnace						
1×10^{-2}	38.3	0.038	25,100	12.5	353	0.28
Nuclear Criticality						
1×10^{-2}	0.00012	6×10^{-8}	0.011	5.3×10^{-5}	0.0012	4.7×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	1.6	0.0008	1,070	0.54	15.1	0.006
Radioactive Material Spill						
1×10^{-2}	0.77	0.00036	502	0.25	7.1	0.0028

[a] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table 5.2.10.3–2. Annual Cancer Risks for the TA-55 Upgrade Alternative for 80 ppy

Accident	Offsite MEI	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	2.6×10^{-7}	0.00012	1.3×10^{-5}
Fire in a Single Building	2.1×10^{-7}	0.00069	1.5×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.125	0.0028
Nuclear Criticality	6×10^{-10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	8.0×10^{-6}	0.0054	6.0×10^{-5}
Radioactive Material Spill	3.6×10^{-6}	0.0025	2.8×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

The accident with the highest risk to the offsite population (see Table 5.2.10.3–2) is the explosion in a feed casting furnace. The increased number of LCFs in the offsite population would be 0.125 per year (i.e., about 1 chance in 8 per year of a LCF in the total population). The highest risk of a LCF to an offsite MEI located at a distance of 1,750 m (5,742 ft) in the north-northeast direction from the accident would be 0.00038 per year (i.e., about 1 chance in 2,630 per year of a LCF). The highest risk of a LCF to a non-involved worker located at a distance of 1,000 m (3,287 ft) from the accident would be 0.0028 per year (i.e., about 1 chance in 360 per year of a LCF).

Hazardous Chemical Impacts

DOE estimated the impacts of the potential release of the most hazardous chemicals that would be used under the TA-55 Upgrade Alternative. A chemical's vapor pressure, acceptable concentration (ERPG-2), and quantity available for release are factors used to rank a chemical's hazard. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool, about one inch in depth, in the area around the point of release. Additional information on the evaporation and dispersion of each chemical is provided in Appendix C. Table 5.2.10.3–3 provides information on each chemical and the frequency and consequences of an accidental release for the three production cases. The American Industrial Hygiene Association defines ERPG-2 as the maximum airborne concentration below which 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. The distance from the release point to the point where the ERPG-2 concentration is reached in relation to the site boundary reflects the consequence of the chemical's release. As the distance to the ERPG-2 concentration increases, the potential number of persons onsite and offsite that may be exposed to concentrations in excess of ERPG-2 would also be expected to increase.

Table 5.2.10.3–3. TA-55 Upgrade Alternative Chemical Accident Frequency and Consequences for 80 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 1.75 km (ppm)	
Nitric acid	3,420	6	0.37	1.08	0.44	10^{-4}
Hydrofluoric acid	340	20	0.5	4.44	1.54	10^{-4}
Hydrochloric acid	384	20	1.6	47.1	16.6	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.

The distance to the site boundary is about 1.9 km (1.2 mi). Except for hydrochloric acid, a chemical release would not be expected to exceed the ERPG-2 limits offsite. For hydrochloric acid, the concentration at the site boundary would be 45.7 ppm, exceeding the 20 ppm ERPG-2 limit.

Concentrations at the location of a non-involved worker at a distance of 1,000 m (3,281 ft) from a hydrochloric acid release point would also exceed ERPG-2 limits.

Involved Worker Impacts

For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Prediction of potential health effects becomes increasingly difficult to quantify as the distance between the accident location and the receptor decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be acutely injured or killed by physical effects of the accident.

For the TA-55 Upgrade Alternative, the number of workers required for operations is estimated to be 630 (including security guards). Each process facility within the upgraded facility would have attached safe haven structures designed in accordance with a number of life safety, fire protection, and safeguards and security requirements. These structures are required for personnel protection during various accident scenarios and are made of reinforced concrete similar in design to the process building wall construction. They would be designed to accommodate 120 percent of the building occupancy for a number of hours and would require their own independent ventilation systems.

The facility ventilation system would control dispersal of any airborne radiological debris from an accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk or injury.

5.2.11 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as being Black or African American; American Indian or Alaska Native; Asian; Native Hawaiian and other Pacific Islander; or another non-White race; or persons of Hispanic or Latino ethnicity. Persons whose incomes are below the Federal poverty threshold are designated low-income.

At LANL, the 80-km (50-mi) radius includes portions of Rio Arriba, Taos, Los Alamos, Mora, Sandoval, Santa Fe, San Miguel, Bernalillo, and Torrance Counties in New Mexico. Table 5.2.11–1 provides the racial and ethnic composition of these counties based on the 2000 Census, as well as the number of people below the poverty level. Figure 5.2.11–1 shows the minority populations located within an 80-km (50-mi) radius of the site. Figure 5.2.11–2 shows the low-income populations located within the same 80-km (50-mi) radius. This study area corresponds to the region of potential radiological impacts. Figures 5.2.11–1 and 5.2.11–2 show the distribution of these populations throughout the area around the site.

Table 5.2.11–1. Racial, Ethnic, and Socioeconomic Composition Surrounding LANL

Population Group	Population	Percent of Total
Hispanic or Latino	406,956	44.3
Black or African American	16,459	1.8
American Indian and Alaska Native	44,696	4.9
Asian	13,246	1.4
Native Hawaiian and Other Pacific Islander	624	0.1
Other Race	1,570	0.2
Two or More Races	14,031	1.5
White	420,025	45.8
Total	**917,607**	**100**

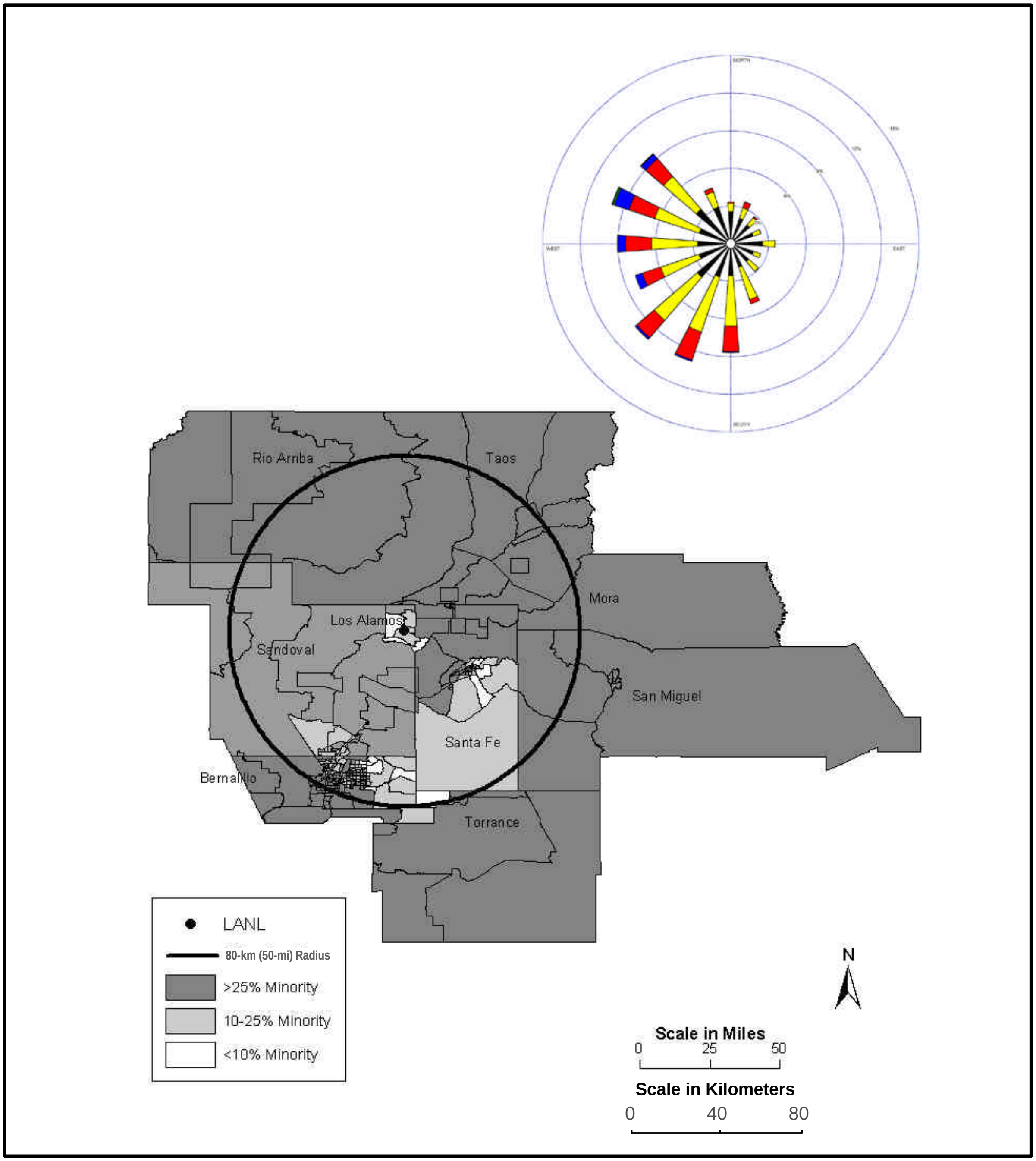

Figure 5.2.11–1. Distribution of the Minority Population Surrounding LANL

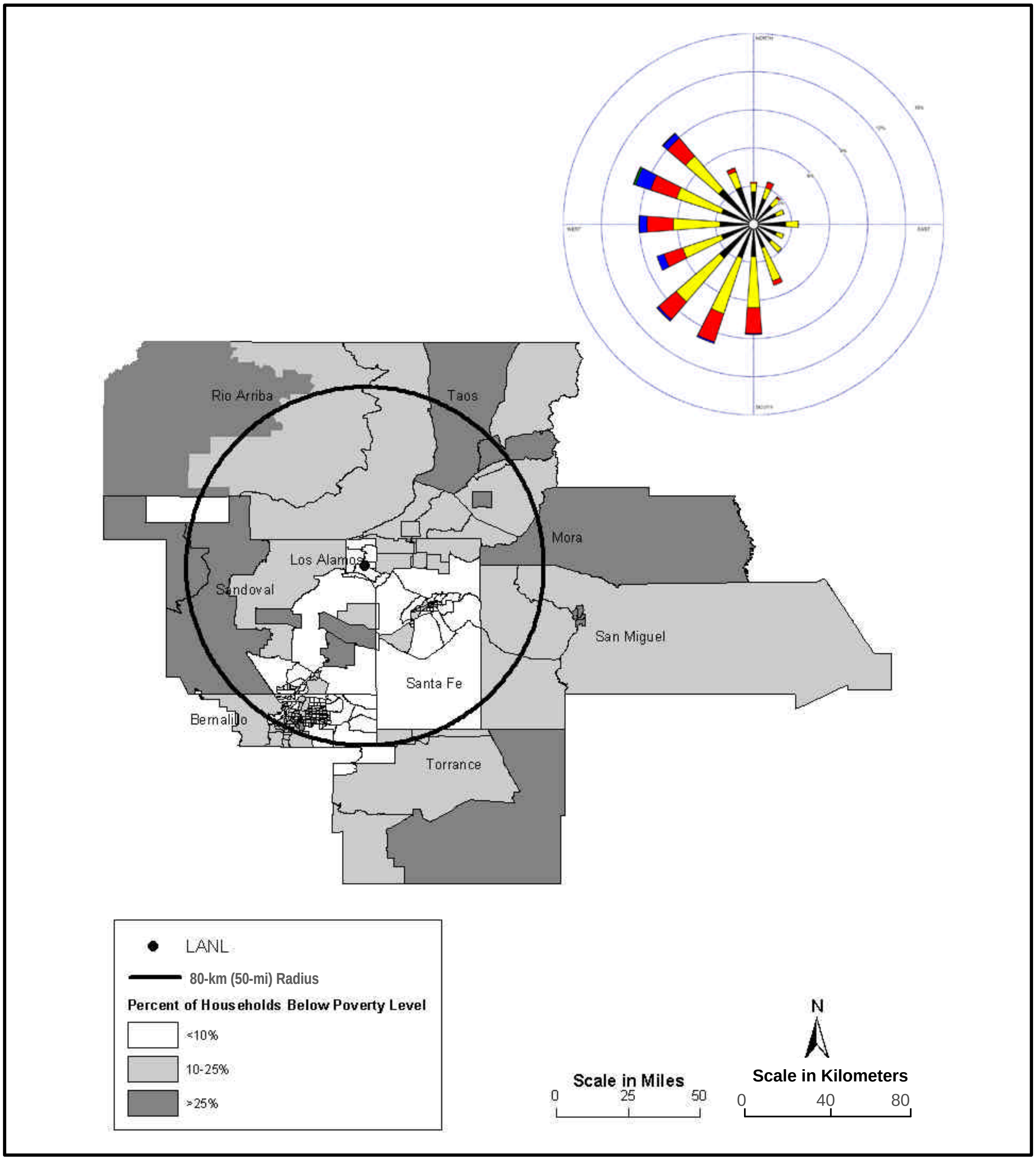

Figure 5.2.11–2. Distribution of the Low-Income Population Surrounding LANL

In 2002, minority populations comprised 30.9 percent of the U.S. population and 50.5 percent of the New Mexico population. The percentage of minority populations in the area surrounding LANL is 54.2 percent, more than that in the United States and the State of New Mexico.

Low-income populations comprised 12.4 percent of the U.S. population, based on 1999 income, and 18.4 percent of the New Mexico population. Within the counties surrounding LANL, 14.1 percent of the population lives below the poverty level.

As shown in Section 5.2.9, Human Health and Safety, there are no large adverse impacts to any populations. Therefore, there would be no disproportionately high and adverse impacts to minority or low-income populations.

5.2.12 Transportation

Impacts to the human environment from transportation can result from two sources: operation of the vehicle and the presence of the cargo. Vehicle-related impacts could include increased emissions, traffic congestion, noise, and traffic accidents. Cargo-related impacts could include incident-free radiation dose to those on and near the highway and radiation dose or chemical exposure from the cargo when the containers are breached following an accident.

This EIS is primarily concerned with determining a candidate DOE site for the MPF. A second EIS would be prepared once a DOE site is identified for more detailed analysis. Accordingly, this EIS focuses on a limited suite of analyses that will most specifically aid decisionmakers in distinguishing transportation impacts among the five DOE sites under consideration. NNSA has selected for quantitative analysis incident-free radiation dose to workers and the public, accident radiation dose-risk (which includes the probability of the accident occurring) to all individuals affected by the accident, and traffic accident fatalities. In addition, the analysis presents a qualitative discussion on traffic impacts near the DOE facility under both construction and operations. Traffic impacts would result from commuting workers and construction deliveries. Other potential analytical endpoints are roughly proportional to the analyzed endpoints and would yield similar relative distinction among the five DOE sites.

Appendix D, Radiological Transportation Analysis Methodology, presents NNSA's methodology in analyzing the selected analytical endpoints and provides some detail on the calculations, including the more important input parameters.

5.2.12.1 No Action Alternative

Construction Impacts

Under the No Action Alternative, there would be no construction at LANL.

Operations Impacts

Radiological transportation under the No Action Alternative for LANL would include transport of pits from Pantex (near Amarillo, Texas) to LANL, recycle of enriched uranium parts to and from the Y-12 National Security Complex (Oak Ridge, Tennessee), return of re-assembled pits to Pantex, and shipment of TRU waste to WIPP (near Carlsbad, New Mexico). Low-level waste (LLW) would be disposed of onsite at LANL. The number of pits processed per year would be limited to approximately 20. Table 5.2.12.1–1 presents the number of shipments under the No Action Alternative. Tables 5.2.12.1–2 and 5.2.12.1–3 present the incident-free impacts from this transportation. Tables 5.2.12.1–4 and 5.2.12.1–5 present the accident impacts.

Table 5.2.12.1–1. Number of Shipments per Year—No Action Alterative

Transported Materials	Number of Shipments
Pits	4
EU parts	4
TRU waste	20
Total	**28**

EU = enriched uranium.

Table 5.2.12.1–2. Annual Incident-Free Transportation Impacts to Workers— No Action Alternative

Transported Materials	Collective Dose (person-rem)	LCFs
Pits	0.017	6.6×10^{-6}
EU parts	0.064	2.6×10^{-5}
TRU waste	0.15	5.9×10^{-5}
Total	**0.23**	**9.1 ´ 10^{-5}**

Table 5.2.12.1–3. Annual Incident-Free Transportation Impacts to the General Public— No Action Alternative

Transported Materials	Collective Dose (person-rem)	LCFs
Pits	0.021	1.1×10^{-5}
EU parts	0.088	4.4×10^{-5}
TRU waste	0.25	1.3×10^{-4}
Total	**0.36**	**1.8 ´ 10^{-4}**

Table 5.2.12.1–4. Annual Transportation Accident Radiological Impacts— No Action Alternative

Transported Materials	Collective Dose (person-rem)	LCFs
Pits	2.5×10^{-8}	1.2×10^{-11}
EU parts	8.8×10^{-11}	4.4×10^{-14}
TRU waste	4.6×10^{-5}	2.3×10^{-8}
Total	**4.6 ´ 10^{-5}**	**2.3 ´ 10^{-8}**

Table 5.2.12.1–5. Annual Nonradiological Fatalities from Transportation Accidents— No Action Alternative

Transported Materials	Number of Accidents	Number of Fatalities
Pits	6.2×10^{-4}	3.8×10^{-5}
HEU parts	2.2×10^{-3}	1.6×10^{-4}
TRU Waste	1.3×10^{-3}	1.3×10^{-4}
Total	**4.1 ´ 10^{-3}**	**3.3 ´ 10^{-4}**

Because there would be no change from the baseline in operations employment under the No Action Alternative, there would be no change in traffic in the vicinity of LANL.

5.2.12.2 Modern Pit Facility Alternative

Construction Impacts

Construction of the MPF Alternative at LANL would result in increased traffic due to commuting construction workers and deliveries of construction materials and equipment. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels reported in Section 4.2.10 and would be temporary.

Operations Impacts

Radiological transportation under the MPF Alternative for LANL would include transport of pits from Pantex to LANL, recycle of enriched uranium parts to and from the Y-12 National Security Complex, return of pits and enriched uranium parts to Pantex, and shipment of TRU waste to WIPP. LLW would be disposed of at LANL. NNSA’s analysis includes options for 125, 250, and 450 ppy. Table 5.2.12.2–1 presents the number of shipments under the MPF Alternative. Tables 5.2.12.2–2 and 5.2.12.2–3 present the incident-free impacts from this transportation. Tables 5.2.12.2–4 and 5.2.12.2–5 present the accident impacts.

Table 5.2.12.2–1. Number of Shipments per Year at LANL for the MPF

Transported Materials	125 ppy	250 ppy	450 ppy
Pits	14	28	50
EU parts	10	20	36
TRU waste	74	93	142
Total	**98**	**141**	**228**

Table 5.2.12.2–2. Annual Incident-Free Transportation Impacts to Workers at LANL for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.058	2.3×10^{-5}	0.12	4.6×10^{-5}	0.21	8.3×10^{-5}
EU parts	0.16	6.4×10^{-5}	0.32	1.3×10^{-5}	0.58	2.3×10^{-4}
TRU waste	0.54	2.2×10^{-4}	0.68	2.7×10^{-4}	1.0	4.2×10^{-4}
Total	**0.76**	**3.0 ´ 10^{-4}**	**1.1**	**4.5 ´ 10^{-4}**	**1.8**	**7.3 ´ 10^{-4}**

Table 5.2.12.2–3. Annual Incident-Free Transportation Impacts to the General Public at LANL for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.075	3.7×10^{-5}	0.15	7.5×10^{-5}	0.27	1.3×10^{-4}
EU parts	0.22	1.1×10^{-4}	0.44	2.2×10^{-4}	0.79	3.9×10^{-4}
TRU waste	0.94	4.7×10^{-4}	1.2	5.9×10^{-4}	1.8	9.0×10^{-4}
Total	**1.2**	**6.2 ´ 10^{-4}**	**1.8**	**8.8 ´ 10^{-4}**	**2.9**	**1.4 ´ 10^{-3}**

Table 5.2.12.2–4. Annual Transportation Accident Radiological Impacts at LANL for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs
Pits	8.7×10^{-8}	4.4×10^{-11}	1.7×10^{-7}	8.7×10^{-11}	3.1×10^{-7}	1.6×10^{-10}
EU parts	2.2×10^{-11}	1.1×10^{-13}	4.4×10^{-10}	2.2×10^{-13}	8.0×10^{-10}	4.0×10^{-13}
TRU waste	1.7×10^{-4}	8.5×10^{-8}	2.1×10^{-4}	1.1×10^{-7}	3.3×10^{-4}	1.6×10^{-7}
Total	**1.7 ´ 10^{-4}**	**8.6 ´ 10^{-8}**	**2.2 ´ 10^{-4}**	**1.1 ´ 10^{-7}**	**3.3 ´ 10^{-4}**	**1.6 ´ 10^{-7}**

Table 5.2.12.2–5. Annual Nonradiological Fatalities from Transportation Accidents for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities
Pits	2.2×10^{-3}	1.3×10^{-4}	4.3×10^{-3}	2.7×10^{-4}	7.7×10^{-3}	4.8×10^{-4}
EU parts	5.5×10^{-3}	3.9×10^{-4}	0.011	7.8×10^{-4}	0.020	1.4×10^{-3}
TRU waste	4.8×10^{-3}	4.9×10^{-4}	6.0×10^{-3}	6.1×10^{-4}	9.2×10^{-3}	9.4×10^{-4}
Total	**0.012**	**1.0 ´ 10^{-3}**	**0.021**	**1.7 ´ 10^{-3}**	**0.037**	**2.8 ´ 10^{-3}**

The addition of 988-1,797 new employees under the three capacity options would represent an increase in LANL employment ranging from 9.3-17 percent, with a corresponding increase in commuting traffic. Although this traffic increase would tend to exacerbate congestion on local roads, the increase is small compared to the overall average daily traffic level reported in Section 4.2.10.

Sensitivity Analysis

Should NNSA elect to operate a new 450 ppy facility at LANL in two shifts, the impacts would increase. The incident-free doses for the 450 ppy facility reported in Tables 5.2.12.2–1 and 5.2.12.2–2 would increase by a factor of approximately 1.8 because of the numbers of shipments would increase. The accident values in Table 5.2.12.2–3 would also increase by a factor of 1.8 because of the increased probability of the accident; however, the consequences of an accident, should one occur, would not change. The duration of traffic congestion during shift change would increase.

5.2.12.3 TA-55 Upgrade Alternative

Construction Impacts

Upgrading TA-55 at LANL would result in increased traffic due to commuting construction workers and deliveries of construction materials and equipment. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels reported in Section 4.2.10 and would be temporary.

Operations Impacts

Radiological transportation under the TA-55 Upgrade Alternative for LANL would include transport of pits from Pantex to LANL, recycle of enriched uranium parts to and from the Y-12 National Security Complex, return of pits and enriched uranium parts to Pantex, and shipment of TRU waste to WIPP. LLW would be disposed of at LANL. NNSA estimates that approximately 80 ppy could be processed at the upgraded facility. Table 5.2.12.3–1 presents the number of shipments for the TA-55 Upgrade Alternative. Tables 5.2.12.3–2 and 5.2.12.3–3 present the incident-free impacts from this transportation. Tables 5.2.12.3–4 and 5.2.12.3–5 present the accident impacts.

Table 5.2.12.3–1. Number of Shipments per Year—TA-55 Upgrade Alternative

Transported Materials	Number of Shipments
Pits	10
EU parts	6
TRU waste	55
Total	**71**

Table 5.2.12.3–2. Annual Incident-Free Transportation Impacts to Workers—TA-55 Upgrade Alternative

Transported Materials	Collective Dose (person-rem)	LCFs
Pits	0.041	1.7×10^{-5}
EU parts	0.097	3.9×10^{-5}
TRU waste	0.40	1.6×10^{-4}
Total	**0.54**	**2.2 ´ 10^{-4}**

Table 5.2.12.3–3. Annual Incident-Free Transportation Impacts to the General Public—TA-55 Upgrade Alternative

Transported Materials	Collective Dose (person-rem)	LCFs
Pits	0.53	2.7×10^{-5}
EU parts	0.13	6.6×10^{-5}
TRU waste	0.70	3.5×10^{-4}
Total	**0.88**	**4.4 ´ 10^{-4}**

Table 5.2.12.3–4. Annual Transportation Accident Radiological Impacts—TA-55 Upgrade Alternative

Transported Materials	Collective Dose (person-rem)	LCFs
Pits	6.2×10^{-8}	3.1×10^{-11}
EU parts	1.3×10^{-10}	6.6×10^{-14}
TRU waste	1.3×10^{-4}	6.4×10^{-8}
Total	**1.3 ´ 10^{-4}**	**6.4 ´ 10^{-8}**

Table 5.2.12.3–5. Annual Nonradiological Fatalities from Transportation Accidents—TA-55 Upgrade Alternative

Transported Materials	Number of Accidents	Number of Fatalities
Pits	1.5×10^{-3}	9.6×10^{-5}
HEU parts	3.3×10^{-3}	2.3×10^{-4}
TRU Waste	3.6×10^{-3}	3.6×10^{-4}
Total	**8.4 ´ 10^{-3}**	**6.9 ´ 10^{-4}**

The addition of 680 new employees would represent an increase in LANL employment of 6.4 percent, with a corresponding increase in commuting traffic. Although this traffic increase would tend to exacerbate congestion on local roads, the increase is small compared to the overall average daily traffic level reported in Section 4.2.10 and less than that for the MPF Alternative.

5.2.13 Waste Management

This section considers the burden that waste generation associated with the construction and operation of the MPF places on the LANL waste treatment, storage, and disposal infrastructure. Impacts are evaluated based on routine waste generation, excluding wastes generated from environmental restoration or decontamination and decommissioning (D&D) activities. Impacts associated with transportation of radioactive waste from LANL to offsite disposal facilities are provided in Section 5.2.12.

5.2.13.1 No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change to the current and planned LANL waste management activities described in Section 4.2.11.

5.2.13.2 Modern Pit Facility Alternative

Construction Impacts

Construction of the MPF would generate solid and liquid sanitary waste and liquid hazardous waste. Table 5.2.13.2–1 summarizes the total volume of waste generated over the 6 years of construction activity for the three proposed MPF operating capacities.

Table 5.2.13.2–1. Total Waste Generation From Construction of the MPF (m^3)

Waste type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Hazardous waste	4.9	5.1	5.9
Sanitary waste	7,110	7,870	11,200
Sanitary wastewater	37,500	41,300	54,100

Source: MPF Data 2003.

MPF construction activities would increase LANL's routine waste generation by as much as 83 percent. However, LANL is capable of meeting applicable waste acceptance criteria, and offsite disposal capacities are much greater than LANL's projected waste volumes.

Solid nonhazardous wastes are currently disposed of in the Los Alamos County Landfill, which is located onsite. In 2004, that facility will be replaced by a new offsite regional solid waste disposal facility. Sanitary waste generated during MPF construction would increase LANL's routine waste generation by 53-83 percent, depending on the operating capacity. The waste would be disposed of at the offsite facility, which would be expected to have adequate capacity to handle the projected waste volume.

Hazardous wastes would be sent offsite for treatment and disposal at a commercial facility. The waste generated from MPF construction activities represents an increase of about 1 percent in the routine annual hazardous waste generated at LANL. Commercial treatment is readily available and currently used to treat LANL hazardous wastes.

Sanitary wastewater generated during MPF construction would be managed using portable toilet systems or put into the LANL sanitary sewer system. The anticipated volume of sanitary wastes (17,100-24,700 L/day [4,500-6,500 gal/day]) represents about 1 percent of the design capacity of the Sanitary Wastewater Systems (SWS) Plant at TA-46 and would have minimal impact.

A detention pond would be constructed to manage stormwater runoff from the entire MPF site including the Construction Laydown Area and Concrete Batch Plant. The basin would be sized to limit stormwater discharge from the developed site to no greater than the pre-existing conditions, with a basin area of approximately 0.4 ha (1 ac) per 16 ha (40 ac) of developed land.

A Concrete Batch Plant would operate at the MPF site during the construction phase. The Concrete Batch Plant would include a basin to manage wastewater from equipment washout activities. The facility would be located on approximately 4 ha (10 ac) and adjacent to the PIDAS area. The Concrete Batch Plant would be disassembled and the area would be restored once MPF construction is completed.

Operations Impacts

Normal operation of the MPF would generate TRU waste, LLW, mixed LLW, hazardous waste, and sanitary waste. Table 5.2.13.2–2 summarizes the estimated waste generation rates for the three proposed MPF operating capacities.

Table 5.2.13.2–2. MPF Operations Annual Waste Generation (m^3)

Waste type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
TRU waste	590	740	1,130
LLW	2,070	3,300	5,030
Mixed LLW—solid	1.5	2.0	3.5
Mixed LLW—liquid	0.2	0.4	0.7
Hazardous waste—solid	2.5	3.0	5.0
Hazardous waste—liquid	0.3	0.4	0.6
Sanitary waste	5,500	5,800	6,900
Sanitary wastewater	45,000	61,900	81,800

Source: MPF Data 2003.

The projected TRU waste volumes for the three proposed MPF operating capacities represent an increase of 620, 780, and 1,200 percent, respectively, in the annual routine TRU waste generation at LANL. TRU waste generated from plutonium pit manufacturing includes gloves, filters, and other operations/maintenance waste from the MPF gloveboxes. Americium process waste would be solidified and packaged as TRU waste. About 36 percent of the TRU waste would be mixed waste. The waste would be transferred from the MPF process buildings to the Waste Staging/TRU Packaging Building, which would be located outside of the PIDAS. The Waste Staging/TRU Packaging Building would include a staging area with capacity for approximately 1,200 TRU waste drums (about 250 m^3 [8,829 ft^3] of TRU waste). A drum loading area equipped with overhead bridge cranes would load the waste drums into Transuranic Package Transporter (TRUPACT-II) shipping containers and load the TRUPACT-II containers onto trucks for transport to WIPP. The size of the Waste Staging/TRU Packaging Building (approximately 1,950 m^2 [20,990 ft^2]) is not expected to vary with the MPF operating capacity. Section 6.5 discusses the availability of WIPP for disposal of TRU waste resulting from MPF operations.

LLW from MPF operations would include job control waste, failed equipment, and other general operations/maintenance waste. Any liquid LLW resulting from MPF operations would be solidified prior to leaving the facility. LLW volumes for the three proposed MPF operating capacities would increase the annual routine LLW generation at LANL by 400, 600, and 900 percent, respectively. The LLW would be transferred to TA-54, Area G, for onsite disposal. As described in Section 4.2.11.1, DOE has decided to expand LLW disposal capacity into Zones 4 and 6 at Area G. Additional sites within Area G are expected to provide 50-100 years of disposal capacity for LANL-generated LLW. The projected LLW volume for disposal at Area G is about 320,000 m^3 (11,300,800 ft^3) (DOE 2000h). The remaining Area G (1,255,000 m^3 [44,113,250 ft^3]) could readily accommodate the projected LLW volumes (104,000 – 251,000 m^3 [3,672,760 – 8,864,000 ft^3]) from MPF operations.

MPF operations would generate small amounts of hazardous waste and mixed LLW. These wastes include lead acid batteries, lubricating oils/fluids, rags, and sorbents. The projected hazardous waste volume from MPF operations represents 3-6 percent of the annual volume routinely managed by LANL. Commercial treatment is readily available and currently used to treat LANL hazardous wastes.

LANL's routine mixed LLW generation is very small (about 5 m^3/yr [176 ft^3/yr]). MPF operations would increase the annual routine mixed LLW generation by 29-71 percent over current LANL operations. This waste would be managed in accordance with the LANL Site Treatment Plan. The mixed LLW would be transferred to TA-54, where it would be shipped to commercial or DOE treatment and disposal facilities. LANL is capable of meeting applicable waste acceptance criteria, and offsite disposal capacities are much greater than the projected MPF waste volumes.

Nonhazardous waste from MPF operations includes sanitary solid waste and wastewater. Sanitary waste would be disposed offsite at the regional solid waste disposal facility. Although sanitary waste volumes would increase by 250-310 percent relative to current LANL routine operations, the offsite facility would be expected to have adequate capacity to handle the projected amount of waste.

Sanitary wastewater would be transferred to the SWS Plant at TA-46. The projected sanitary wastewater volumes for the three proposed MPF operating capacities are 123,000, 170,000, and 224,000 L/day (32,600, 44,800, and 59,200 gal/day), respectively. In 2000, the SWS Plant processed a maximum of about 950,000 L/day (250,000 gal/day) relative to its design capacity of 2.3 million L/day (600,000 gal/day) (DOE 2002k). There would be adequate capacity for the SWS Plant to manage the sanitary wastewater from MPF operations.

MPF operations are not expected to generate radioactive wastewater. However, the potential does exist for generating radioactively contaminated water from the operation and maintenance of safety showers in contamination areas, the operation of decontamination stations, the mopping of floors in contamination areas, and the testing of fire sprinkler systems located in contamination areas. Wastewaters that could potentially be contaminated would be collected, sampled, and analyzed prior to discharge. Any contaminated wastewater would be solidified by processing through the liquid process waste facilities for the plutonium purification process (MPF Data 2003).

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the LANL waste management infrastructure from those described above for single-shift operation. Although this would substantially increase the LANL routine waste generation, the volumes resulting from double-shift operation are not expected to exceed the available capacities of the waste management facilities. See Section 6.5 for a discussion of the availability of WIPP for disposal of TRU waste resulting from MPF operations.

5.2.13.3 TA-55 Upgrade Alternative

Under this alternative, DOE would upgrade the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. Waste management activities under this alternative would be similar to those described for the Pit Fabrication and Reuse Facility in Section A.3.3 of the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996c).

Modifications to PF-4 would include a major upgrade of the residue recovery/metal feed area. Many of the gloveboxes in this part of the facility would be replaced. There would also be significant glovebox decontamination/decommissioning/disposal operations as new process development and certification operations are moved into other areas of PF-4. When the upgrades are completed, the Pit Fabrication and Reuse Facility at PF-4 would have the capability of producing 80 ppy.

DOE would construct a small glovebox decontamination/handling facility at TA-54 that is specifically designed to prepare the decommissioned gloveboxes from PF-4 for disposal at WIPP. Wastes associated with the replacement of approximately 140 gloveboxes over a 10-year period are addressed as part of the operations phase for this alternative.

Construction Impacts

Construction activities would generate solid and liquid sanitary waste and liquid hazardous waste. Table 5.2.13.3–1 summarizes the total volume of waste generated over the 4 years of construction activity.

Table 5.2.13.3–1. Total Waste Generation from TA-55 Upgrades (m^3)

Waste type	Volume
Hazardous waste	3
Sanitary waste	7,500
Sanitary wastewater[a]	6,000

[a] Assumes 14 m^3 per worker year
Source: MPF Data 2003.

Construction activities would increase LANL's routine waste generation by as much as 85 percent. However, LANL is capable of meeting applicable waste acceptance criteria, and offsite disposal capacities are much greater than LANL's projected waste volumes.

Sanitary waste generated during construction would increase LANL's routine waste generation by 85 percent. As described above, the waste would be disposed of at the offsite regional solid waste disposal facility, which would be expected to have adequate capacity to handle the projected waste volume.

Hazardous waste generated from construction activities represents an increase of about 1 percent in the routine annual hazardous waste generated at LANL. The waste would be sent offsite for treatment and disposal at a commercial facility. Such treatment is readily available and currently used to treat LANL hazardous wastes.

Sanitary wastewater generated during construction would be managed using portable toilet systems or put into the LANL sanitary sewer system. The anticipated volume of sanitary wastes 4,164 L/day (1,100 gal/day) represents less than 1 percent of the design capacity of the SWS Plant and would have minimal impact.

Operations Impacts

Normal operation of the upgraded TA-55 facility would generate TRU waste, LLW, mixed LLW, hazardous waste, sanitary waste, and sanitary wastewater. Table 5.2.13.3–2 summarizes the estimated waste generation rates for the production of 80 ppy.

Table 5.2.13.3–2. Operations Annual Waste Generation Under the TA-55 Upgrade Alternative (m^3)

Waste type	80 ppy Operating Capacity
TRU waste - solid[a]	440
TRU waste - liquid	5
LLW - solid	1,430
LLW - liquid	15
Mixed LLW	53
Hazardous waste - solid	203
Hazardous waste - liquid	2
Sanitary waste	552
Sanitary wastewater	12,300

[a] Includes 56 m^3 per year over a 10-year period to replace gloveboxes in PF-4.
Source: MPF Data 2003.

The projected TRU waste volume for PF-4 operations represents an increase of 470 percent in the annual routine TRU waste generation at LANL. This TRU waste includes gloves, filters, and other operations/maintenance waste from the PF-4 gloveboxes. Americium process waste would be solidified and packaged as TRU waste. A small amount (2 m^3 [71 ft^3]) of the annual TRU waste volume is expected to be mixed waste. The solid TRU waste would be transferred from PF-4 to TA-54 for storage pending shipment offsite for disposal. Liquid TRU waste would be processed through the Radioactive Liquid Waste Treatment Facility (RLWTF) in TA-50. Section 6.5 discusses the availability of WIPP for disposal of TRU waste resulting from PF-4 operations.

LLW from pit manufacturing operations would include job control waste, failed equipment, and other general operations/maintenance waste. The projected LLW volumes would increase the annual routine LLW generation at LANL by 280 percent. Any liquid LLW would be transferred to the RLWTF. The solid LLW would be transferred to TA-54, Area G, for onsite disposal. As described in Section 4.2.11.1, Area G is expected to provide 50-100 years of disposal capacity for LANL-generated LLW and could readily accommodate the projected LLW volumes from PF-4 operations.

Pit manufacturing operations would generate hazardous waste and mixed LLW. These wastes include lead acid batteries, lubricating oils/fluids, rags, and sorbents.

The projected hazardous waste volume from pit manufacturing operations would increase the annual volume routinely managed by LANL by 210 percent. Although this would substantially increase the hazardous waste volume routinely managed at LANL, commercial treatment is readily available.

Pit manufacturing would increase the annual routine mixed LLW generation at LANL by a factor of 9.0 over current LANL operations. This waste would be managed in accordance with the LANL Site Treatment Plan. The mixed LLW would be transferred to TA-54, where it would be shipped to commercial or DOE treatment and disposal facilities. LANL is capable of meeting applicable waste acceptance criteria, and offsite disposal capacities are greater than the projected waste volumes.

Nonhazardous waste from MPF operations includes sanitary solid waste and wastewater. Sanitary waste would be disposed offsite at the regional solid waste disposal facility. The sanitary waste volumes would increase by 25 percent relative to current LANL routine operations. The offsite facility would be expected to have adequate capacity to handle the projected amount of waste.

Sanitary wastewater would be transferred to the SWS Plant at TA-46. The projected sanitary wastewater volume is 33,690 L/day (8,900 gal/day). This represents 1.5 percent of the design capacity 2.2 million L/day (600,000 gal/day) of the SWS. There would be adequate capacity for the SWS Plant to manage the sanitary wastewater from pit manufacturing operations.

MPF operations are not expected to generate radioactive wastewater. However, the potential does exist for generating radioactively contaminated water from the discharge of fire-sprinkler water inside the process areas. If that were to occur, the water would be contained and treated as process wastewater. Any contaminated wastewater would be processed by the RLWTF at TA-50.

5.3 NEVADA TEST SITE

The following sections discuss the environmental impacts associated with the No Action Alternative and the MPF Alternative at NTS. The environmental impacts are presented below for each of the following environmental resource areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, and waste management.

5.3.1 Land Use and Visual Resources

5.3.1.1 Land Use

The proposed concept for the MPF is a multibuilding aboveground configuration. There would be three separate process buildings: Material Receipt, Unpacking, and Storage; Feed Preparation; and Manufacturing. They would be flanked by a number of smaller support facilities which would include: the Analytical Support Building, Production Support Building, Process Building Entry Control Facilities, Operations Support Facilities, Engineering Support Facility, PIDAS, Safe Havens, Standby Diesel Generator Buildings, Diesel Fuel Storage Tank, Chillers/Chemical Feed and Chilled Water Pump Buildings, Cooling Towers, Alternate Power Electrical Transformers, Truck Loading Docks, Liquid Nitrogen/Argon Storage Tanks, Chemical Storage Tanks, Bottled Gas Storage and Metering Buildings, HVAC Exhaust Stacks, Waste Staging/TRU Packaging Building, Commodities Warehouse, Roads and Parking Areas, and a Runoff Detention Area. In addition to these structures, a Construction Laydown Area and a Concrete Batch Plant would be built for the construction phase only. Upon construction completion, they would be removed and the area would be allowed to naturally return to its original state.

All buildings would be either one or two stories. The site would require two HVAC exhaust stacks; the tallest, standing 30 m (100 ft), would be located inside the PIDAS. Facility exhaust would be HEPA-filtered prior to discharge through the stacks.

Under the multibuilding configuration, production rates would dictate the size of the facilities proposed. The three potential facility capacities are 125, 250, and 450 ppy. Required acreage for each of the facility capacities during construction and operations is presented in Table 5.2.1.1–1.

The MPF reference location at NTS is within Area 6 (see Figure 4.3.1.1–2). The northern quarter of the area is designated as the Nuclear Test Zone, the south central portion is categorized as the Defense Industrial Zone, and the remaining area is designated as the Reserved Zone. The MPF reference location would be located on land designated as a Defense Industrial Zone within Area 6.

No Action Alternative

Under the No Action Alternative, Area 6 operational capabilities and storage would continue at current levels. Since no new buildings or facilities would be built and operations would not change, there would be no impact on land use at the site.

Modern Pit Facility Alternative

Construction Impacts

Depending on the facility capacity, an estimated 56-69 ha (138-171 ac) of land for buildings, walkways, building access, parking, buffer space, and construction-related workspace would be required to construct the MPF. The land required for the proposed MPF construction would represent approximately 0.02 percent of the NTS total land area. However, 56-69 ha (138-171 ac) represents an extremely small proportion of the NTS total land area of 3,561 km^2 (1,375 mi^2).

Although there would be a change in land use, the proposed MPF is compatible and consistent with land use plans and the current land use designation, Defense Industrial Zone, for this area. No impacts to NTS land use plans or policies are expected.

Operations Impacts

Depending on the facility capacity, an estimated 44-56 ha (110-138 ac) of land for buildings, walkways, building access, parking, and buffer space would be required to operate the MPF. The reduction in required acreage from construction to operations represents the removal of the Construction Laydown Area and the Concrete Batch Plant upon construction completion. The land required for the proposed MPF operations would represent approximately 0.01-0.02 percent of the NTS total land area. However, 44-56 ha (110-138 ac) represents an extremely small proportion of the NTS total land area of 3,561 km^2 (1,375 mi^2).

Although there would be a change in land use, the proposed MPF is compatible and consistent with land use plans and the current land use designation, Defense Industrial Zone, for this area. No impacts to NTS land use plans or policies are expected.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not have any additional effect on land use for this alternative.

5.3.1.2 Visual Resources

No Action Alternative

Under the No Action Alternative, there would be no impact on visual resources at NTS or Area 6 since no new facilities would be built.

Modern Pit Facility Alternative

Construction Impacts

Activities related to the construction of new buildings required for the MPF Alternative would result in a change to the visual appearance of the reference location due to the presence of construction equipment, new buildings in various stages of construction, and possibly increased dust. These changes would be temporary and, due to the isolated location of the area, the MPF would not be visible from locations beyond NTS boundaries. Site visitors and employees observing the MPF and its construction would find these activities similar to past construction activities of other developed areas on NTS. Thus, impacts on visual resources during construction would be minimal.

Operations Impacts

The MPF facilities, which would include one- and two-story buildings, storage tanks, and two HVAC exhaust stacks, would change the appearance of the reference location in Area 6. However, this change would be consistent with the currently developed areas of Area 6. Thus, MPF's placement in the Defense Industrial Zone within Area 6 boundaries would be consistent with the current Class IV BLM Visual Resources Management rating of developed areas within Area 6. As noted above, the MPF and its supporting structures would not be visible beyond the NTS boundary. Views of the building, tanks, and exhaust stacks would be limited to visitors or employees using the NTS road network.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not change the layout or physical features of the MPF reference location. Therefore, there would be no additional impacts to Visual Resources.

5.3.2 Site Infrastructure

This section describes the impact on site infrastructure at NTS for the No Action Alternative and the modifications that would be needed for the construction and operation of the MPF Alternative. These impacts are evaluated by comparing current site infrastructure to key facility resource needs for the No Action Alternative and the MPF Alternative.

5.3.2.1 No Action Alternative

Under the No Action Alternative, there would be no change to the site infrastructure at NTS. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

5.3.2.2 Modern Pit Facility Alternative

Construction Impacts

The projected demand on key site infrastructure resources associated with construction activities of the three proposed plant sizes (125, 250, or 450 ppy) for the MPF Alternative on an annual basis are shown in Table 5.3.2.2–1. Infrastructure requirements for construction would have a minor impact on current site infrastructure resources. Existing infrastructure at NTS would be adequate to support annual construction requirements for the proposed plant sizes for the projected 6-year construction period.

Table 5.3.2.2–1. Annual Site Infrastructure Requirements for Construction of MPF at NTS

Proposed Alternatives	Electrical		Fuel		Process Gases
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Gases (m^3/yr)
Site capacity	**176,844**	**45**	**Not limited[a]**	**NA**	**Not limited[a]**
Available site capacity	**75,476**	**18**	**Not limited**	**NA**	**Not limited**
No Action Alternative					
Total site requirement	101,377	27	4,201,805	0	
Percent of site capacity	57%	60%	Not limited	0	Not limited
MPF Alternative					
125 ppy					
Total site requirement	102,000	30	5,720,000	0	Not limited
Percent of site capacity	58%	67%	Not limited	0	Not limited
Change from No Action	1,000	3	1,520,000	0	2,200
Percent of available capacity	1.3%	17%	Not limited	0	Not limited
Peak requirement	NA	NA	2,600,000	0	4,000
250 ppy					
Total site requirement	102,000	30.5	5,900,000	0	Not limited
Percent of site capacity	58%	68%	Not limited	0	Not limited
Change from No Action	1,125	3.5	1,700,000	0	2,500
Percent of available capacity	1.5%	19%	Not limited	0	Not limited
Peak requirement	NA	NA	2,900,000	0	4,200
450 ppy					
Total site requirement	103,000	31	6,400,000	0	Not limited
Percent of site capacity	58%	69%	Not limited	0	Not limited
Change from No Action	1,333	4	2,170,000	0	3,200
Percent of available capacity	1.8%	22%	Not limited	0	Not limited
Peak requirement	NA	NA	3,700,000	0	5,700

[a] Not limited due to offsite procurement.
NA = Not Applicable.
Source: MPF Data 2003.

Operations Impacts

The estimated annual site infrastructure requirements for the pit production capacities of 125, 250, or 450 ppy are presented in Table 5.3.2.2–2. There would be a significant impact to site electrical power capacity from each pit production capacity. Electrical energy requirements for the production of 125, 250, or 450 ppy would exceed available site electrical energy capacity by 6, 51, and 133 percent, respectively. Available peak electrical load would be exceeded by 14, 31, and 103 percent for the production of 125, 250, or 450 ppy, respectively. NTS would have to procure additional power. Currently, NTS does not use natural gas or coal which are necessary for the production of steam for heating. Coal would have to be transported to the site, or a natural gas pipeline installed, to serve as fuel sources for the generation of steam. Impacts to liquid fuel and process gases would be negligible.

Table 5.3.2.2–2. Annual Site Infrastructure Requirements for Facility Operations Under MPF at NTS

Proposed Alternatives	Electrical		Fuel		Process Gases	
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Nitrogen (m^3/yr)	Argon (m^3/yr)
Site capacity	**176,844**	**45**	**Not limited[c]**	**NA**	**Not limited[c]**	**Not limited[c]**
Available site capacity	**75,476**	**18**	**Not limited**	**NA**	**Not limited**	**Not limited**
No Action Alternative						
Total site requirement	101,377	27	4,201,805	0	Not limited	Not limited
Percent of site capacity	57%	60%	Not limited	0	Not limited	Not limited
MPF Alternative						
125 ppy[a,b]						
Total site requirement	180,000	47.5	4,460,000	4,400,000		
Percent of site capacity	102%	106%	Not limited	NA	Not limited	Not limited
Change from No Action	79,800	20.5	260,000	4,400,000[d]	224,000	4,200
Percent of available capacity	106%	114%	Not limited	NA	Not limited	Not limited
250 ppy[a,b]						
Total site requirement	215,000	50.5	4,500,000	4,990,000	Not limited	Not limited
Percent of site capacity	122%	112%	Not limited	NA	Not limited	Not limited
Change from No Action	114,000	23.5	360,000	4,990,000 [d]	245,000	7,300
Percent of available capacity	151%	131%	Not limited	NA	Not limited	Not limited
450 ppy[a,b]						
Total site requirement	280,000	63.5	4,800,000	7,730,000	Not limited	Not limited
Percent of site capacity	157%	141%	Not limited	NA	Not limited	Not limited
Change from No Action	176,000	36.5	580,000	7,739,000 [d]	303,000	11,800
Percent of available capacity	233%	203%	Not limited	NA	Not limited	Not limited

[a] Peak load is based on electrical demands of HVAC, lighting, and miscellaneous electrical systems. Peak load and annual electrical consumption estimates for the three pit production capacities are based on ratioing SRS FY99 Pit Manufacturing data (MPF Data 2003) to the multiple facility sizes. Estimates based on 24 hrs/day, 365 days per year.
[b] Diesel fuel estimates based on vendor fuel consumption data ratioed for expected diesel generator size. Diesel generator testing of 1 hour per week.
[c] Not limited due to offsite procurement.
[d] Natural gas requirement for the generation of steam. Steam is used for heating.
NA = Not Applicable.
Source: MPF Data 2003.

Sensitivity Analysis

Sufficient electrical power capacity is not available at NTS for surge use of two-shift operations. Additional electrical power would have to be procured to meet surge operations demands. Natural gas or coal capacity would have to be adequate to support surge operations. There would be negligible impacts to liquid fuel or process gases from surge production capacity.

5.3.3 Air Quality and Noise

5.3.3.1 Nonradiological Releases

No Action Alternative

Construction Impacts

There would be no nonradiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of criteria and toxic pollutants would continue to be generated. These emissions are part of the baseline described in Chapter 4. No increases in emissions or air pollutant concentrations are expected under the No Action Alternative. Therefore, a PSD increment analysis is not required.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because NTS is located in an attainment area for all criteria pollutants; therefore, no conformity analysis is required.

Modern Pit Facility Alternative

Construction Impacts

Construction of new structures would result in temporary increases in air quality impacts from construction equipment, trucks, and employee vehicles. Exhaust emissions from these sources would result in releases of sulfur dioxide, nitrogen oxide, particulate matter, total suspended particulates, and carbon monoxide. The calculation of emissions from construction equipment was based on emission factors provided in the EPA document AP-42, "Compilation of Air Pollutant Emission Factors" (EPA 1995). For highway vehicles (worker commuting vehicles and delivery vehicles), emission factors were obtained from the EPA Mobile Source Emission Factor Model, MOBILE6.2 (EPA 2002).

Fugitive dust generated during the clearing, grading, and other earth moving operations is dependent on a number of factors including silt and moisture content of the soil, wind speed, and area disturbed. A common procedure to estimate fugitive emissions from an entire construction site is to use the EPA emission factor of 2.69 metric tons/ha (1.20 tons/ac) per month of activity (EPA 1995). This emission factor represents total suspended particulates (i.e., particles less than 30 microns in diameter). A multiplication factor of 0.75 was used to correct the emission rate to one for PM_{10} (EPA 1995). Also, it was assumed that water would be applied to disturbed areas. This would reduce emission rates by about 50 percent. Facility construction would necessitate a Concrete Batch Plant at the building site. Particulate matter, consisting primarily of cement dust, would be the only regulated pollutant emitted in the concrete mixing process. Emission factors for the Concrete Batch Plant were obtained from AP-42 (EPA 1995).

The estimated maximum annual pollutant emissions resulting from construction activities are presented in Table 5.2.3.1–1. Actual construction emissions are expected to be less, since conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the NTS boundary. Therefore, air quality impacts resulting from construction would be small.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.3.9, Human Health and Safety.

Operations Impacts

Pit manufacturing activities would result in the release of criteria and toxic pollutants into the surrounding air. The primary volume contributors are nitrogen and argon, used to maintain inert atmospheres for glovebox operations. Carbon dioxide would be used as a cleaning agent and helium would be used for leak-testing operations. Hydrogen and nitrogen dioxide are reaction products from aqueous purification operations (pyrochemical purification would produce lower amounts of hydrogen and nitrogen dioxide). The chemicals used for dye-penetrant testing of welds are assumed to be volatilized and released to the atmosphere. Organic solvents used for cleaning and chemicals used in the Analytical Laboratory for various analyses would not be expected to contribute any appreciable quantities of any other chemicals to the annual nonradioactive air emissions. Air emissions from periodic functional testing support systems (primarily standby diesel generators) would include carbon monoxide, nitrogen dioxide, PM_{10}, sulfur dioxide, VOCs, and total suspended particulates (WSRC 2002e). The estimated emission rates (kg/yr) for nonradiological pollutants emitted under each of the three new plant capacity scenarios are presented in Table 5.2.3.1–2. These emissions would be incremental to the NTS baseline. If NTS is selected as the preferred site, a PSD increment analysis would be performed under a project-specific tiered EIS to determine whether the pit manufacturing activities would cause a significant pollutant emission increase.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because NTS is located in an attainment area for all criteria pollutants. Therefore, although each alternative would emit criteria pollutants, a conformity review is not necessary.

The maximum concentrations ($\mu g/m^3$) at the NTS boundary that would be associated with the release of criteria pollutants under each of the three plant capacity scenarios (i.e., 125, 250, and 450 ppy) were modeled and are presented in Table 5.3.3.1–1. These concentrations were compared to the most stringent (Federal or state) ambient air quality standards. For each of the three capacity scenarios, incremental concentration increases would be small. For most pollutants, there would be an incremental increase of less than 1 percent of the baseline. The greatest increase would occur for nitrogen dioxide under the 450 ppy scenario, but ambient concentrations would remain below the ambient air quality standard. Since estimated emissions are maximum potential emissions and all emergency generators would not operate at the same time, the estimated emissions and resulting concentrations are conservative.

Table 5.3.3.1–1. Criteria Pollutant Concentrations at the NTS Boundary for MPF—Operations

Pollutant	Averaging Period	Most Stringent Standard or guideline [a] (μg/m³)	Maximum Incremental Concentration (μg/m³)			
			Baseline [b]	MPF Alternative		
				125 ppy	250 ppy	450 ppy
Carbon monoxide	8-hour	10,000	1,150	2.2	3.0	4.9
	1-hour	40,000	1,950	3.1	4.3	7.0
Nitrogen dioxide	Annual	100	NA	1.2	1.7	2.8
Sulfur dioxide	Annual	80	NA	0.076	0.10	0.17
	24-hour	365	NA	0.38	0.52	0.86
	3-hour	1,300	NA	0.86	1.2	1.9
PM_{10}	Annual	50	NA	0.030	0.042	0.068
	24-hour	150	20.2	0.15	0.21	0.34
Total Suspended Particulates	Annual	60	NA	0.082	0.11	0.18
	24-hour	150	NA	0.41	0.56	0.92

NA = not available.
[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] The No Action Alternative is represented by the baseline.
Source: MPF Data 2003; DBHCC 1993.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.3.9, Human Health and Safety.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased releases of criteria pollutants. The increase in releases of criteria pollutants from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility releases. Similarly, the increase of criteria pollutants from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.3.3.1–1). A review of the maximum incremental concentrations in Table 5.3.3.1–1 indicates that if the maximum incremental concentration of each criteria pollutant for the 450 ppy facility were conservatively doubled for surge capacity, concentrations would still not approach the most stringent standards or guideline concentrations.

5.3.3.2 Radiological Releases

No Action Alternative

Construction Impacts

There would be no radiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of radionuclides would continue to be emitted. These emissions are part of the baseline described in Chapter 4. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.3.9, Human Health and Safety.

Modern Pit Facility Alternative

Construction Impacts

No radiological releases to the environment are expected in association with construction activities. However, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site preparation activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the nature and extent of any contamination and would be required to remediate any contamination in accordance with established site procedures.

Operations Impacts

Radioactive air emissions from pit manufacturing activities would involve plutonium, americium, and enriched uranium. The pit manufacturing activities would be performed within gloveboxes or vaults for radiological containment; and include plutonium recovery using aqueous or pyrochemical processes, foundry, machining, assembly, post-assembly operations, inspection and certification, waste handling, and preparing the final product (pits) for shipment. Analytical operations would normally be conducted in laboratories consisting of rooms with gloveboxes and hoods for radiological containment. Each module would be separated from occupied areas of the laboratory facility by airlocks. Sample transfers would occur using a vacuum tube transfer system from the Feed Preparation and Manufacturing Facilities to the Analytical Support Facility. The ventilation exhaust from process and laboratory facilities would be filtered through double banks of HEPA filters before being released to the air via a 30-m (100-ft) tall stack. HEPA filters are the best available control technology for particulate emissions and are capable of removing more than 99.99 percent of entrained particles from the exhaust air.

DOE estimated routine radionuclide air emissions for three different plant capacities: 125, 250, 450 ppy (see Table 5.3.3.2–1). Releases under each of the three capacity scenarios would be small. Total radionuclide emissions at NTS would increase by less than 0.0001 percent. This is primarily due to increased emissions of plutonium isotopes. To ensure that total emissions are not underestimated, DOE's method for estimating emissions was conservative. Therefore, actual emissions from pit manufacturing operations would be smaller.

DOE estimated the radiation doses to the offsite MEI and the offsite population surrounding NTS. As shown in Table 5.3.3.2–2, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The maximum estimated dose to the offsite population residing within an 80-km (50-mi) radius would also be very low. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.3.9, Human Health and Safety.

Table 5.3.3.2–1. Annual Radiological Air Emissions for the MPF at NTS—Operations

Isotope	Annual Emissions (Ci/yr)			
	Baseline[a,b]	**125 ppy**	**250 ppy**	**450 ppy**
Americium-241	4.7×10^{-2}	2.08×10^{-7}	3.81×10^{-7}	7.61×10^{-7}
Plutonium-239		7.72×10^{-6}	1.19×10^{-5}	2.05×10^{-5}
Plutonium-240		2.01×10^{-6}	3.10×10^{-6}	5.35×10^{-6}
Plutonium-241		1.48×10^{-4}	2.28×10^{-4}	3.94×10^{-4}
Total Plutonium	$\mathbf{2.9 \times 10^{-1}}$	$\mathbf{1.58 \times 10^{-4}}$	$\mathbf{2.43 \times 10^{-4}}$	$\mathbf{4.20 \times 10^{-4}}$
Uranium-234		4.19×10^{-9}	5.58×10^{-9}	8.38×10^{-9}
Uranium-235		1.32×10^{-10}	1.76×10^{-10}	2.64×10^{-10}
Uranium-236		2.13×10^{-11}	2.84×10^{-11}	4.26×10^{-11}
Uranium-238		1.18×10^{-12}	1.58×10^{-12}	2.36×10^{-12}
Total Uranium	**NA**	$\mathbf{4.34 \times 10^{-9}}$	$\mathbf{5.79 \times 10^{-9}}$	$\mathbf{8.69 \times 10^{-9}}$
Tritium	426	---	---	---
Total	**426.3**	$\mathbf{1.58 \times 10^{-4}}$	$\mathbf{2.43 \times 10^{-4}}$	$\mathbf{4.21 \times 10^{-4}}$

[a] The No Action Alternative is represented by the baseline.
[b] Onsite emissions only.
NA = not available.
Source: WSRC 2002f.

Table 5.3.3.2–2. Annual Doses Due to Radiological Air Emissions from MPF Operations at NTS

Receptor	125 ppy	250 ppy	450 ppy
Offsite MEI[a] (mrem/yr)	1.6×10^{-9}	2.5×10^{-9}	4.5×10^{-9}
Population within 80 km (person-rem per year)	2.7×10^{-8}	4.3×10^{-8}	7.7×10^{-8}

[a] The offsite MEI is assumed to reside at the site boundary.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased radiological air emissions. The increase in radiological air emissions from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility emissions. Similarly, the increase in radiological air emissions from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.3.3.2–1). A review of the annual radiological emissions in Table 5.3.3.2–2 indicates that if the emissions for the 450 ppy facility were conservatively doubled for surge capacity, concentrations remain very low. The additional dose represented by these emissions would be well below regulatory limits.

5.3.3.3 Noise

No Action Alternative

Construction Impacts

Under the No Action Alternative, continuing operations at NTS would not involve any new construction. Thus, there would be no impacts from construction noise on wildlife or the public.

Operations Impacts

The noise-generating activities described in Section 4.2.3.4 would continue. These noise-generating activities are included in the NTS baseline and are not expected to change under the No Action Alternative.

Modern Pit Facility Alternative

Construction Impacts

Construction of new buildings at Area 6 would involve the movement of workers and construction equipment and would result in some temporary increase in noise levels near the area. Noise sources associated with construction at Area 6 would not include loud impulsive sources such as blasting. Although noise levels in construction areas could be as high as 110 decibels (dBA), these high local noise levels would not extend far beyond the boundaries of the construction site. Table 5.2.3.3–1 shows the attenuation of construction noise over relatively short distances. At 122 m (400 ft) from the construction site, construction noises would range from approximately 55-85 dBA. The *Environmental Impact Data Book* (Golden et al. 1980) suggests that noise levels higher than 80-85 dBA are sufficient to startle or frighten birds and small mammals. Thus, there would be little potential for disturbing wildlife outside a 122-m (400-ft) radius of the construction site. Given the distance to the site boundary (4.6 km [2.8 mi]), there would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Operations Impacts

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise impacts from pit manufacturing operations at the new buildings would be expected to be similar to those from existing operations at Area 6. There would be an increase in equipment noise (e.g., heating and cooling systems, generators, vents, motors, material-handling equipment) from pit manufacturing activities. However, given the distance to the site boundary (about 4.6 km [2.8 mi]), noise emissions from equipment would not likely disturb the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources (e.g., public address systems and testing of radiation and fire alarms) could have onsite impacts, such as the disturbance of wildlife. But these noise sources would be intermittent and would not be expected to disturb wildlife outside of facility boundaries. Traffic noise associated with the operation of these facilities would occur onsite and along offsite local and regional transportation routes used to bring materials and workers to the site. Noise from traffic associated with the operation of these facilities would likely produce less than a 1-dBA increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance to the public. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Sensitivity Analysis

If any of the three facilities operated at surge capacity, a second shift would be added. However, because of the distance of the facilities to the site boundary, noise from second-shift operations would not be noticeable offsite. Second-shift worker traffic would slightly increase noise levels on local roads. However, most material deliveries would likely occur during normal business hours, so there would be no increase in noise from truck traffic during the second shift. Impacts would be similar for each of the three plant capacities analyzed. Second-shift workers would be exposed to the same level of noise as first-shift workers. DOE would implement the same hearing protection programs for the second shift as used for the first. The second shift would not affect worker hearing.

5.3.4 Water Resources

Environmental impacts associated with the proposed alternatives at NTS could affect groundwater resources. No impacts to surface water are expected. At NTS, groundwater resources would be used to meet all construction and operations water requirements. Table 5.3.4–1 summarizes existing surface water and groundwater resources at NTS, the total NTS site-wide water resource requirements for each alternative, and the potential changes to water resources at NTS resulting from the proposed alternatives.

Table 5.3.4–1. Potential Changes to Water Resources from the MPF at NTS

Affected Resource Indicator	No Action[a]	MPF Alternative		
		125 ppy Single-Shift Operation	250 ppy Single-Shift Operation	450 ppy Single-Shift Operation
Construction – *Water Availability and Use*				
Water source	Ground	Ground	Ground	Ground
Total site-wide water construction requirement (million L/yr)	2,400	2,410.7	2,411.8	2,416.3
Percent change from No Action Alternative water use (2,400 million L/yr)	NA	0.45%	0.49%	0.68%
Water Quality				
Wastewater discharge into lagoons and ponds	4.6	6.68	6.89	7.61
Percent change from No Action Alternative wastewater discharge	NA	45.2%	49.8%	65.9%
Operations – *Water Availability and Use*				
Water source	Ground	Ground	Ground	Ground
Total site-wide water operation requirement (million L/yr)	2,400	2,677.4	2,729.5	2,904.3
Percent change from No Action Alternative water use (2,400 million L/yr)	NA	11.6%	13.7%	21.0%
Water Quality				
Wastewater discharge into lagoons and ponds (million L/yr)	4.6	45.0	61.9	81.8
Percent change from No Action Alternative wastewater discharge (million L/yr)	NA	978.3%	1345.7%	1778.3%
Floodplain				
Actions in 100-year floodplain	NA	Uncertain	Uncertain	Uncertain
Actions in 500-year floodplain	NA	Uncertain	Uncertain	Uncertain

All discharges to natural drainages require NPDES permits.
NA = not applicable.
million L/yr = million liters per year.
[a] Source: DOE 2002k.
Source: MPF Data 2003.

5.3.4.1 Surface Water

No Action Alternative

No additional impacts on surface water resources are anticipated at NTS under the No Action Alternative beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Surface water would not be used to support the construction of the MPF at NTS as groundwater is the source of water at NTS. There are no natural surface waterbodies in the vicinity that are a viable source of water. Therefore, there would be no impact to surface water availability from construction. Sanitary wastewater would be generated by construction personnel. As plans include use of portable toilets, onsite discharge of sanitary wastewater would be minimized.

During construction, an estimated total of 37.48 million L (9.9 million gal), 41.26 million L (10.9 million gal), and 54.13 million L (14.3 million gal) of liquid wastes would be generated for the 125, 250, and 450 ppy facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal generation of liquid waste over that timeframe, it is estimated that approximately 6.25 million L/yr (1.65 million gal/yr), 6.88 million L/yr (1.82 million gal/yr), and 9.02 million L/yr (2.38 million gal/yr) of liquid waste would be generated for the 125, 250, and 450 ppy facilities, respectively. It is estimated the one-third of the liquid wastes generated during construction would be from sanitary wastewater, with the remaining amount attributed to concrete construction activities. Water runoff from construction would be handled according to the NTS discharge permit for stormwater involving construction activities.

The potential for stormwater runoff from construction areas to impact downstream surface water quality is small. Although runoff from the vicinity of the site drains toward Frenchman Lake, which has standing water during the winter months, surface drainages in the vicinity and onsite in general are ephemeral, and runoff infiltration is rapid on alluvium. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) would be employed during construction to minimize suspended sediment and material transport, as well as potential water quality impacts. NTS would comply with Federal and state regulations to prevent, control, and handle potential spills from construction activities. However, the reference location at NTS is not located near any surface water; therefore, no impacts to surface water from potential construction-related spills would be expected.

Because of the size of NTS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains. A rise in the surface elevation of any standing water on playas creates a potential flood hazard. Therefore, safeguards would be constructed as necessary for the proposed MPF buildings and would be sited in accordance with applicable regulatory requirements and DOE orders, including Executive Order 11988, Floodplain Management.

Operations Impacts

No impacts on surface water resources are expected as a result of MPF operations at NTS. No surface water would be used to support facility activities and there would be no discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of facility operations stemming from staff use of lavatory, shower, and breakroom facilities, and from miscellaneous potable and sanitary uses. It is estimated that 45.0 million L (11.9 million gal), 61.9 million L (16.4 million gal) and 81.8 million L (21.6 million gal) of sanitary wastewater would be generated for the 125 ppy, 250 ppy, and 450 ppy facilities, respectively. These quantities would represent 978 percent, 1,346 percent, and 1,778 percent increases in sanitary wastewater discharges, respectively. NTS's current discharge permit would require modification and approval concerning the increase in wastewater discharges. The sanitary wastewater would be treated, monitored, and discharged into sewage lagoons and ponds according to permit requirements. No industrial or other regulated discharges to surface waters are anticipated.

The MPF would not generate any radioactive water emissions. However, there is a potential for generating radioactive contaminated water from the operation and maintenance of safety showers in contaminated areas, the operation of decontamination stations, the mopping of floors in contaminated areas, and the testing of fire sprinkler systems located in contaminated areas. Wastewater that has the potential for being radioactively contaminated would be collected, sampled, and analyzed prior to discharge. Radioactive wastewater would be converted to a solid and disposed of in accordance with DOE procedures. The water emissions that are sampled, analyzed, and determined to be contaminated can be converted to a solid by processing through the MPF liquid process waste facilities for the plutonium purification process.

Sensitivity Analysis

For a 450 ppy facility working a double shift, more wastewater would be generated by the increased number of workers. The sanitary wastewater treatment system would require appropriate modifications to handle the increase in flow.

5.3.4.2 Groundwater

No Action Alternative

No additional impacts on groundwater availability or quality are anticipated at NTS under the No Action Alternative beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and meeting the potable and sanitary needs of construction employees. The proposed use of portable toilets by construction personnel would greatly reduce water use over that normally required during construction. In addition, the water required for concrete mixing would likely be procured offsite. As a result, it is estimated that construction activities would require a total of approximately 71.92 million L (19 million gal), 79.49 million L (21 million gal), and 109.79 million L (29 million gal) of groundwater for the 125, 250, and 450 ppy capacity facilities, respectively, mainly to support MPF construction. It is expected that construction should take approximately 6 years. Assuming an equal usage over that timeframe, it is estimated that approximately 10.7, 11.8, and 16.3 million L/yr would be needed for the 125, 250, and 450 ppy facilities, respectively. The total site water requirements including these quantities would be well within the sustainable site capacity of 5.15 billion L (1.36 billion gal). It is anticipated that this water would be derived from NTS's groundwater distribution system via a temporary service connection or trucked to the point-of-use, especially during the early stages of construction.

There would be no onsite discharge of wastewater to the subsurface, and appropriate spill prevention controls and countermeasure plans would be employed to minimize the chance of petroleum, oils, lubricants, and other materials used during construction being released to the surface or subsurface and to ensure that waste materials are properly disposed. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts

Activities at NTS under the MPF Alternative would use groundwater primarily to meet the potable and sanitary needs of facility support personnel and for cooling tower water makeup. A summary of water usage by category and total is listed in Table 5.3.4.2–1. The percent change in water consumption from the No Action Alternative ranges from 11.6-21.0 percent of existing NTS usage of 2.4 billion L/yr (634 million gal/yr). Additionally, NTS has an annual maximum production capacity of approximately 8 billion L/yr (2.1 billion gal/yr) and sustainable site capacity of approximately 5.15 billion L/yr (1.36 billion gal/yr). The maximum additional water requirement for MPF is 6.3 percent of NTS's maximum production capacity and 9.8 percent of the sustainable site capacity.

Table 5.3.4.2–1. Summary of Water Consumption During Operations at NTS (million L)

	125 ppy	250 ppy	450 ppy
Domestic Water	44.9	61.7	81.6
Cooling Tower Makeup	232.5	267.8	422.7
Total	**277.4**	**329.5**	**504.3**
Total needed for site operation	2,677.4	2,729.5	2,904.3
Percent Change	11.6%	13.7%	21.0%

Source: MPF Data 2003.

No sanitary or industrial effluent would be directly discharged to the subsurface. Therefore, no operational impacts on groundwater quality would be expected.

Routine chemical additives would be added to the domestic water to control bacteria and pH, as well as to cooling tower water makeup for bacteria and corrosion control. Table 5.3.4.2–2 summarizes the chemicals added. Use of these types of chemicals is standard and no adverse impacts would be expected.

Table 5.3.4.2–2. Chemical Additives to Domestic Water and Cooling Tower Water Makeup (kg)

Chemical	125 ppy	250 ppy	450 ppy
Water Chemicals			
Sodium hypochlorite	90	124	164
Sodium hydroxide	58	80	106
Polyphosphate	180	247	327
Cooling Tower Makeup			
Betz Slimicide	120	130	210
Betz 25K series (corrosion inhibitor)	7,000	8,000	12,700

Source: MPF Data 2003.

Sensitivity Analysis

The double shift for 450 ppy would cause a significant increase in water use over the 450 ppy single shift, which is already a 21 percent increase in water use at the site. However, requirements for the 450 ppy double shift would still be well within the sustainable site capacity of 5.15 billion L/yr (1.36 billion gal/yr).

5.3.5 Geology and Soils

5.3.5.1 No Action Alternative

Under the No Action Alternative, no additional impacts on geology and soils are anticipated at NTS. The environmental impacts and operations (current and planned) described in Chapter 4 would continue. Hazards from large-scale geologic conditions, such as earthquakes, and from other site geologic conditions with the potential to affect existing NTS facilities are summarized in Section 4.2.5 and further detailed in the *Final Environmental Impact Statement for the Nevada Test Site and offsite locations in the State of Nevada* (DOE 1996b).

5.3.5.2 Modern Pit Facility Alternative

Construction Impacts

The construction of the MPF is expected to disturb land in the northern part of Frenchman Flat. Table 5.2.5.2–1 shows the amount of disturbance for the three different plant sizes. The major differences in the three facility layouts are in the sizes of the detention basin, Construction Laydown Area, and the roads and parking. The area of disturbance was calculated by extending the MPF area 9 m (30 ft) from the surrounding roads and the borders of the construction area and Concrete Batch Plant.

Aggregate and other geologic resources (e.g., sand) would be required to support construction activities at Frenchman Flat, but these resources are abundant in southern Nevada. In addition to MPF construction and upgrades, excavation to remove and replace some existing utility systems would also be conducted. The land area to be disturbed is relatively small; the impact on geologic and soil resources would be relatively minor. The potential exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the site's Environmental Restoration Program and in accordance with appropriate requirements and agreements. Construction of the MPF would require a stormwater permit that would address erosion control measures to minimize the impacts of erosion.

As discussed in Section 4.3.5, faults located in the vicinity of Frenchman Flat have the potential for earthquakes.

The MPF representative site is located in a region that has been seismically active within the last few thousand to tens of thousands of years. Earthquakes on the faults in Frenchman Flat and larger earthquakes on the farther faults would result in ground motion at the MPF site. Ground shaking affects primarily the integrity of inadequately designed or nonreinforced structures, but does not damage or only slightly damages properly or specially designed facilities.

Operations Impacts

The operation of the MPF at any of the three capacities would not be expected to result in impacts on geologic and soil resources. New, upgraded, and modified facilities would be evaluated, designed, and constructed in accordance with DOE Order 420.1, which requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Sensitivity Analysis

Utilizing the 450 ppy facility for two-shift operations would not impact geologic or soil resources. A second shift of workers would use the same parking lot as the first shift. No increase in the size of the parking lot is foreseen.

5.3.6 Biological Resources

5.3.6.1 Terrestrial Resources

No Action Alternative

Under the No Action Alternative, impacts on terrestrial resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing NTS environment and operations would continue to be an accurate portrayal of the site conditions as well as current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

The area identified for construction of the MPF consists primarily of white bursage (*Ambrosia dumosa*) and creosote bush (*Larrea tridentata*) or saltbush (*Atriplex* spp.) and white bursage shrubland vegetation (Skougard 2002) that supports a limited diversity of wildlife. Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of primarily shrubland habitat would be cleared or modified during MPF construction. During site-clearing activities, highly mobile wildlife species or wildlife species with large home ranges (such as deer and birds) would be able to relocate to adjacent undeveloped areas. However, successful relocation may not occur due to competition for resources to support the increased population and the carrying capacity limitations of areas outside the proposed development. Species relocation may result in additional pressure to lands already at or near carrying capacity. The impacts could include overgrazing (in the case of herbivores), stress, and over-wintering mortality. For less mobile species (reptiles, amphibians, and small mammals), direct mortality could occur during the actual construction event or ultimately result from habitat alteration. Acreage used for the development also would be lost as potential hunting habitat for raptors and other predators.

Operations Impacts

Impacts to terrestrial resources are very similar regardless of the level of pit production operations (potential pit production capacities of 125, 250, and 450 ppy including surge capacities). The major difference is the size of the modification or loss of shrubland plant communities and wildlife habitat. The acreage modified or lost would range from 44-56 ha (110-138 ac) depending upon pit production capacity.

In addition to the areas to be disturbed, there would be a decrease in quality of the habitat immediately adjacent to the proposed development due to increased noise level, traffic, lights, and other human activity, both pre- and post-construction. The adjacent habitat also would experience a loss of quality from the reduction in size, segmentation of the habitat, and restriction on mobility for some species (Kelly and Rotenberry 1993).

There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect terrestrial resources. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential for any adverse affects to plant and animal communities (terrestrial resources) in the surrounding environment.

Sensitivity Analysis

There would be minimal impacts to terrestrial resources during the two-shift operations. Wildlife road strikes (vehicle and wildlife collisions) may increase during morning and evening shift changes due to more vehicle traffic coupled with decreased visibility and higher wildlife activity.

5.3.6.2 Wetlands

No Action Alternative

Under the No Action Alternative, there would be no impacts to wetlands because no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

Of the known 24 springs and seeps found at NTS, most of which support wetland vegetation, none are located on the proposed MPF site. Therefore, there would be no direct impacts to wetlands. Implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan would avoid any degradation to wetlands in the area.

Operations Impacts

There are no adverse impacts predicted to wetlands from implementation of any of the MPF production capacities. There would be no direct untreated effluent discharges to the environment. With implementation and adherence to administrative procedures, along with facility design and engineering controls, MPF operations are not expected to adversely affect any wetlands in the area.

Sensitivity Analysis

There would be no impacts to wetlands during two-shift operations.

5.3.6.3 Aquatic Resources

No Action Alternative

Under the No Action Alternative, impacts on aquatic resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and NTS operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

There are no perennial or seasonal aquatic habitats within the proposed MPF location. Thus, there would be no direct impacts to aquatic resources. Indirect effects to aquatic resources would be avoided by implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan.

Operations Impacts

There would be no direct discharge of untreated operational effluent from MPF operations. Stormwater runoff from new facilities, roadways, parking lots, and other impervious areas is not predicted to result in any indirect adverse impacts on area aquatic resources. The quality of runoff water would be similar to runoff from other NTS built environments and the quantity would represent a very minor contribution to the watershed.

Sensitivity Analysis

There would be no impacts to aquatic resources during two-shift operations.

5.3.6.4 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, impacts to threatened and endangered species and other special interest species would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not associated with the MPF.

Modern Pit Facility Alternative

Section 7 of the *Endangered Species Act* requires all Federal agencies to ensure that actions they authorize, fund, or carry out do not jeopardize the continued existence of endangered or threatened species. Agencies must assess potential impacts and determine if proposed projects may affect federally-listed or proposed-for-listing species. Table 4.3.6.4–1 identifies Federal- and state-listed species and other special interest species that are known to be present or could occur at NTS.

Construction Impacts

Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of shrubland vegetation and habitat would be cleared or modified during MPF construction. This represents less than 1 percent of the undeveloped area at NTS. Should NTS be selected for construction and operations of the MPF, then the DOE, prior to any habitat modifying activities, would conduct site-specific surveys at the appropriate time and assess, in concert with the USFWS, the potential impacts to special-interest species. Acreage temporarily modified from construction would be lost as potential habitat, foraging areas, or hunting habitat for special interest avian, mammalian, and reptile species until the area revegetates. Revegetation would probably occur within a 1-3 year timeframe depending upon site maintenance and climate conditions.

Operations Impacts

Depending upon pit production capacity, acreage permanently modified or lost as habitat, foraging areas, or as a prey base for species of special interest would range from 44-56 ha (110-138 ac). There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely effect special interest species. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential impacts to any individual within a special-interest species population.

The desert tortoise is the only threatened/endangered species in the area where the MPF would be constructed and operated. Because NTS contains less than 1 percent of desert tortoise habitat, no significant impacts would be expected.

Sensitivity Analysis

There would be no impacts to threatened and endangered species during two-shift operations.

5.3.7 Cultural and Paleontological Resources

5.3.7.1 Cultural Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to prehistoric, historic, or Native American cultural resources. The cultural resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Under this alternative, a block of land would be disturbed during construction of the MPF facility. The size of the disturbed area would vary by the output of the facility, and would include the plant buildings and structures (inside the PIDAS fence), security fencing and perimeter roads, support buildings and parking, a detention basin, a Concrete Batch Plant, a Construction Laydown Area, and a 9-m (30-ft) wide buffer zone surrounding the facility. For purposes of analyzing impacts to cultural resources, the three sizes of disturbed areas would be 62 ha (152 ac) (125 ppy), 63 ha (156 ac) (250 ppy), and 74 ha (182 ac) (450 ppy).

The MPF reference location at NTS has not been inventoried for cultural resources, thus the presence of resources that would be impacted during construction of the MPF is currently unknown. This is true of many areas within NTS. However, an unrelated survey conducted in Area 6 indicated a low density of cultural resources in that area, relative to other areas at NTS and the other DOE sites under consideration. Thus, there is a low probability that resources would be impacted during MPF construction at the reference location. Probabilities for other areas on NTS would depend on the locations, since some areas exhibit a high density of cultural resources. Although the number of resources that would be impacted is unknown, the probability for resource impacts would increase with an increase in the number of acres disturbed.

Because the exact location of the MPF at NTS is not yet determined, cultural resources arising from infrastructure construction (such as water, sewer, gas, electricity, access roads) are not analyzed here. They will be analyzed in the site-specific EIS. However, like the facility itself, the greater the number of acres disturbed, the greater the possibility for impacts to cultural resources.

Prior to any ground-disturbing activity, DOE would identify and evaluate any cultural resources that could potentially be impacted by the construction of the MPF. Methods for identification could include field survey, shovel tests, archival research, and consultation with interested Native American tribes. DOE would determine the possibility for impacts to the resources and implement appropriate measures to avoid, reduce, or mitigate the impacts. Identification, evaluation, determination of impact, and implementation of measures would be conducted in consultation with the Nevada SHPO and in accordance with the *Cultural Resources Management Plan for the Nevada Test Site* (DOE 1999d). If previously unknown cultural resources, such as subsurface resources, are discovered during construction, activities in the area of the discovery would stop and the discovery would be evaluated and treated appropriately, as determined by DOE in consultation with the Nevada SHPO.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on cultural resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on cultural resources.

5.3.7.2 Paleontological Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to paleontological resources. The paleontological resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

No known fossil localities have been recorded on NTS and no fossils were located during the construction of the Device Assembly Facility (DAF) (DOE 2002k). However, the Quaternary deposits that make up Frenchman Flat and Area 6 could contain paleontological materials. Thus, there is a probability that paleontological resources would be impacted due to construction of the MPF or the associated infrastructure at the reference location. This is also true for any other area on NTS. The probability for impacts to paleontological resources would increase with an increase in the number of acres disturbed.

Paleontological resources would be included in the scope of any cultural resource inventories conducted prior to the beginning of construction. If previously unknown paleontological resources are discovered during construction, activities in the area of the discovery would stop and the discovery would be treated appropriately, as determined by DOE.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on paleontological resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on paleontological resources.

5.3.8 Socioeconomics

5.3.8.1 Regional Economy Characteristics

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at NTS. Therefore, there would be no impacts to the ROI employment, income, labor force, population, housing, or community services in the area.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. Construction of the facility to produce 125 ppy would require a total of 2,650 man-years of labor. During peak construction, 770 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 740 indirect jobs would be created, for a total of 1,510 jobs. This represents less than 0.5 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would likely be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $44,900 for the construction industry, direct income would increase by $34.6 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $59.0 million ($34.6 million direct and $24.4 million indirect).

Facility–250 ppy. Construction of the facility to produce 250 ppy would require a total of 2,950 man-years of labor. During peak construction, 850 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 820 indirect jobs would be created, for a total of 1,670 jobs. This represents less than 0.5 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would likely be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $44,900 for the construction industry, direct income would increase by

$38.2 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $65.1 million ($38.2 million direct and $26.9 million indirect).

Facility–450 ppy. Construction of the facility to produce 450 ppy would require a total of 3,800 man-years of labor. During peak construction, 1,100 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that 1,060 indirect jobs would be created, for a total of 2,160 jobs. This represents less than 0.5 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would likely be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $44,900 for the construction industry, direct income would increase by $49.4 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $84.2 million ($49.4 million direct and $34.8 million indirect).

Operations Impacts

Facility–125 ppy. Operation of the facility to produce 125 ppy would require 988 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 620 indirect jobs would be created, for a total of 1,610 jobs. This represents less than 0.5 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $49,200 for the government services industry, direct income would increase by $48.6 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $72.6 million ($48.6 million direct and $24 million indirect).

Facility–250 ppy. Operation of the facility to produce 250 ppy would require 1,358 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 850 indirect jobs would be created, for a total of 2,210 jobs. This represents less than 0.5 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $49,200 for the government services industry, direct income would increase by $66.8 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $99.8 million ($66.8 million direct and $33 million indirect).

Facility–450 ppy. Operation of the facility to produce 450 ppy would require 1,797 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 1,130 indirect jobs would be created, for a total of approximately 2,930 jobs. This represents less than 0.5 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $49,200 for the government services industry, direct income would increase by $88.4 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $132 million ($88.4 million direct and $43.7 million indirect).

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. However, the existing ROI labor force would likely be able to fill these jobs.

5.3.8.2 Population and Housing

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at NTS. Therefore, there would be no impacts to the ROI population or housing.

Modern Pit Facility Alternative

Construction Impacts

Facility–125, 250, or 450 ppy. There would be no impact to the ROI population or housing markets because most of the new jobs would likely be filled by workers already residing in the ROI and no in-migration would occur.

Operations Impacts

Facility–125, 250, or 450 ppy. There would be no impact to the ROI population or housing markets because most of the new jobs would likely be filled by workers already residing in the ROI and no in-migration would occur.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. However, the existing labor force would likely be able to fill these jobs. Therefore, there would be no additional impacts to ROI population or housing.

5.3.8.3 Community Services

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at NTS. Therefore, there would be no impacts to ROI community services.

Modern Pit Facility Alternative

Construction Impacts

Facility–125, 250, or 450 ppy. There would be no impact to ROI community services because most of the new jobs would likely be filled by workers already residing in the ROI.

Operations Impacts

Facility–125, 250, or 450 ppy. There would be no impact to ROI community services because most of the new jobs would likely be filled by workers already residing in the ROI.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. The existing labor force would likely be able to fill these jobs. Therefore, there would be no additional impacts to ROI community services.

5.3.9 Human Health and Safety

5.3.9.1 Radiological Impacts

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in NTS operations.

Construction Impacts

Under the No Action Alternative, there would be no radiological impacts on members of the public or workers because this alternative would not involve any construction.

Operations Impacts

Under the No Action Alternative, the radiological releases to the environment from NTS would continue at the same rates described in Section 4.3.9. The associated impacts on the general public living within 80 km (50 mi) of NTS and the offsite MEI would continue at the levels shown in Table 4.3.9.1–2. As shown in that table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The fatal cancer risk to the offsite MEI due to radiological releases from NTS operations is estimated to be 8.5×10^{-8}, while 2.2×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of NTS from normal NTS operations.

Under this alternative, the radiation dose received by NTS workers would continue at the rates described in Section 4.3.9. These worker radiation doses at NTS for the year 2000 are presented in Table 4.3.9.1–3. The number of projected fatal cancers among NTS workers from normal operations in 2000 is 6.4×10^{-4}.

Modern Pit Facility Alternative

Construction Impacts

No radiological risks would be incurred by members of the public from construction activities. Construction workers could be at a small radiological risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site, including that associated with residual contamination at the facilities being upgraded. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as reasonably achievable.

Operations Impacts

Impacts to the Public. DOE expects minimal public health impacts from the radiological consequences of MPF operations. Public radiation doses would likely occur from airborne releases only (Section 5.3.3). Table 5.3.9.1–1 lists incremental radiation doses estimated for the non-involved worker and the public (offsite MEI and collective population dose) and corresponding incremental LCFs. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

As shown in the table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a LCF to this individual from operations would be less than or equal to 2.3×10^{-15} per year (i.e., about 1 chance in 440 trillion per year of a LCF). The projected number of fatal cancers to the population within 80 km (50 mi) would be less than or equal to 3.8×10^{-11} per year (i.e., about 1 chance in 26 billion per year of a LCF).

Table 5.3.9.1–1. Annual Radiological Impacts on the Public from MPF Operations at NTS for All Three Pit Production Rates

Receptor	125 ppy	250 ppy	450 ppy
Population within 80 km			
Collective dose (person-rem)	2.7×10^{-8}	4.3×10^{-8}	7.7×10^{-8}
Percent of natural background radiation[a]	0.00000000012%	0.00000000019%	0.00000000035%
LCFs[b]	1.3×10^{-11}	2.1×10^{-11}	3.8×10^{-11}
Offsite MEI[c]			
Dose (mrem)	1.6×10^{-9}	2.5×10^{-9}	4.5×10^{-9}
Percent of regulatory dose limit	0.000000016%	0.000000025%	0.000000045%
Percent of natural background radiation[a]	0.00000000051%	0.00000000080%	0.0000000014%
Cancer fatality risk[b]	8.0×10^{-16}	1.3×10^{-15}	2.3×10^{-15}

[a] The average annual dose from background radiation at NTS is 314 mrem (see Section 4.3.9); the 69,501 people living within 80 km (50 mi) of NTS in the year 2043 would receive an annual dose of 21,823 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 LCFs per person-rem.
[c] The offsite MEI is assumed to reside at the site boundary, 31,600 m (103,680 ft) south from the MPF. An actual residence may not currently be present at this location.

Impacts to Modern Pit Facility Workers. Estimates of annual radiological doses to workers involved with MPF facility operations are independent of geographical location. These dose estimates are solely a function of:

- The number of radiological workers, as determined in the development of the MPF staffing estimate for each throughput alternative. The current estimates were developed by application of a factor to the total workers for each workgroup based on operating experience in plutonium facilities. Approximately 60 percent of total operating staff are estimated to be radiological workers.

- The working dose rate at the glovebox surface for each unit operation or workstation. These dose rates were calculated based on the maximum mass (plutonium, americium) and form (metal, oxide) of material being handled. Standard “weapons grade” isotopic distribution and americium content of 0.5 percent were assumed.

- The amount of time spent by direct operators/first line supervisors in the radiation area. This was determined from a time-motion estimate of direct “hands-in-gloves” labor required to perform each individual operation and the number of parts processed per year for a given pit production rate. Efficiency scaling factors were applied for various operations. For Foundry and Machining Operations, this was assumed to be 50 percent; for Assembly and Post-Assembly & Testing, efficiencies were 90 percent.

As indicated above, the collective annual doses (mrem/yr) received by individual direct operators is calculated based on the number of operators required for the various production rates, the time spent in the radiation area, and the associated dose rates for each operation. The collective exposures for support group workers were added to these numbers and were calculated using empirical data that implies that exposure for these workers can be estimated as a percentage of direct operator exposure (e.g., Analytical Laboratory Technician ~25 percent of direct operator exposure). The average individual dose is calculated as the collective exposure divided by the estimated number of radiological workers for each throughput alternative.

The estimates of annual radiological doses to workers under each of the three pit production rates are provided in Table 5.3.9.1–2. As shown in the table, the annual doses to individual workers for all levels of production would be well below the DOE limit of 5,000 mrem (10 CFR 835.202) and the DOE-recommended control level of 1,000 mrem (10 CFR 835.1002). The projected number of fatal cancers in the workforce from annual operations involving 125 ppy would be 0.064 (or 1 chance in 16 that the worker population would experience a fatal cancer per year of operations). For annual pit production rates of 250 and 450, the projected number of fatal cancers would be 0.12 and 0.22, respectively (1 chance in 8 or 5, respectively, that the worker population would experience a fatal cancer per year of operations).

Table 5.3.9.1–2. Annual Radiological Impacts on MPF Workers at NTS from Operations for All Three Pit Production Rates

Production Rate	125 ppy	250 ppy	450 ppy
Number of Radiological Workers	**550**	**800**	**1,100**
Individual Workers[a]			
Average individual dose, mrem/yr	290	390	510
Average worker cancer fatality risk[b]	1.2×10^{-4}	1.6×10^{-4}	2.0×10^{-4}
Worker Population			
Collective dose (person-rem)	160	310	560
Cancer fatality risk[b]	0.064	0.12	0.22

[a] The regulatory dose limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, the maximum annual dose to a worker would be kept below the DOE Control Level of 1,000 mrem/yr, as established in 10 CFR 835.1002. Further, DOE recommends that facilities adopt a more limiting 500-mrem/yr Administrative Control Level (DOE 1999e). To reduce doses to levels that are as low as is reasonably achievable, an effective dose reduction plan would be enforced.
[b] Based on a cancer risk estimator of 0.0004 LCFs per person-rem.

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the MPF under any of the three capacities would approximately double the quantities of radioactive emissions from the MPF presented for single-shift operation at each capacity. Thus, the calculated radiation dose and LCFs to the offsite MEI and the population living within 80 km (50 mi) of NTS would approximately double.

Similarly, double-shift operation of the MPF under any of the three capacities would approximately double the radiation dose to MPF workers presented for single-shift operation at each capacity. Thus, the calculated adverse health impacts to the MPF workers would be approximately double.

5.3.9.2 Nonradiological Impacts

This section considers illness, injury, and fatality rates associated with construction and operations of the MPF on the NTS workforce. Nonradiological impacts to workers were evaluated using occupational injury, illness, and fatality rates obtained from BLS, U.S. Department of Labor data. DOE values are historically lower than BLS values owing to the increased focus on safety fostered by complex-wide programs, including ISM and the VPP. Additionally, the small number of fatal accidents reported in the CAIRS makes associated calculated fatality rates statistically invalid.

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in injury, illness, and fatality trends currently observed at NTS.

Modern Pit Facility Alternative

Construction Impacts

The potential risk of occupational injuries and fatalities to workers constructing the MPF would be expected to be bounded by injury and fatality rates for general industrial construction. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for both the peak workforce loading and for the duration of construction activities including site preparation (6¾ years). These values are shown below in Table 5.3.9.2–1.

Table 5.3.9.2–1. Injury, Illness, and Fatality Estimates for Construction of the MPF at NTS

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Peak Annual Employment	770	850	1,100
Total Recordable Cases	66	73	95
Total Lost Workday Cases	32	35	46
Total Fatalities	0.16	0.17	0.023
Project Duration (6¾ years)			
Total Recordable Cases	228	254	328
Total Lost Workday Cases	110	122	157
Total Fatalities	0.54	0.60	0.78

Source: MPF Data 2003, BLS 2002b.

No chemicals have been identified that would be a risk to members of the public from construction activities associated with any of the MPF operating capacities. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. Implementation of ISMS programs to construction activities would also decrease the potential for worker exposures by providing hazards identification and control measures for construction activities (WSRC 2002c).

Operations Impacts

During normal (accident-free) operations, total facility staffing would range from approximately 988-1,797, depending on the operating capacity of the selected MPF. The potential risk of occupational injuries and fatalities to workers operating the MPF would be expected to be bounded by injury and fatality rates for general chemical manufacturing. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for facility populations estimated for each of the operating capacities. These values are shown below in Table 5.3.9.2–2.

Table 5.3.9.2–2. Injury, Illness, and Fatality Annual Estimates for Normal Operations of the MPF at NTS

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Total Recordable Cases	43	59	78
Total Lost Workday Cases	22	30	40
Total Fatalities	0.04	0.05	0.07

Source: MPF Data 2003, BLS 2002b.

No chemical-related health impacts are associated with normal (accident-free) operations of the MPF at the three identified operating capacities. Initial screens for the hazard analysis did not result in the identification of any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by facility safety programs such as ISMS, work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness (WSRC 2002c).

Sensitivity Analysis

DOE could operate the MPF using a double-shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450-ppy facility would approximately double the impacts to the NTS illness and injury rates for facility associated activities. No chemical-related health impacts would be associated with this increase in operations.

5.3.10 Facility Accidents

This section presents the potential impacts on workers (both involved and non-involved) and the public due to potential accidents associated with operation of the MPF at NTS. Additional details supporting the information presented here are provided in Appendix C.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident’s progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.

- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.

- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, DOE predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident.

Emergency Preparedness

Each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

5.3.10.1 No Action Alternative

Under the No Action Alternative, all current activities would continue at existing levels. Potential accident scenarios for the No Action Alternative are addressed in existing documentation included by reference (DOE 1996c).

5.3.10.2 Modern Pit Facility Alternative

Radiological Impacts

DOE estimated radiological impacts to three receptors: (1) the MEI at the NTS boundary; (2) the offsite population within 80 km (50 mi) of NTS; and (3) a non-involved worker 1,000 m (3,281 ft) from the accident location. DOE did not evaluate total dose to non-involved workers because of the uncertain nature of their locations at the time of the accident.

Tables 5.3.10.2–1 through 5.3.10.2–3 show the frequencies and consequences of the postulated set of accidents for the public (offsite MEI and the general population living within 80 km [50 mi] of the facility) and a hypothetical non-involved worker for the three pit production rates. The dose shown in the tables are calculated by the MACCS computer code based on accident data. The latent cancer fatality (LCF) values are calculated using a dose-to-LCF conversion factor. For the MEI and the population the conversion factor is 0.0005 LCFs per rem or person-rem respectively. For workers, the dose-to-risk conversion factor is 0.0004 LCFs per rem. If the dose to an MEI or worker exceeds 20 rem, the dose-to-risk conversion factor is doubled to 0.001 and 0.0008 respectively. Tables 5.3.10.2–4 through 5.3.10.2–6 show the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *Topical Report - Supporting Documentation for the Accident Impacts Presented in the Modern Pit Facility Environmental Impact Statement* (Tetra Tech 2003). The selection process, screening criteria used, and conservative estimates of material at risk and source term (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at the MPF. Thus, in the event that any other accident that was not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5.3.10.2–1. MPF Alternative Radiological Accident Frequency and Consequences at NTS for 125 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	2.71	0.0014	1,120	0.56	239	0.19
Fire in a Single Building						
1×10^{-4}	1.27	0.00064	504	0.25	124	0.099
Explosion in a Feed Casting Furnace						
1×10^{-2}	1.49	0.00074	591	0.3	145	0.12
Nuclear Criticality						
1×10^{-2}	3.4×10^{-6}	1.7×10^{-9}	0.0012	5.8×10^{-7}	0.00049	2.5×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	0.099	5.0×10^{-5}	39.4	0.02	9.69	0.0048
Radioactive Material Spill						
1×10^{-2}	0.03	1.5×10^{-5}	11.8	0.0059	2.91	0.0015

CRT = Cargo Restraint Transporter.
[a] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

The accident with the highest risk to the offsite population (see Tables 5.3.10.2–4 through 5.3.10.2–6) is the explosion in a feed casting furnace for the 125 ppy, 250 ppy, and 450 ppy production cases. The increased number of LCFs in the offsite population would be 0.003 per year (i.e., about 1 chance in 300 per year of a LCF in the total population) for all three production cases. The highest risk of a LCF to an offsite MEI located at a distance of 22,129 m (72,602 ft) in the south southeast direction from the accident would be 7.4×10^{-6} per year (i.e., about 1 chance in 135,000 per year of a LCF) for all three production cases. The highest risk of a LCF to a non-involved worker located at a distance of 1,000 m (3,281 ft) from the accident would be 0.0012 per year (i.e., about 1 chance in 830 per year of a LCF) for all three production cases.

Table 5.3.10.2–2. MPF Alternative Radiological Accident Frequency and Consequences at NTS for 250 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	2.8	0.0014	1,150	0.58	246	0.2
Fire in a Single Building						
1×10^{-4}	1.32	0.00066	522	0.26	129	0.1
Explosion in a Feed Casting Furnace						
1×10^{-2}	1.49	0.00074	591	0.3	145	0.12
Nuclear Criticality						
1×10^{-2}	3.4×10^{-6}	1.7×10^{-9}	0.0012	5.8×10^{-7}	0.00049	2.5×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	0.099	5.0×10^{-5}	39.4	0.02	9.69	0.0048
Radioactive Material Spill						
1×10^{-2}	0.03	1.5×10^{-5}	11.8	0.0059	2.91	0.0015

[a] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.3.10.2–3. MPF Alternative Radiological Accident Frequency and Consequences at NTS for 450 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	5.38	0.0027	2,220	1.11	474	0.38
Fire in a Single Building						
1×10^{-4}	2.55	0.0013	1,010	0.51	249	0.2
Explosion in a Feed Casting Furnace						
1×10^{-2}	1.49	0.00074	591	0.3	145	0.12
Nuclear Criticality						
1×10^{-2}	3.5×10^{-6}	1.7×10^{-9}	0.0012	5.8×10^{-7}	0.00049	2.5×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	0.20	9.9×10^{-5}	78.8	0.039	19.4	0.0097
Radioactive Material Spill						
1×10^{-2}	0.03	1.5×10^{-5}	11.8	0.0059	2.91	0.0015

[a] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.3.10.2–4. Annual Cancer Risks Due to MPF Accidents at NTS for 125 ppy

Accident	Offsite MEI	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.4×10^{-8}	5.6×10^{-6}	1.9×10^{-6}
Fire in a Single Building	6.4×10^{-8}	2.5×10^{-5}	9.9×10^{-6}
Explosion in a Feed Casting Furnace	7.4×10^{-6}	0.003	0.0012
Nuclear Criticality	1.7×10^{-11}	5.8×10^{-9}	2.5×10^{-9}
Fire-induced Release in the CRT Storage Room	5.0×10^{-7}	0.0002	4.8×10^{-5}
Radioactive Spill Material	1.5×10^{-7}	5.9×10^{-5}	1.5×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.

Table 5.3.10.2–5. Annual Cancer Risks Due to MPF Accidents at NTS for 250 ppy

Accident	Offsite MEI	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.4×10^{-8}	5.8×10^{-6}	2.0×10^{-6}
Fire in a Single Building	6.6×10^{-8}	2.6×10^{-5}	1.0×10^{-5}
Explosion in a Feed Casting Furnace	7.4×10^{-6}	0.003	0.0012
Nuclear Criticality	1.7×10^{-11}	5.8×10^{-9}	2.5×10^{-9}
Fire-induced Release in the CRT Storage Room	5.0×10^{-7}	0.0002	4.8×10^{-5}
Radioactive Spill Material	1.5×10^{-7}	5.9×10^{-5}	1.5×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.

Table 5.3.10.2–6. Annual Cancer Risks Due to MPF Accidents at NTS for 450 ppy

Accident	Offsite MEI	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	2.7×10^{-8}	1.1×10^{-5}	3.8×10^{-6}
Fire in a Single Building	1.3×10^{-7}	5.1×10^{-5}	2.0×10^{-5}
Explosion in a Feed Casting Furnace	7.4×10^{-6}	0.003	0.0012
Nuclear Criticality	1.7×10^{-11}	5.8×10^{-9}	2.5×10^{-9}
Fire-induced Release in the CRT Storage Room	9.9×10^{-7}	0.00039	9.7×10^{-5}
Radioactive Spill Material	1.5×10^{-7}	5.9×10^{-5}	1.5×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.

Hazardous Chemicals Impacts

DOE estimated the impacts of the potential release of the most hazardous chemicals used at the MPF. A chemical's vapor pressure, acceptable concentration (ERPG-2), and quantity available for release are factors used to rank a chemical's hazard. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Additional information on the evaporation and dispersion of each chemical is provided in Appendix C. Tables 5.3.10.2–7 through 5.3.10.2–9 provide information on each chemical and the frequency and consequences of an accidental release. The source term shown represents the amount of the chemical that is accidentally released. The American Industrial Hygiene Association defines ERPG-2 as the maximum airborne concentration below which 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. The distance from the release points to the point where the ERPG-2 concentration is reached in relation to the site boundary reflects the consequence of the chemical's release. As the distance to the ERPG-2 point increases, the potential number of persons onsite and offsite that may be exposed to concentrations in excess of ERPG-2 would be expected to increase. The distance to the nearest site boundary is 7.6 km (4.7 mi). None of the chemicals released in an accident would exceed ERPG-2 limits offsite.

Table 5.3.10.2–7. MPF Alternative Chemical Accident Frequency and Consequences at NTS for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 7.6 km (ppm)	
Nitric acid	10,500	6	0.28	0.5	0.01	10^{-4}
Hydrofluoric acid	550	20	0.35	2.0	0.016	10^{-4}
Formic acid	1,500	10	0.08	0.07	0	10^{-4}

[a] Site boundary is at a distance of 7.6 km (4.7 mi) east.

Table 5.3.10.2–8. MPF Alternative Chemical Accident Frequency and Consequences at NTS for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 7.6 km (ppm)	
Nitric acid	21,000	6	0.4	0.98	0.02	10^{-4}
Hydrofluoric acid	1,100	20	0.48	3.9	0.03	10^{-4}
Formic acid	3,000	10	0.12	0.14	0	10^{-4}

[a] Site boundary is at a distance of 7.6 km (4.7 mi) east.

Table 5.3.10.2–9. MPF Alternative Chemical Accident Frequency and Consequences at NTS for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 7.6 km (ppm)	
Nitric acid	40,000	6	0.54	1.8	0.038	10^{-4}
Hydrofluoric acid	2,000	20	0.64	6.93	0.056	10^{-4}
Formic acid	5,500	10	0.15	0.25	0.0054	10^{-4}

[a] Site boundary is at a distance of 7.6 km (4.7 mi) east.

Involved Worker Impacts

For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Prediction of potential health effects becomes increasingly difficult to quantify as the distance between the accident location and the receptor decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be acutely injured or killed by physical effects of the accident.

The number of workers that would be at the MPF during operations would range from 988-1,797 (125-450 ppy) (including security guards). Each process facility within the MPF would have attached safe haven structures designed in accordance with a number of life safety, fire protection, and safeguards and security requirements. These structures are required for personnel protection during various accident scenarios and are made of reinforced concrete similar in design to the process building wall construction. They would be designed to accommodate 120 percent of the building occupancy for a number of hours and would require their own independent ventilation systems (WSRC 2002b).

The facility ventilation system would control dispersal of any airborne radiological debris from the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk of injury.

5.3.11 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as being Black or African American; American Indian and Alaska Native; Asian; Native Hawaiian and other Pacific Islander; or another non-White race; or persons of Hispanic or Latino ethnicity. Persons whose incomes are below the Federal poverty threshold are designated low-income.

At NTS, the 80-km (50-mi) radius includes portions of Clark, Nye, and Lincoln Counties in Nevada and a portion of Inyo County, California. Table 5.3.11–1 provides the racial and ethnic composition of these counties based on the 2000 Census, as well as the number of people below the poverty level. Figure 5.3.11–1 shows the minority populations located within an 80-km (50-mi) radius of the site. Figure 5.3.11–2 shows the low-income populations located within the same 80-km (50-mi) radius. This study area corresponds to the region of potential radiological impacts. Figures 5.3.11–1 and 5.3.11–2 show the distribution of these populations throughout the area around the site.

In 2002, minority populations comprised 30.9 percent of the U.S. population, and the same percentage of the Nevada population. The percentage of minority populations in the area surrounding NTS is greater than that in the United States or the State of Nevada; however, the minority populations in the area are concentrated in the Las Vegas metropolitan area, outside the 80-km (50-mi) impact area, as shown in Figure 5.3.11–1.

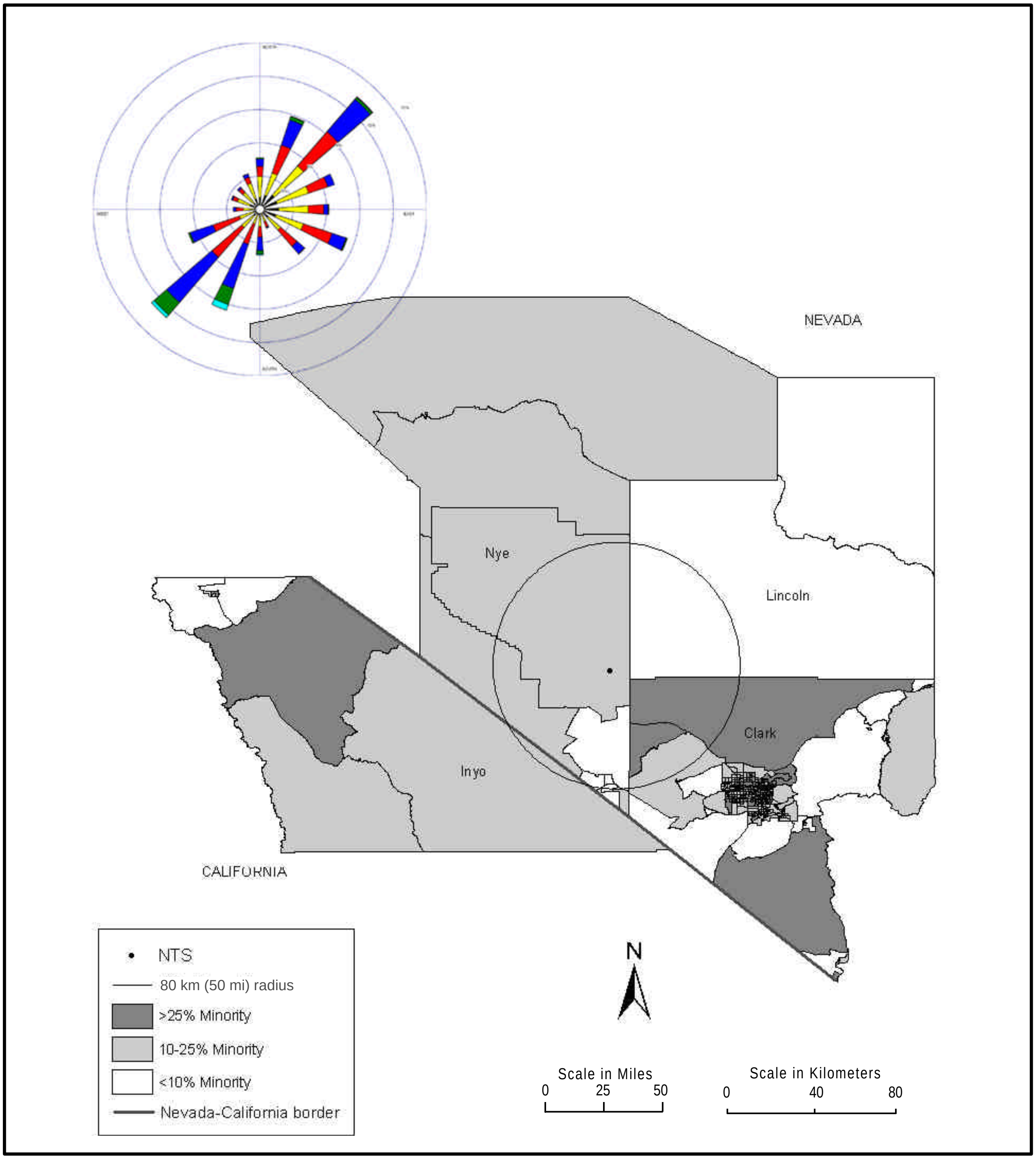

Figure 5.3.11–1. Distribution of the Minority Population Surrounding NTS

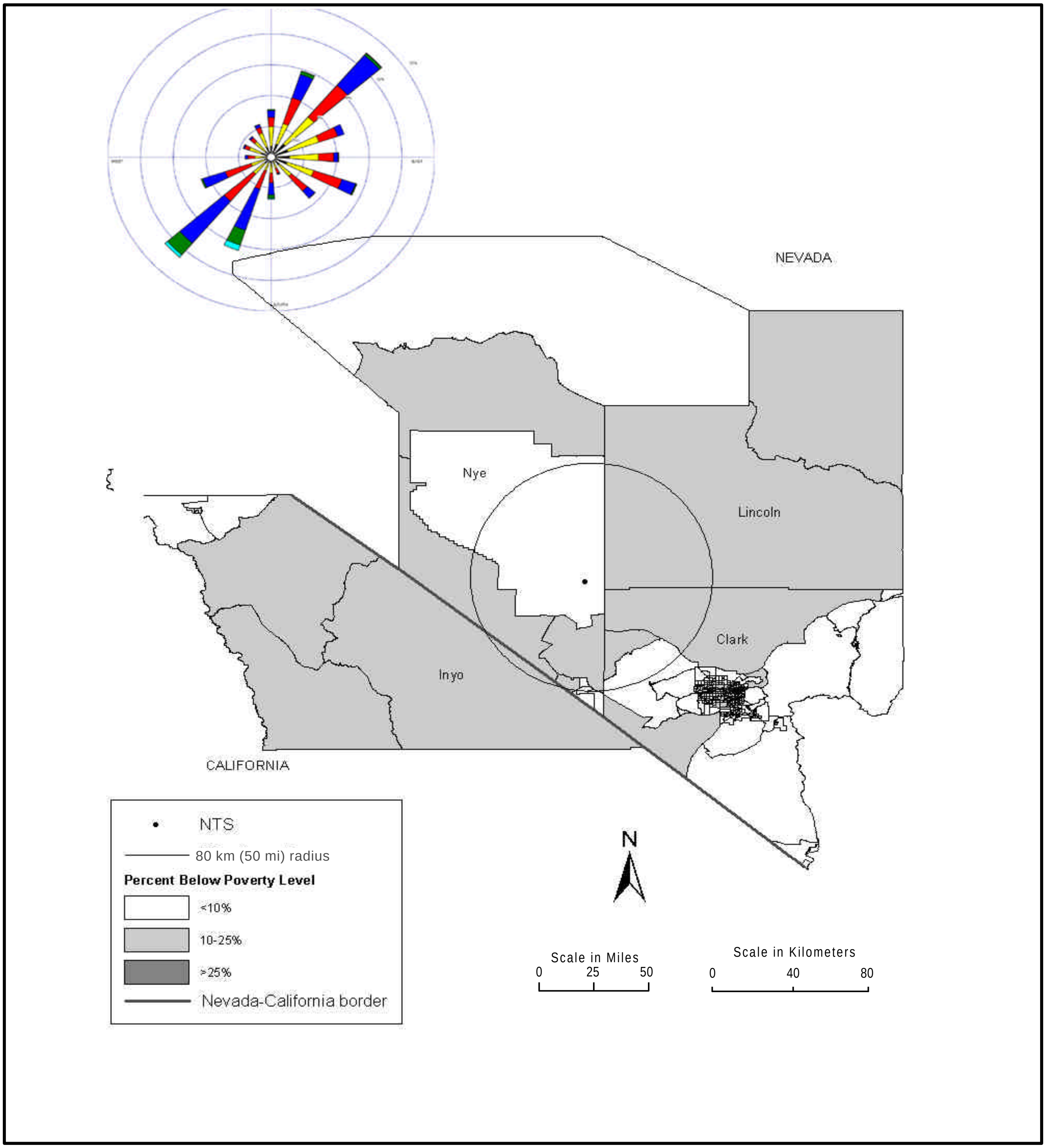

Figure 5.3.11–2. Distribution of the Low-Income Population Surrounding NTS

Table 5.3.11–1. Racial, Ethnic, and Socioeconomic Composition Surrounding NTS

Population Group	Population	Percent of Total
Hispanic or Latino	307,334	21.5
Black or African American	121,865	8.5
American Indian and Alaska Native	10,092	0.7
Asian	71,639	5.0
Native Hawaiian and Other Pacific Islander	5,980	0.4
Other Race	2,133	0.1
Two or More Races	38,076	2.7
White	873,241	61.1
Total	**1,430,360**	**100**

Low-income populations comprised 12.4 percent of the U.S. population, based on 1999 income, and 10.5 percent of the Nevada population. Within the counties surrounding NTS, 10.8 percent of the population lives below the poverty level.

As shown in Section 5.3.9, Human Health and Safety, there are no large adverse impacts to any populations. Therefore, there would be no disproportionately high and adverse impacts to minority or low-income populations.

5.3.12 Transportation

Impacts to the human environment from transportation can result from two sources: operation of the vehicle and the presence of the cargo. Vehicle-related impacts could include increased emissions, traffic congestion, noise, and traffic accidents. Cargo-related impacts could include incident-free radiation dose to those on and near the highway and radiation dose or chemical exposure from the cargo when the containers are breached following an accident.

This EIS is primarily concerned with determining a candidate DOE site for MPF. A second EIS would be prepared once a DOE site is identified for more detailed analysis. Accordingly, this EIS focuses on a limited suite of analyses that will most specifically aid decisionmakers in distinguishing transportation impacts among the five DOE sites under consideration. NNSA has selected for quantitative analysis incident-free radiation dose to workers and the public, accident radiation dose-risk (which includes the probability of the accident occurring) to all individuals affected by the accident, and traffic accident fatalities. In addition, the analysis presents a qualitative discussion on traffic impacts near the DOE facility under both construction and operations. Traffic impacts would result from commuting workers and construction deliveries. Other potential analytical endpoints are roughly proportional to the analyzed endpoints and would yield similar relative distinction among the five DOE sites.

Appendix D presents DOE's methodology in analyzing the selected analytical endpoints and provides some detail on the calculations, including the more important analytical parameters.

5.3.12.1 No Action Alternative

There are no activities at NTS under the No Action Alternative that are related to the Proposed Action.

5.3.12.2 Modern Pit Facility Alternative

Construction Impacts

Construction of the MPF at NTS would result in increased traffic due to commuting construction workers and deliveries of construction materials and equipment. Although this traffic increase would tend to exacerbate congestion on local roads, the increase would be small compared to the average daily traffic levels reported in Section 4.3.10 and would be temporary.

Operation Impacts

Radiological transportation under the MPF Alternative for NTS would include transport of pits from Pantex (near Amarillo, Texas) to NTS, recycle of enriched uranium parts to and from the Y-12 (Oak Ridge, Tennessee), return of pits and enriched uranium parts to Pantex, and shipment of TRU waste to WIPP (near Carlsbad, New Mexico). LLW would be disposed of at NTS (Nye County, Nevada). DOE's analysis includes options for 125, 250, and 450 ppy. Table 5.3.12.2–1 presents number of shipments for the MPF Alternative. Tables 5.3.12.2–2 and 5.3.12.2–3 present the incident-free impacts from this transportation. Tables 5.3.12.2–4 and 5.3.12.2–5 present the accident impacts.

Table 5.3.12.2–1. Number of Shipments per Year at NTS for the MPF Alternative

Transported Materials	125 ppy	250 ppy	450 ppy
Pits	14	28	50
EU Parts	10	20	36
TRU Waste	74	93	142
Total	**98**	**133**	**228**

EU = enriched uranium.

Table 5.3.12.2–2. Annual Incident-Free Transportation Impacts to Workers at NTS for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.16	6.4×10^{-5}	0.32	1.3×10^{-4}	0.58	2.3×10^{-4}
EU parts	0.24	9.4×10^{-5}	0.47	1.9×10^{-4}	0.85	3.4×10^{-4}
TRU waste	1.8	7.3×10^{-4}	2.3	9.2×10^{-4}	3.5	1.4×10^{-3}
Total	**2.2**	**9.0 ´ 10^{-4}**	**3.1**	**1.2 ´ 10^{-3}**	**4.9**	**2.0 ´ 10^{-3}**

The addition of 988-1,797 new employees under the three capacity options would represent an increase in NTS employment ranging from 45-82 percent, with a corresponding increase in commuting traffic. Although this traffic increase would tend to exacerbate the existing congestion on local roads, the increase is small compared to the average daily traffic level reported in Section 4.3.10.

Table 5.3.12.2–3. Annual Incident-Free Transportation Impacts to the General Public at NTS for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.19	9.5×10^{-5}	0.38	1.9×10^{-4}	0.68	3.4×10^{-4}
EU parts	0.32	1.6×10^{-4}	0.63	3.2×10^{-4}	1.10	5.7×10^{-4}
TRU waste	3.1	1.5×10^{-3}	3.9	1.9×10^{-3}	5.9	2.9×10^{-3}
Total	**3.6**	**1.8 ´ 10^{-3}**	**4.9**	**2.4 ´ 10^{-3}**	**7.7**	**3.9 ´ 10^{-3}**

Table 5.3.12.2–4. Annual Transportation Accident Radiological Impacts at NTS for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs
Pits	2.3×10^{-7}	1.1×10^{-10}	4.6×10^{-7}	2.3×10^{-10}	8.2×10^{-7}	4.1×10^{-10}
EU parts	2.9×10^{-10}	1.5×10^{-13}	5.8×10^{-10}	2.9×10^{-13}	1.1×10^{-9}	5.3×10^{-13}
TRU waste	9.2×10^{-4}	4.6×10^{-7}	1.2×10^{-3}	5.8×10^{-7}	1.8×10^{-3}	8.8×10^{-7}
Total	**9.2 ´ 10^{-4}**	**4.6 ´ 10^{-7}**	**1.2 ´ 10^{-3}**	**5.8 ´ 10^{-7}**	**1.8 ´ 10^{-3}**	**8.8 ´ 10^{-7}**

Table 5.3.12.2–5. Annual Nonradiological Fatalities from Traffic Accidents at NTS for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities	Number of Fatalities	Number of Accidents
Pits	4.2×10^{-3}	2.7×10^{-4}	8.5×10^{-3}	5.4×10^{-4}	0.015	9.6×10^{-4}
EU parts	7.0×10^{-3}	4.8×10^{-4}	0.014	9.7×10^{-4}	0.025	1.7×10^{-3}
TRU waste	0.016	1.3×10^{-3}	0.021	1.6×10^{-3}	0.031	2.4×10^{-3}
Total	**0.028**	**2.0 ´ 10^{-3}**	**0.043**	**3.1 ´ 10^{-3}**	**0.072**	**5.1 ´ 10^{-3}**

Sensitivity Analysis

Should DOE elect to operate a new 450-ppy facility at NTS in two shifts, the impacts would increase. The incident-free doses for the 450-ppy facility reported in Tables 5.3.12.2–2 and 5.3.12.2–3 would increase by approximately the factor 1.8 because the number of shipments would increase. The accident values in Table 5.3.12.2–4 would also increase by a factor of 1.8 because of the increased probability of the accident; however, the consequences of an accident, should one occur, would not change. The duration of traffic congestion during shift change would increase.

5.3.13 Waste Management

This section considers the burden that waste generation associated with construction and operations of MPF places on NTS waste treatment, storage, and disposal infrastructure. Impacts are evaluated based on routine waste generation, excluding wastes generated from environmental restoration or D&D activities. Impacts associated with transportation of radioactive waste from NTS to offsite disposal facilities are provided in Section 5.3.12.

5.3.13.1 No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change to the current and planned NTS waste management activities described in Section 4.3.11.

5.3.13.2 Modern Pit Facility Alternative

Construction Impacts

Construction of MPF would generate solid and liquid sanitary waste and liquid hazardous waste. Table 5.2.13.2–1 summarizes the total volume of waste generated over the 6 years of construction activity for the three proposed MPF operating capacities.

Table 5.3.13.2–1. Total Waste Generation From Construction of the MPF (m^3)

Waste Type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Hazardous waste	4.9	5.1	5.9
Sanitary waste	7,110	7,870	11,200
Sanitary wastewater	37,500	41,300	54,100

Source: MPF Data 2003.

MPF construction activities would moderately increase routine waste generation at NTS. Sanitary solid waste would increase by 23-36 percent and hazardous waste generation would increase by 3-4 percent over current NTS routine operations.

Nonhazardous wastes are currently disposed in three onsite landfills. The disposal location would be determined by the characteristics of MPF construction waste. Existing and planned disposal sites at NTS would have adequate capacity to handle MPF construction waste. For example, the projected sanitary waste volume represents less than 1.7 percent of the disposal capacity of the 9U-10c Solid Waste Disposal Site for construction and demolition debris (660,000 m^3 [23,307,900 ft^3]).

Hazardous wastes would be sent offsite for treatment and disposal at a commercial facility. Commercial treatment is readily available and currently used to treat most NTS hazardous wastes.

Sanitary wastewater generated during MPF construction would be disposed either by a septic system or by a lagoon system. Portable sanitary units would be used during the construction phase until the permanent wastewater system became available.

A detention pond would be constructed to manage stormwater runoff from the entire MPF site including the Construction Laydown Area and Concrete Batch Plant. The basin would be sized to limit stormwater discharge from the developed site to no greater than the pre-existing conditions, with a basin area of approximately 0.4 ha (1 ac) per 16 ha (40 ac) of developed land.

A Concrete Batch Plant would operate at the MPF site during the construction phase. The Concrete Batch Plant would include a basin to manage wastewater from equipment washout activities. The facility would be located on approximately 4 ha (10 ac) adjacent to the PIDAS. The Concrete Batch Plant would be disassembled and the area would be restored once MPF construction is completed.

Operations Impacts

Normal operation of the MPF would generate TRU waste, LLW, mixed LLW, hazardous waste, and sanitary waste. Table 5.3.13.2–2 summarizes the estimated waste generation rates for the three proposed MPF operating capacities.

Table 5.3.13.2–2. MPF Operations Annual Waste Generation (m^3)

Waste Type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
TRU waste	590	740	1,130
LLW	2,070	3,300	5,030
Mixed LLW—solid	1.5	2.0	3.5
Mixed LLW—liquid	0.2	0.4	0.7
Hazardous waste—solid	2.5	3.0	5.0
Hazardous waste—liquid	0.3	0.4	0.6
Sanitary waste	5,500	5,800	6,900
Sanitary wastewater	45,000	61,900	81,800

Source: MPF Data 2003.

NTS does not routinely generate TRU waste but manages about 600 m^3 (21,200 ft^3) of legacy waste that was transferred to NTS from offsite generators pending disposal at WIPP. DOE expects to complete disposition of the stored non-classified TRU waste at NTS prior to the timeframe of MPF construction and operations. TRU waste generated from plutonium pit manufacturing includes gloves, filters, and other operations/maintenance waste from MPF gloveboxes. Americium process waste would be solidified and packaged as TRU waste. About 36 percent of the TRU waste would be mixed waste. The waste would be transferred from the MPF process buildings to the Waste Staging/TRU Packaging Building, which would be located outside the PIDAS. The Waste Staging/TRU Packaging Building would include a staging area with capacity for approximately 1,200 TRU waste drums (about 250 m^3 [8,880 ft^3] of TRU waste). A drum loading area equipped with overhead bridge cranes would load the waste drums into TRUPACT-II shipping containers and load the TRUPACT-II containers onto trucks for transportation to WIPP. The size of the Waste Staging/TRU Packaging Building (approximately 1,950 m^2 [21,000 ft^2]) is not expected to vary with the MPF operating capacity. Section 6.5 discusses the availability of WIPP for disposal of TRU waste resulting from MPF operations.

NTS routinely generates little LLW but manages large volumes of LLW in its role as a national disposal site for the DOE complex. LLW from MPF operations would include job control waste, failed equipment, and other general operations/maintenance waste. Any liquid LLW resulting from MPF operations would be solidified prior to leaving the facility. The annual LLW generation for the three proposed MPF operating capacities represents 5.9, 9.5, and 14.5 percent, respectively, of the LLW volume disposed at NTS during 2001 (34,800 m^3 [1,229,000 ft^3]) (DOE 2002b). LLW would be transferred from MPF to the Area 5 Radioactive Waste Management

Site (RWMS) for characterization and certification prior to disposal at the RWMSs in Area 3 and Area 5. The capacity of these RWMSs (1,000,000 m^3 [35,315,000 ft^3]) could readily accommodate the projected LLW volume from MPF operations.

MPF operations would generate small amounts of hazardous waste and mixed LLW. These wastes include lead acid batteries, lubricating oils/fluids, rags, and sorbents. The projected hazardous waste volumes from MPF operations represent about 11-22 percent of the annual volumes routinely managed by NTS. The waste would be sent to the Hazardous Waste Storage Unit at Area 5 and then shipped offsite to a commercial facility for treatment and disposal. Commercial treatment is readily available and currently used to treat most NTS hazardous wastes. The impacts of managing this waste at NTS would be minimal.

NTS does not routinely generate mixed LLW but manages substantial volumes in its role as one of two national disposal sites for the DOE complex. Mixed LLW generated from MPF operations would be managed in accordance with the NTS Site Treatment Plan. The mixed LLW would be transferred to the Area 5 RWMS for characterization and identification of appropriate treatment. Once treated, the waste would be disposed onsite. The annual mixed LLW volume from MPF operations represents less than 0.004 percent of the disposal capacity (118,908 m^3 [4,199,200 ft^3]) and 0.021 percent of the anticipated permit limit (20,000 m^3 [706,300 ft^3]) for the Pit 3 disposal unit in Area 5. The impacts of managing this waste at NTS would be minimal.

Sanitary waste from MPF operations would be disposed at the onsite landfill in Area 23. The MPF waste would approximately double the annual routine waste volume from current NTS operations. The annual sanitary waste volume from MPF operations represents less than 3.3 percent of the disposal capacity (210,000 m^3 [7,416,200 ft^3]) for the landfill in Area 23 (DOE 2002c).

Sanitary wastewater generated during MPF operations would be disposed either by a septic system or by a lagoon system. The impacts of managing this waste at NTS would be minimal.

MPF operations are not expected to generate radioactive wastewater. However, the potential does exist for generating radioactively contaminated water from the operation and maintenance of safety showers in contamination areas, the operation of decontamination stations, the mopping of floors in contamination areas, and the testing of fire sprinkler systems located in contamination areas. Wastewaters that could potentially be contaminated would be collected, sampled, and analyzed prior to discharge. Any contaminated wastewater would be solidified by processing through the liquid-process waste facilities for the plutonium purification process (MPF Data 2003).

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the NTS waste management infrastructure from those described above for single-shift operation. Although this would substantially increase the NTS routine waste generation, the volumes resulting from double-shift operation are not expected to exceed the available capacities of the waste management facilities. See Section 6.5 for a discussion of the availability of WIPP for disposal of TRU waste resulting from MPF operations.

5.4 PANTEX SITE

The following sections discuss the environmental impacts associated with the No Action Alternative and the MPF Alternative at Pantex. The environmental impacts are presented below for each of the following environmental resource areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, and waste management.

5.4.1 Land Use and Visual Resources

5.4.1.1 Land Use

The proposed concept for MPF is a multibuilding aboveground configuration. There would be three separate process buildings: Material Receipt, Unpacking, and Storage; Feed Preparation; and Manufacturing. They would be flanked by a number of smaller support facilities which would include: the Analytical Support Building, Production Support Building, Process Building Entry Control Facilities, Operations Support Facilities, Engineering Support Facility, PIDAS, Safe Havens, Standby Diesel Generator Buildings, Diesel Fuel Storage Tank, Chillers/Chemical Feed and Chilled Water Pump Buildings, Cooling Towers, Alternate Power Electrical Transformers, Truck Loading Docks, Liquid Nitrogen/Argon Storage Tanks, Chemical Storage Tanks, Bottled Gas Storage and Metering Buildings, HVAC Exhaust Stacks, Waste Staging/TRU Packaging Building, Commodities Warehouse, Roads and Parking Areas, and a Runoff Detention Area. In addition to these structures, a Construction Laydown Area and a Concrete Batch Plant would be built for the construction phase only. Upon construction completion, they would be removed and the area would be returned to its original state.

All buildings would be either one or two stories. The site would require two HVAC exhaust stacks; the tallest, standing 30 m (100 ft), would be located inside the PIDAS. Facility exhausts would be HEPA-filtered prior to discharge through the stacks.

Under the multibuilding configuration, production rates would dictate the size of the facilities proposed. The three potential facility capacities are 125, 250, and 450 ppy. Required acreage for each of the facility capacities during construction and operations is presented in Table 5.2.1.1–1. As discussed in Section 3.1.2.4, these areas are for a generic campus type layout and the actual facility footprint covers much less area.

The MPF reference location at Pantex is a 36-ha (90-ac) tract of land just north of Zone 11 and south of Zone 4 West and Zone 4 East (see Figure 4.4.1.1–2). The land was cultivated until 1993 and replanted with native grasses in 1996. This tract of land is surrounded on all sides by a similar land use, open space. It is now considered a non-industrial, low maintenance area within the Protected Area boundaries.

No Action Alternative

Under the No Action Alternative, no new buildings or facilities would be built and there would be no impact on land use at the site.

Modern Pit Facility Alternative

Construction Impacts

Depending on the facility capacity, an estimated 56-69 ha (138-171 ac) of land for buildings, walkways, building access, parking, buffer space, and construction-related workspace would be required to construct the MPF. The land required for the proposed MPF construction would represent approximately 0.9-1.1 percent of Pantex's total land area of 62 km^2 (24 mi^2), a very small proportion. The 36-ha (90-ac) reference location has adequate space to handle the total facilities footprint and NNSA believes that, should Pantex be selected for the MPF site, the proposed facility design could be adapted to the space available.

Although there would be a change in land use, the proposed MPF is compatible and consistent with land use plans for this area. No impacts to Pantex land use plans or policies are expected.

Operations Impacts

Depending on the facility capacity, an estimated 44-56 ha (110-138 ac) of land for buildings, walkways, building access, parking, and buffer space would be required to operate the MPF. The reduction in required acreage from construction to operations represents the removal of the Construction Laydown Area and the Concrete Batch Plant upon construction completion. The land required for the proposed MPF operations would represent approximately 0.7-0.9 percent of Pantex's total land area of 62 km^2 (24 mi^2), a very small proportion. As detailed above, NNSA believes that, should Pantex be selected for the MPF site, the proposed facility design could be adapted to the space available.

Although there would be a change in land use, the proposed MPF is compatible and consistent with land use plans for this area. No impacts to Pantex land use plans or policies are expected.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not have any additional effect on land use for this alternative.

5.4.1.2 Visual Resources

No Action Alternative

Under the No Action Alternative, there would be no impact on visual resources at Pantex since no new facilities would be built.

Modern Pit Facility Alternative

Construction Impacts

Activities related to the construction of new buildings required for the MPF Alternative would result in a change to the visual appearance of the reference location due to the presence of construction equipment, new buildings in various stages of construction, and possibly increased dust. The reference location is obstructed from offsite view by existing buildings and infrastructure. However, dust and construction equipment mobilization may be visible to the general public. Members of the public, as well as onsite employees and visitors, observing MPF construction would find these activities temporary and similar to the past construction activities of other developed areas on the Pantex site. Thus, impacts on visual resources during construction would be minimal.

Operations Impacts

The MPF, which would include one- and two-story buildings, storage tanks, and two HVAC exhaust stacks, would change the appearance of the reference location. Located in the midst of the industrial complex, the facility would be visible to onsite employees and visitors, but not to the general public. The offsite view of MPF buildings would be obstructed by existing buildings and infrastructure. This change would be consistent with the currently developed areas of the Pantex site. Thus, new construction would not change the current Class IV BLM Visual Resource Management rating of developed areas within Pantex boundaries.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not change the layout or the physical features of the MPF reference location. Therefore, there would be no additional impacts to Visual Resources.

5.4.2 Site Infrastructure

This section describes the impact on site infrastructure at Pantex for the No Action Alternative and the modifications that would be needed for the construction and operations of the MPF Alternative. These impacts are evaluated by comparing current site infrastructure to key facility resource needs for the No Action Alternative and MPF Alternative.

5.4.2.1 No Action Alternative

Under the No Action Alternative, there would be no change to the site infrastructure at Pantex. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

5.4.2.2 Modern Pit Facility Alternative

Construction Impacts

The projected demand on key site infrastructure resources associated with construction activities of the three proposed plant sizes (125, 250, or 450 ppy) for the MPF Alternative on an annual basis are shown in Table 5.4.2.2–1. Existing infrastructure at Pantex would be sufficient to support annual construction requirements for the proposed plant sizes for the projected 6-year construction period. Infrastructure requirements for construction would have a negligible impact on current site infrastructure.

Table 5.4.2.2–1. Annual Site Infrastructure Requirements for Construction of MPF at Pantex

Proposed Alternatives	Electrical		Fuel		Process Gases
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Gases (m^3/yr)
Site capacity	**201,480**	**47.5**	**Not limited[a]**	**289,000,000**	**Not limited[a]**
Available site capacity	**119,630**	**33.9**	**Not limited**	**276,090,000**	**Not limited**
No Action Alternative					
Total site requirement	81,850	13.6	59,960	12,910,000	Not limited
Percent of site capacity	41%	29%	Not limited	5%	Not limited
MPF Alternative					
125 ppy					
Total site requirement	83,000	16.6	1,580,000	12,910,000	Not limited
Percent of site capacity	41%	35%	Not limited	5%	Not limited
Change from No Action	1,000	3	7,520,000	0	2,200
Percent of available capacity	0.8%	9%	Not limited	0	Not limited
Peak requirement	NA	NA	2,600,000	0	4,000
250 ppy					
Total site requirement	83,000	17.1	1,800,000	12,910,000	Not limited
Percent of site capacity	41%	36%	Not limited	5%	Not limited
Change from No Action	1,125	3.5	1,700,000	0	2,500
Percent of available capacity	0.9%	3%	Not limited	0	Not limited
Peak requirement	NA	NA	2,900,000	0	4,200
450 ppy					
Total site requirement	83,000	17.6	2,200,000	12,910,000	Not limited
Percent of site capacity	41%	37%	Not limited	5%	Not limited
Change from No Action	1,333	4	2,170,000	0	3,200
Percent of available capacity	1.1%	12%	Not limited	0	Not limited
Peak requirement	NA	NA	3,700,000	0	5,700

[a] Not limited due to offsite procurement.
NA = Not Applicable
Source: MPF Data 2003.

Operations Impacts

The estimated annual site infrastructure requirements for the pit production capacities of 125, 250, or 450 ppy are presented in Table 5.4.2.2–2. Existing site infrastructure would be adequate to support pit production capacities of 125 and 250 ppy. There would be significant impacts on site electrical energy for the production of 450 ppy. Available site electrical energy at Pantex would be exceeded by approximately 47 percent for the production of 450 ppy. Available peak load capacity would be exceeded by 8 percent. It is expected that additional electrical capacity could be procured from the electrical power provider to support the increased requirements. Impacts to fuel and process gases would be negligible.

Table 5.4.2.2–2. Annual Site Infrastructure Requirements for Facility Operations Under MPF at Pantex

Proposed Alternatives	Electrical		Fuel		Process Gases	
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Nitrogen (m^3/yr)	Argon (m^3/yr)
Site capacity	**201,480**	**47.5**	**Not limited[c]**	**289,000,000**	**Not limited[c]**	**Not limited[c]**
Available site capacity	**119,630**	**33.9**	**Not limited**	**276,090,000**	**Not limited**	**Not limited**
No Action Alternative[d]						
Total site requirement	81,850	13.6	59,960	12,910,000	Not limited	Not limited
Percent of site capacity	41%	29%	Not limited	5%	Not limited	Not limited
MPF Alternative						
125 ppy[a,b]						
Total site requirement	162,000	34.1	320,000	17,000,00		
Change from No Action	79,800	20.5%	260,000	4,400,000[d]	224,000	4,200
Percent of site capacity	80%	72%	Not limited	6%	Not limited	Not limited
Percent of available capacity	67%	60%	Not limited	2%	Not limited	Not limited
250 ppy[a,b]						
Total site requirement	196,000	37.1	420,000	18,000,000		
Change from No Action	114,000	23.5	360,000	4,990,000[d]	245,000	7,300
Percent of site capacity	97%	78%	Not limited	6%	Not limited	Not limited
Percent of available capacity	95%	69%	Not limited	2%	Not limited	Not limited
450 ppy[a,b]						
Total site requirement	257,000	50.1	640,000	21,000,000	Not limited	Not limited
Change from No Action	176,000	36.5	580,000	7,730,000[d]	303,000	11,800
Percent of site capacity	128%	105%	Not limited	7%	Not limited	Not limited
Percent of available capacity	147%	108%	Not limited	2%	Not limited	Not limited

[a] Peak load is based on electrical demands of HVAC, lighting, and miscellaneous electrical systems. Peak load and annual electrical consumption estimates for the three pit production capacities are based on ratioing SRS FY99 Pit Manufacturing data (MPF Data 2003) to the multiple facility sizes. Estimates based on 24 hrs/day, 365 days per year.
[b] Diesel fuel estimates based on vendor fuel consumption data ratioed for expected diesel generator size. Diesel generator testing of 1 hour per week.
[c] Not limited due to offsite procurement.
[d] Used to make steam.
Source: MPF Data 2003.

Sensitivity Analysis

Sufficient electrical energy capacity is not available at Pantex for surge use of two-shift operations. It is expected that additional electrical capacity could be procured from Southwestern Public Service to support the increased requirements. There would be negligible impacts to liquid fuel or process gases from surge production capacity.

5.4.3 Air Quality and Noise

5.4.3.1 Nonradiological Releases

No Action Alternative

Construction Impacts

There would be no nonradiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of criteria and toxic pollutants would continue to be generated. These emissions are part of the baseline described in Chapter 4. No increases in emissions or air pollutant concentrations are expected under the No Action Alternative. Therefore, a PSD increment analysis is not required.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because Pantex is located in an attainment area for all criteria pollutants; therefore, no conformity analysis is required.

Modern Pit Facility Alternative

Construction Impacts

Construction of new structures would result in temporary increases in air quality impacts from construction equipment, trucks, and employee vehicles. Exhaust emissions from these sources would result in releases of sulfur dioxide, nitrogen oxide, $PM_{10,}$ total suspended particulates, and carbon monoxide. The calculation of emissions from construction equipment was based on emission factors provided in the EPA document AP-42, “Compilation of Air Pollutant Emission Factors” (EPA 1995). For highway vehicles (worker commuting vehicles and delivery vehicles) emission factors were obtained from the EPA Mobile Source Emission Factor Model, MOBILE6.2 (EPA 2002).

Fugitive dust generated during the clearing, grading, and other earth-moving operations is dependent on a number of factors including silt and moisture content of the soil, wind speed, and area disturbed. A common procedure to estimate fugitive emissions from an entire construction site is to use the EPA emission factor of 2.69 metric tons/ha (1.20 tons/ac) per month of activity (EPA 1995). This emission factor represents total suspended particulates (i.e., particles less than 30 microns in diameter). A multiplication factor of 0.75 was used to correct the emission rate to one for PM_{10} (EPA 1995). Also, it was assumed that water would be applied to disturbed areas. This would reduce emission rates by about 50 percent. Facility construction would necessitate a Concrete Batch Plant at the building site. Particulate matter, consisting primarily of cement dust, would be the only regulated pollutant emitted in the concrete mixing process. Emission factors for the Concrete Batch Plant were obtained from AP-42 (EPA 1995).

The estimated maximum annual pollutant emissions resulting from construction activities are presented in Table 5.2.3.1–1. Actual construction emissions are expected to be less, since conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the Pantex site boundary. Therefore, air quality impacts resulting from construction would be small.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.4.9, Human Health and Safety.

Operations Impacts

Pit manufacturing activities would result in the release of criteria and toxic pollutants into the surrounding air. The primary volume contributors are nitrogen and argon, used to maintain inert atmospheres for glovebox operations. Carbon dioxide would be used as a cleaning agent and helium would be used for leak testing operations. Hydrogen and nitrogen dioxide are reaction products from aqueous purification operations (pyrochemical purification would produce lower amounts of hydrogen and nitrogen dioxide). The chemicals used for dye-penetrate testing of welds are assumed to be volatilized and released to the atmosphere. Organic solvents used for cleaning and chemicals used in the Analytical Laboratory for various analyses would not be expected to contribute any appreciable quantities of any other chemicals to the annual nonradioactive air emissions. Air emissions from periodic functional testing support systems (primarily standby diesel generators) would include carbon monoxide, nitrogen dioxide, PM_{10}, sulfur dioxide, VOCs, and total suspended particulates (WSRC 2002e). The estimated emission rates (kg/yr) for nonradiological pollutants emitted under each of the three new facility scenarios are presented in Table 5.2.3.1–2. These emissions would be incremental to the Pantex baseline. If Pantex is selected as the preferred site, a PSD increment analysis would be performed under a project-specific tiered EIS to determine whether the pit manufacturing activities would cause a significant pollutant emission increase.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because Pantex is located in an attainment area for all criteria pollutants. Therefore, although each alternative would emit criteria pollutants, a conformity review is not necessary.

The maximum concentrations ($\mu g/m^3$) at the Pantex site boundary that would be associated with the release of criteria pollutants under each of the three plant capacity scenarios (i.e., 125, 250, and 450 ppy) were modeled and are presented in Table 5.4.3.1–1. These concentrations were compared to the most stringent (Federal or state) ambient air quality standards. For each of the three capacity scenarios, incremental concentration increases would be small. For most pollutants, there would be an incremental increase of less than 1 percent of the baseline. The greatest increase would occur for nitrogen dioxide under the 450 ppy scenario, but ambient concentrations would remain below the ambient air quality standard. Since estimated emissions are maximum potential emissions and all emergency generators would not operate at the same time, the estimated emissions and resulting concentrations are conservative.

Table 5.4.3.1–1. Criteria Pollutant Concentrations at the Pantex Site Boundary for the MPF—Operations

Pollutant	Averaging Period	Most Stringent Standard or Guideline [a] (μg/m³)	Maximum Incremental Concentration (μg/m³)[b]			
			Baseline [b]	MPF		
				125 ppy	250 ppy	450 ppy
Carbon monoxide	8-hour	10,000	161	4.1	5.7	9.3
	1-hour	40,000	924	5.9	8.2	13
Nitrogen dioxide	Annual	100	0.90	2.1	2.189	4.75
Sulfur dioxide	Annual	80	<0.01	0.15	0.2	0.33
	24-hour	365	<0.01	0.73	1.0	1.6
	3-hour	1,300	<0.01	1.6	2.2	3.7
PM_{10}	Annual	50	8.73	0.058	0.079	0.13
	24-hour	150	88.5	0.29	0.40	0.65
Total Suspended Particulates	3-hour	200	NA	0.16	0.21	0.35
	1-hour	400	NA	0.78	1.1	1.8

NA = not available.
[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] The No Action Alternative is represented by the baseline.
Source: MPF Data 2003, TAC 30.1.101.21.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.4.9, Human Health and Safety.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased releases of criteria pollutants. The increase in releases of criteria pollutants from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility releases. Similarly, the increase of criteria pollutants from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.4.3.1–1). A review of the maximum incremental concentrations in Table 5.3.4.1–1 indicates that if the maximum incremental concentration of each criteria pollutant for the 450 ppy facility were conservatively doubled for surge capacity, concentrations would still not approach the most stringent standards or guideline concentrations.

5.4.3.2 Radiological Releases

No Action Alternative

Construction Impacts

There would be no radiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of radionuclides would continue to be emitted. These emissions are part of the baseline described in Chapter 4. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.4.9, Human Health and Safety.

Modern Pit Facility Alternative

Construction Impacts

No radiological releases to the environment are expected in association with construction activities. However, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site preparation activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the nature and extent of any contamination and would be required to remediate any contamination in accordance with established site procedures.

Operations Impacts

Radioactive air emissions from pit manufacturing activities would involve plutonium, americium and enriched uranium. The pit manufacturing activities would be performed within gloveboxes or vaults for radiological containment, and include plutonium recovery using aqueous or pyrochemical processes, foundry, machining, assembly, post assembly operations, inspection and certification, waste handling, and preparing the final product (pits) for shipment. Analytical operations would normally be conducted in laboratories consisting of rooms with gloveboxes and hoods for radiological containment. Each laboratory module would be separated from occupied areas of the laboratory facility by airlocks. Sample transfers would occur using a vacuum tube transfer system from the Feed Preparation and Manufacturing Facilities to the Analytical Support Facility. The ventilation exhaust from process and laboratory facilities would be filtered through double banks of HEPA filters before being released to the air via a 30-m (100-ft) tall stack. HEPA filters are the best available control technology for particulate emissions and are capable of removing more than 99.99 percent of entrained particles from the exhaust air.

DOE estimated routine radionuclide air emissions for three different plant capacities: 125, 250, 450 ppy (see Table 5.4.3.2–1). Releases under each of the three capacity scenarios would be small. Total radionuclide emissions would increase by less than 0.016 percent. To ensure that total emissions are not underestimated, DOE's method for estimating emissions was conservative. Therefore, actual emissions from pit manufacturing operations would be smaller.

DOE estimated the radiation doses to the offsite MEI and the offsite population surrounding Pantex. As shown in Table 5.4.3.2–2, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The maximum estimated dose to the offsite population residing within an 80-km (50-mi) radius would also be very low. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.4.9, Human Health and Safety.

Table 5.4.3.2–1. Annual Radiological Air Emissions for the MPF at Pantex—Operations

Isotope	Annual Emissions (Ci/yr)			
	Baseline[a,b]	125 ppy	250 ppy	450 ppy
Americium-241	NA	2.08×10^{-7}	3.81×10^{-7}	7.61×10^{-7}
Plutonium-239	NA	7.72×10^{-6}	1.19×10^{-5}	2.05×10^{-5}
Plutonium-240	NA	2.01×10^{-6}	3.10×10^{-6}	5.35×10^{-6}
Plutonium-241	NA	1.48×10^{-4}	2.28×10^{-4}	3.94×10^{-4}
Uranium-234	6.47×10^{-11}	4.19×10^{-9}	5.58×10^{-9}	8.38×10^{-9}
Uranium-235	NA	1.32×10^{-10}	1.76×10^{-10}	2.64×10^{-10}
Uranium-236	NA	2.13×10^{-11}	2.84×10^{-11}	4.26×10^{-11}
Uranium-238	6.73×10^{-7}	1.18×10^{-12}	1.58×10^{-12}	2.36×10^{-12}
Tritium	2.714	---	---	---
All other	3.28×10^{-6}	---	---	---
Total	**2.714**	**1.58×10^{-4}**	**2.43×10^{-4}**	**4.21×10^{-4}**

NA = not available.
[a] The No Action Alternative is represented by the baseline.
[b] Onsite emissions only.
Source: WSRC 2002f.

Table 5.4.3.2–2. Annual Doses Due to Radiological Air Emissions from MPF Operations at Pantex

Receptor	125 ppy	250 ppy	450 ppy
Offsite MEI[a] (mrem/yr)	1.7×10^{-8}	2.8×10^{-8}	5.0×10^{-8}
Population within 80 km (person-rem per year)	1.2×10^{-7}	2.0×10^{-7}	3.6×10^{-7}

[a] The offsite MEI is assumed to reside at the site boundary.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased radiological air emissions. The increase in radiological air emissions from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility emissions. Similarly, the increase in radiological air emissions from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.4.3.2–1). Surge capacity of the 450 ppy plant is expected to be approximately 810 pits. A review of the annual radiological emissions in Table 5.4.3.2–2 indicates that if the emissions for the 450 ppy facility were conservatively doubled, concentrations would remain very low. The additional dose represented by these emissions would be well below regulatory limits.

5.4.3.3 Noise

No Action Alternative

Construction Impacts

Under the No Action Alternative, continuing operations at Pantex would not involve any new construction. Thus, there would be no impacts from construction noise on wildlife or the public.

Operations Impacts

The noise-generating activities described in Section 4.2.3.4 would continue. These noise-generating activities are included in the Pantex baseline and are not expected to change under the No Action Alternative.

Modern Pit Facility Alternative

Construction Impacts

Construction of new buildings would involve the movement of workers and construction equipment and would result in some temporary increase in noise levels near the area. Noise sources associated with construction at Area 6 would not include loud impulsive sources such as blasting. Although noise levels in construction areas could be as high as 110 dBA, these high local noise levels would not extend far beyond the boundaries of the construction site. Table 5.2.3.3–1 shows the attenuation of construction noise over relatively short distances. At 122 m (400 ft) from the construction site, construction noises would range from approximately 55-85 dBA. The *Environmental Impact Data Book* (Golden et al. 1980) suggests that noise levels higher than 80-85 dBA are sufficient to startle or frighten birds and small mammals. Thus, there would be little potential for disturbing wildlife outside a 122-m (400-ft) radius of the construction site. Given the distance to the site boundary (2.5 km [1.6 mi]), there would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Operations Impacts

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise impacts from pit manufacturing operations at the new buildings would be expected to be similar to those from existing operations. There would be an increase in equipment noise (e.g., heating and cooling systems, generators, vents, motors, material-handling equipment) from pit manufacturing activities. However, given the distance to the site boundary (about 2.5 km [1.6 mi]), noise emissions from equipment would not likely disturb the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources (e.g., public address systems and testing of radiation and fire alarms) could have onsite impacts, such as the disturbance of wildlife. But these noise sources would be intermittent and would not be expected to disturb wildlife outside of facility boundaries. Traffic noise associated with the operation of these facilities would occur onsite and along offsite local and regional transportation routes used to bring materials and workers to the site. Noise from traffic associated with the operation of these facilities would likely produce less than a 1-dBA increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance to the public. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, 450 ppy) for the MPF.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Sensitivity Analysis

If any of the three facilities operated at surge capacity, a second shift would be added. However, because of the distance of the facilities to the site boundary, noise from second-shift operations would not be noticeable offsite. Second-shift worker traffic would slightly increase noise levels on local roads. However, most material deliveries would likely occur during normal business hours, so there would be no increase in noise from truck traffic during the second shift. Impacts would be similar for each of the three plant capacities analyzed. Second-shift workers would be exposed to the same level of noise as first-shift workers. DOE would implement the same hearing protection programs for the second shift as used for the first. The second shift would not affect worker hearing.

5.4.4 Water Resources

Environmental impacts associated with the proposed alternatives at Pantex could affect groundwater resources. No impacts to surface water are expected. At Pantex, groundwater resources would be used to meet all construction and operations water requirements. Table 5.4.4–1 summarizes existing surface water and groundwater resources, the total Pantex site-wide water resource requirement for each alternative, and the potential changes to water resources at Pantex resulting from the proposed alternatives.

Table 5.4.4–1. Potential Changes to Water Resources from MPF at Pantex

Affected Resource Indicator	No Action[a]	MPF Alternative		
		125 ppy Single-Shift Operation	250 ppy Single-Shift Operation	450 ppy Single-Shift Operation
Construction – *Water Availability and Use*				
Water source	Ground	Ground	Ground	Ground
Total site-wide water operation requirement (million L/yr)	492	502.7	503.8	508.3
Percent change from No Action water use (492 million L/yr)	NA	2.2%	2.4%	3.3%
Water Quality				
Wastewater discharge into lagoons and ponds (million L/yr)	141	143	143	144
Percent change from No Action Alternative wastewater discharge	NA	26.6%	29.3%	38.4%
Operations – *Water Availability and Use*				
Water source	Ground	Ground	Ground	Ground
Total site-wide water operation requirement (million L/yr)	492	769.4	821.9	996.3
Percent change from No Action water use (492 million L/yr)	NA	56.4%	67.0%	102.5%
Water Quality				
Wastewater discharge into lagoons and ponds (million L/yr)	141	186.0	202.9	222.8
Percent change from No Action Alternative Wastewater discharge (141 million L/yr)	NA	31.9%	43.9%	58.0%
Floodplain				
Actions in 100-year floodplain	NA	None	None	None
Actions in 500-year floodplain	NA	None	None	None

All discharges to natural drainages require NPDES permits.
NA = not applicable.
million L/yr = million liters per year.
[a]Source: DOE 2002k.
Source: MPF Data 2003.

5.4.4.1 Surface Water

No Action Alternative

No additional impacts on surface water resources are anticipated at Pantex under the No Action Alternative beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Surface water would not be used to support the construction of the MPF Alternative at the Pantex as groundwater is the source of water at Pantex. Therefore, there would be no impact to surface water availability from construction. Sanitary wastewater would be generated by construction personnel. As plans include use of portable toilets, onsite discharge of sanitary wastewater would be minimized.

During construction, an estimated total of 37.5 million L (9.9 million gal), 41.26 million L (10.9 million gal), and 54.13 million L (14.3 million gal) of liquid wastes would be generated for the 125 ppy, 250 ppy, and 450 ppy facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal generation of liquid waste over that timeframe, it is estimated that approximately 6.25 million L/yr (1.65 million gal/yr), 6.88 million L/yr (1.82 million gal/yr), and 9.02 million L/yr (2.38 million gal/yr) of liquid waste would be generated for the 125, 250, and 450 ppy facilities, respectively. It is estimated that one-third of the liquid wastes generated during construction would be from sanitary wastewater, with the remaining amount attributed to concrete construction activities. Water runoff from construction would be handled according to Pantex's NPDES permit for stormwater involving construction activities.

Stormwater runoff from construction areas could potentially impact downstream surface water quality, although runoff would likely be collected in detention ponds. In addition, appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) would be employed during construction to minimize suspended sediment and material transport, as well as potential water quality impacts. Pantex would comply with Federal and state regulations to prevent, control, and handle potential spills from construction activities. However, the MPF reference location is not located near any surface water; therefore, no impacts to surface water from potential construction-related spills would be expected.

Floodplains at the Pantex site have been delineated. The MPF reference location at Pantex is not within the 100- or 500-year floodplains, or the Standard Project Flood boundaries. Therefore, no impacts to floodplains would be anticipated, nor would project facilities be expected to be impacted by flooding.

Operations Impacts

No impacts on surface water resources would be expected as a result of MPF operations at Pantex. No surface water would be used to support facility activities, and there would be no discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of operations stemming from staff use of lavatory, shower, and breakroom facilities, and from miscellaneous potable and sanitary uses. It is estimated that 45.0 million L (11.9 million gal), 61.9 million L (16.4 million gal), and 81.8 million L (21.6 million gal) of sanitary wastewater would be generated for the 125 ppy, 250 ppy, and 450 ppy facilities, respectively. These quantities would represent 31.9 percent, 43.9 percent, and 58.0 percent increases in sanitary wastewater discharges, respectively. Pantex's current NPDES permit may require modification and approval concerning the increase in wastewater discharges. The sanitary wastewater would be treated in the Wastewater Treatment Facility (WWTF) and disposed of via land application for the irrigation of crops in cooperation with the Texas Tech University Research Farm. No industrial or other NPDES-regulated discharges to surface waters are anticipated.

The MPF would not generate any radioactive water emissions. However, there is a potential for generating radioactive contaminated water from the operation and maintenance of safety showers in contaminated areas, the operation of decontamination stations, the mopping of floors in contaminated areas, and the testing of fire sprinkler systems located in contaminated areas. Wastewater that has the potential for being radioactively contaminated would be collected, sampled, and analyzed prior to discharge. Radioactive wastewater would be converted to a solid and disposed of in accordance with DOE procedures. The water emissions that are sampled, analyzed, and determined to be contaminated can be converted to a solid by processing through the MPF liquid-process waste facilities for the plutonium purification process.

Sensitivity Analysis

For a 450 ppy facility working a double shift, more wastewater would be generated by the increased number of workers. The sanitary wastewater treatment system would require appropriate modifications to handle the increase in flow.

5.4.4.2 Groundwater

No Action Alternative

No additional impacts on groundwater availability or quality are anticipated at Pantex under the No Action Alternative beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and meeting the potable and sanitary needs of construction employees. The proposed use of portable toilets by construction personnel would greatly reduce water over that normally required by construction activities. In addition, water required for concrete mixing would likely be procured offsite. As a result, it is estimated that construction activities would require a total of approximately 71.92 million L (19 million gal), 79.49 million L (21 million gal), and 109.79 million L (29 million gal) of groundwater for the 125 ppy, 250 ppy, and 450 ppy capacity facilities, respectively, mainly to support MPF construction. It is expected that construction should take approximately 6 years. Assuming an equal usage over that timeframe, it is estimated that approximately 10.7 million L (2.8 million gal), 11.8 million L (3.1 million gal), and 16.3 million L (4.3 million gal) would be needed for the 125, 250, and 450 ppy facilities, respectively. The total site water requirement including these quantities would be no more than a 3.3 percent increase compared to the No Action Alternative and would be within Pantex's water capacity of approximately 1.6 billion L (437.7 million gal). It is anticipated that this water would be derived from Pantex's groundwater distribution system via a temporary service connection or trucked to the point-of-use, especially during the early stages of construction.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls and countermeasure plans would be employed to minimize the chance of petroleum, oils, lubricants, and other materials used during construction being released to the surface or subsurface and to ensure that waste materials are properly disposed. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts

Activities at Pantex for the MPF Alternative would use groundwater primarily to meet the potable and sanitary needs of facility personnel and for cooling tower water makeup. A summary of water need by category and total is listed in Table 5.4.4.2–1. The percent change in water consumption from the No Action Alternative ranges from 56.4 to 102.5. The Pantex wellfield has a water capacity of approximately 1.6 billion L/yr (422.6 million gal/yr), and the range of the additional amount of water needed for the operation of the MPF is from 17.3-31.5 percent of the current water capacity. For comparison, in 2001, the City of Amarillo withdrew 26.23 billion L (6.93 billion gal) of water from the Amarillo City Wellfield. Pantex, governed by the Panhandle Groundwater Conservation District No. 3, does not limit the quantity of water pumped from the aquifer.

Table 5.4.4.2–1. Summary of Water Consumption During Operations at Pantex (million L)

	125 ppy	250 ppy	450 ppy
Domestic Water	44.9	61.7	81.6
Cooling Tower Makeup	232.5	267.8	422.7
Total	**277.4**	**329.5**	**504.3**
Total needed for site operation	769.4	821.9	996.3
Percent Change from No Action Alternative	56.4%	67.0%	102.5%

Source: MPF Data 2003.

No sanitary or industrial effluent would be discharged to the subsurface. Therefore, no operational impacts on groundwater quality would be expected.

Routine chemical additives would be added to the domestic water to control bacteria and pH, as well as to cooling tower water makeup for bacteria and corrosion control. Table 5.4.4.2–2 summarizes the chemicals added. Use of these chemicals is standard and no adverse impacts would be expected.

Table 5.4.4.2–2. Chemical Additives to Domestic Water and Cooling Tower Water Makeup (kg)

Chemical	125 ppy	250 ppy	450 ppy
Water Chemicals			
Sodium hypochlorite	90	124	164
Sodium hydroxide	58	80	106
Polyphosphate	180	247	327
Cooling Tower Makeup			
Betz Slimicide	120	130	210
Betz 25K series (corrosion inhibitor)	7,000	8,000	12,700

Source: MPF Data 2003.

Sensitivity Analysis

The double shift for 450 ppy would cause a significant increase in water use over the 450 ppy single shift, which is already a 102.5 percent increase in water use at the site. This total amount for the single-shift alternative, however, is approximately 62 percent of the Pantex wellfield capacity of 1.6 billion L (422.6 million gal). It is likely that the 450 ppy double-shift water requirement would approach Pantex's capacity.

5.4.5 Geology and Soils

5.4.5.1 No Action Alternative

Under the No Action Alternative, no additional impacts on geology and soils are anticipated at Pantex. The environmental impacts and operations (current and planned) described in Chapter 4 would continue. Hazards from large-scale geologic conditions, such as earthquakes, and from other site geologic conditions with the potential to affect existing Pantex facilities are summarized in Section 4.4.5 and further detailed in the *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons* (DOE 1996d).

5.4.5.2 Modern Pit Facility Alternative

Construction Impacts

The construction of the MPF is expected to disturb land adjacent to existing facilities at Pantex. Table 5.2.5.2–1 shows the amount of disturbance for the three different plant sizes. The major differences in the three facility layouts are in the sizes of the detention basin, Construction Laydown Area, and the roads and parking. The area of disturbance was calculated by extending the MPF area 9 m (30 ft) from the surrounding roads and the borders of the construction area and Concrete Batch Plant.

While the soils that would be disturbed are classified as prime farmland, the disturbed area would not be converted from framing to other purposes as it is not presently farmed. The *Farmland Protection Policy Act* (FPPA) (7 USC 4201 *et seq*.) and associated regulations require agencies to make evaluations of the conversion of farmland to non-agricultural uses by Federal projects and programs. Pantex is exempt from FPPA under section 1540(c)(4) since the acquisition of Pantex property occurred prior to FPPA's effective date of June 22, 1982 (7 USC 4201 *et seq*.).

Aggregate and other geologic resources (e.g., sand) would be required to support construction activities at Pantex, but these resources are abundant in the Amarillo area. In addition to new facility construction and upgrades, excavation to remove and replace some existing utility systems would also be conducted. The land area to be disturbed is relatively small, the impact on geologic and soil resources would be relatively minor. The potential exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the site's Environmental Restoration Program and in accordance with appropriate requirements and agreements. Construction of the MPF would require a stormwater permit that would address erosion control measures to minimize the impacts of erosion.

As discussed in Section 4.4.5, the faults located in the vicinity of Pantex have little potential for earthquakes. Ground shaking affecting primarily the integrity of inadequately designed or nonreinforced structures might occur, but shaking capable of damaging or slightly damaging properly or specially designed or upgraded facilities is not expected.

Operations Impacts

The operation of the MPF at any of the three capacities would not be expected to result in impacts on geologic and soil resources. New, upgraded, and modified facilities would be evaluated, designed, and constructed in accordance with DOE Order 420.1, which requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Sensitivity Analysis

Utilizing the 450 ppy facility for two-shift operations would not impact geologic or soil resources. A second shift of workers would use the same parking lot as the first shift. No increase in the size of the parking lot is foreseen.

5.4.6 Biological Resources

5.4.6.1 Terrestrial Resources

No Action Alternative

Under the No Action Alternative, impacts on terrestrial resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing Pantex environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with MPF.

Modern Pit Facility Alternative

Construction Impacts

The area identified for construction of MPF is classified as a previously cultivated area that has been replanted with native grasses. This tract of land is surrounded by similar land use on all sides, which is wide-open space. The land was last cultivated in 1993 and was planted to native short grasses in 1996 (Robbins 2002). The current state of the altered shortgrass prairie is reflective of conditions of the Southern High Plains of Texas that contain relatively little native undisturbed grassland. Land in the Texas Panhandle, which surrounds Pantex, is used for agricultural purposes and does not support extensive populations of endemic shortgrass prairie wildlife. The remaining undisturbed playas are “islands” of wildlife habitat, allowing the continued existence of many species. The 2002 revision of the *Integrated Plan for Playa Management at Pantex Plant* (BWXT 2002b) calls for adaptive management for species diversity that is consistent with the shortgrass prairie ecosystem of the Southern High Plains. Cultivation, intensive grazing, and invasion of honey mesquite (*Prosopis glandulosa*) have changed species diversity and supporting habitat. Consequently, the importance of managed shortgrass prairie has increased for wildlife and plant species. Thus, preservation and management of remaining grassland is an important goal for biotic community protection. This management issue takes on special significance because few federally managed public lands occur on the Southern High Plains, an important part of the Central Flyway for migratory birds.

Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of primarily shortgrass prairie and habitat would be cleared or modified during MPF construction. During site-clearing activities, highly mobile wildlife species, such as some mammals and birds, would be able to relocate to adjacent, less developed areas. However, successful relocation may not occur due to competition for resources to support the increased population and the carrying capacity limitations of areas outside the proposed development. For less mobile species (reptiles and small mammals), direct mortality could occur on a very small scale during the actual construction event or ultimately result from habitat alteration. Acreage used for the development also would be lost as potential hunting habitat for raptors and other predators.

Operations Impacts

Impacts to terrestrial resources would be very similar regardless of the level of pit production operations (potential pit production capacities of 125, 250, and 450 ppy including surge capacities). The major difference is the size of the modification or loss of shortgrass prairie plant communities and wildlife habitat. The acreage modified or lost would range from 44-56 ha (110-138 ac) depending upon pit production capacity. In addition to the areas to be disturbed, there could be impacts to wildlife in habitat immediately adjacent to the proposed development due to increased noise level, traffic, lights, and other human activity, both pre- and post-construction. Further loss of shortgrass prairie habitat on the site is of regional and local concern due to fragmentation of habitat. However, adverse impacts to wildlife due to the loss of grassland in the highly industrialized Zone 11 would be negligible.

There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect terrestrial resources. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential for any adverse affects to plant and animal communities (terrestrial resources) in the surrounding environment.

Sensitivity Analysis

There would be minimal impacts to terrestrial resources during the two-shift operations. Wildlife road strikes (vehicle and wildlife collisions) may increase during morning and evening shift changes due to more vehicle traffic coupled with decreased visibility and higher wildlife activity.

5.4.6.2 Wetlands

No Action Alternative

Under the No Action Alternative, there would be no impacts to wetlands because no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

The two nearest wetlands to the proposed MPF reference location are Playa 1 and Playa 2. Measuring from the center of the MPF site, the center of Playa 1 is approximately 1,176 m (3,860 ft) northeast and the center of Playa 2 is approximately 1,584 m (5,200 ft) west (Robbins 2002). There would be no direct impacts to wetlands as there are no wetlands within the area proposed for construction of the MPF or any of the associated construction staging and laydown areas. Implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan would avoid the indirect degradation of Playas 1 and 2.

Operations Impacts

There would be no adverse impacts predicted to wetlands from implementation of any of the MPF production capacities. There would be no direct untreated effluent discharges to the environment. With implementation and adherence to administrative procedures, along with facility design and engineering controls, MPF operations are not expected to adversely affect Playa 1, Playa 2, or other wetlands.

Sensitivity Analysis

There would be no impacts to wetlands during the two-shift operations.

5.4.6.3 Aquatic Resources

No Action Alternative

Under the No Action Alternative, impacts on aquatic resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and Pantex operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

There are no perennial or seasonal aquatic habitats within the proposed MPF reference location. Thus, there would be no direct impacts to aquatic resources. Indirect effects to aquatic resources downslope and within the Pantex watershed would be avoided by implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan.

Operations Impacts

There would be no direct discharge of untreated operational effluent from MPF operations. Stormwater runoff from new facilities, roadways, parking lots, and other impervious areas is not predicted to result in any indirect adverse impacts on area aquatic resources. The quality of runoff waters would be similar to runoff from other Pantex built environments and the quantity would represent a very minor contribution to the watershed.

Sensitivity Analysis

There would be no impacts to aquatic resources during the two-shift operations.

5.4.6.4 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, impacts to threatened and endangered species and other special interest species would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not associated with the MPF.

Modern Pit Facility Alternative

Section 7 of the *Endangered Species Act* requires all Federal agencies to ensure that actions they authorize, fund, or carry out do not jeopardize the continued existence of endangered or threatened species. Agencies must assess potential impacts and determine if proposed projects may affect federally-listed or proposed-for-listing species. Table 4.4.6.4–1 identifies those Federal- and state-threatened and endangered listed species and other special interest species that occur or may occur within Carson County and Pantex.

Construction Impacts

Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of restored shortgrass vegetation and habitat would be cleared or modified during MPF construction. It is highly probable that several special-interest species are present or use the area for foraging or hunting. Acreage temporarily modified from construction would be lost as potential habitat, foraging areas, or hunting habitat for special interest avian, mammalian, and reptile species until the area revegetates. Revegetation would probably occur within a 1-3 year timeframe depending upon site maintenance and climate conditions.

Operations Impacts

Depending upon pit production capacity, acreage permanently modified or lost as habitat, foraging areas, or as a prey base for species of special interest would range from 44-56 ha (110-138 ac). There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect special-interest species. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential impacts to any individual within a special-interest species population.

However, there is similar habitat in more remote parts of the Pantex Site, and the USFWS has told Pantex that construction within Zones 11 and 12 would not have adverse impacts on threatened and endangered species. The contractor would be advised to move any Texas horned lizards encountered during fieldwork and to notify the Pantex Regulatory Compliance Department should any bird nests be discovered during fieldwork.

Sensitivity Analysis

There would be no impacts to threatened and endangered species during the two-shift operations.

5.4.7 Cultural and Paleontological Resources

5.4.7.1 Cultural Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to prehistoric, historic, or Native American cultural resources. The cultural resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Under this alternative, a block of land would be disturbed during construction of MPF. The size of the disturbed area would vary by the output of the facility, and would include Pantex buildings and structures (inside the PIDAS fence), security fencing and perimeter roads, support buildings and parking, a detention basin, a Concrete Batch Plant, a Construction Laydown Area, and a 9-m (30-ft) wide buffer zone surrounding the facility. For purposes of analyzing impacts to cultural resources, the three sizes of disturbed areas would be 61 ha (152 ac) (125 ppy), 63 ha (156 ac) (250 ppy), and 74 ha (182 ac) (450 ppy).

No cultural resources would be impacted during construction of the MPF at the reference location. Probabilities for resource impacts at other areas on the Pantex Site would depend on the locations, since some areas (near playas or in developed areas) can exhibit a higher density of cultural resources. Although the number of resources that would be impacted is unknown, the probability for resource impacts would increase with an increase in the number of acres disturbed.

Because the exact location of the MPF at Pantex is not yet determined, cultural resources impacts arising from construction (such as water, sewer, gas, electricity, access roads) are not analyzed here. They will be analyzed in the site-specific EIS. However, like the facility itself, the greater the number of acres disturbed, the greater the possibility for impacts to cultural resources.

Prior to any ground-disturbing activity, DOE would identify and evaluate any cultural resources that could potentially be impacted by the construction of MPF. Methods for identification could include field survey, shovel tests, archival research, and consultation with interested Native American tribes. DOE would determine the possibility for impacts to the resources and implement appropriate measures to avoid, reduce, or mitigate the impacts. Identification, evaluation, determination of impact, and implementation of measures would be conducted in consultation with the Texas SHPO and in accordance with the Cultural Resource Management Plan. If previously unknown cultural resources, such as subsurface resources, are discovered during construction, activities in the area of the discovery would stop and the discovery would be evaluated and treated appropriately, as determined by DOE in consultation with the Texas SHPO.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on cultural resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on cultural resources.

5.4.7.2 Paleontological Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to paleontological resources. The paleontological resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Limited Late-Pleistocene fossil remains have been identified near Pantex boundaries. Thus, there is a possibility that paleontological resources would be impacted due to construction of the MPF or the associated infrastructure at the reference location. This is also true for any other area at Pantex. The probability for impacts to paleontological resources would increase with an increase in the number of acres disturbed.

Paleontological resources would be included in the scope of any cultural resource inventories conducted prior to the beginning of construction. If previously unknown paleontological resources are discovered during construction, activities in the area of the discovery would stop and the discovery would be treated appropriately, as determined by DOE.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on paleontological resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on paleontological resources.

5.4.8 Socioeconomics

5.4.8.1 Regional Economy Characteristics

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at Pantex. Therefore, there would be no impacts to the ROI employment, income, or labor force in the area.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. Construction of the facility to produce 125 ppy would require a total of 2,650 man-years of labor. During peak construction, 770 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that 660 indirect jobs would be created, for a total of 1,430 jobs. This represents approximately 1.3 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that many of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 550 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

The ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $26,100 for the construction industry, direct income would increase by $20.1 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $34.2 million ($20.1 million direct and $14.1 million indirect).

Facility–250 ppy. Construction of the facility to produce 250 ppy would require a total of 2,950 man-years of labor. During peak construction, 850 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 730 indirect jobs would be created, for a total of 1,580 jobs. This represents approximately 1.4 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that many of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 630 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

The ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $26,100 for the construction industry, direct income would increase by $22.2 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $37.8 million ($22.2 million direct and $15.6 million indirect).

Facility–450 ppy. Construction of the facility to produce 450 ppy would require a total of 3,800 man-years of labor. During peak construction, 1,100 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 940 indirect jobs would be created, for a total of 2,040 jobs. This represents less than 2 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that many of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 880 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

The ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $26,100 for the construction industry, direct income would increase by $28.7 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $48.9 million ($28.7 million direct and $20.2 million indirect).

Operations Impacts

Facility–125 ppy. Operation of the facility to produce 125 ppy would require 988 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that 710 indirect jobs would be created, for a total of approximately 1,700 jobs. This represents approximately 1.5 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 540 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

The ROI income would increase 1.1 percent as a result of the new jobs created. Based on the ROI average earnings of $36,500 for the government services industry, direct income would increase by $36.1 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $61.8 million ($36.1 million direct and $25.7 million indirect).

Facility–250 ppy. Operation of the facility to produce 250 ppy would require 1,358 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that 980 indirect jobs would be created, for a total of 2,340 jobs. This represents approximately 20 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 910 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

The ROI income would increase 1.5 percent as a result of the new jobs created. Based on the ROI average earnings of $36,500 for the government services industry, direct income would increase by $49.6 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $84.9 million ($49.6 million direct and $35.3 million indirect).

Facility–450 ppy. Operation of the facility to produce 450 ppy would require 1,797 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 1,290 indirect jobs would be created, for a total of 3,090 jobs. This represents approximately 2.7 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 1,350 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

The ROI income would increase 2 percent as a result of the new jobs created. Based on the ROI average earnings of $36,500 for the government services industry, direct income would increase by $65.6 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $112.3 million ($65.6 million direct and $46.7 million indirect).

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income.

5.4.8.2 Population and Housing

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at Pantex. Therefore, there would be no impacts to the ROI population or housing market.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,400 new residents would be expected in the ROI, including workers and their families. This is less than a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–250 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,600 new residents would be expected in the ROI, including workers and their families. This is less than a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–450 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 2,300 new residents would be expected in the ROI, including workers and their families. This is a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Operations Impacts

Facility–125 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,400 new residents would be expected in the ROI, including workers and their families. This is less than a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–250 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 2,400 new residents would be expected in the ROI, including workers and their families. This is a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–450 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 3,500 new residents would be expected in the ROI, including workers and their families. This is a 1.5 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. There would be additional impacts to the ROI population and additional stress on the local housing market because most of these workers would come from outside the ROI.

5.4.8.3 Community Services

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at Pantex. Therefore, there would be no impacts to the ROI community services.

Modern Pit Facility Alternative

Construction Impacts

Facility–125, 250, or 450 ppy. The increase in population would put an increased demand on local community services. Because the population would increase by less than 1 percent, comparable levels of service could be maintained without increased staffing.

Operations Impacts

Facility–125, 250, or 450 ppy. The increase in population would not increase demand on local community services. Because the population would increase by less than 1.5 percent, comparable levels of service could be maintained without increased staffing.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. There would be additional impacts to the ROI population and additional stress on the local community services because most of these workers would come from outside the ROI.

5.4.9 Human Health and Safety

5.4.9.1 Radiological Impacts

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in Pantex operations.

Construction Impacts

Under the No Action Alternative, there would be no radiological impacts on members of the public or workers because this alternative would not involve any construction.

Operations Impacts

Under the No Action Alternative, the radiological releases to the environment from Pantex would continue at the same rates described in Section 4.4.9. The associated impacts on the general public living within 80 km (50 mi) of Pantex and the offsite MEI would continue at the levels shown in Table 4.4.9.1–2. As shown in that table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The fatal cancer risk to the offsite MEI due to radiological releases from Pantex operations is estimated to be 8.1×10^{-11}, while 7.9×10^{-7} excess fatal cancers are projected in the population living within 80 km (50 mi) of Pantex from normal Pantex operations.

Under this alternative, the radiation dose received by Pantex workers would continue at the rates described in Section 4.4.9. These worker radiation doses at Pantex for the year 2000 are presented in Table 4.4.9.1–3. The number of projected fatal cancers among Pantex workers from normal operations in 2000 is 0.014.

Modern Pit Facility Alternative

Construction Impacts

No radiological risks would be incurred by members of the public from construction activities. Construction workers could be at a small radiological risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site, including that associated with residual contamination at the facilities being upgraded. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as reasonably achievable.

Operations Impacts

Impacts to the Public. DOE expects minimal public health impacts from the radiological consequences of MPF operations. Public radiation doses would likely occur from airborne releases only (Section 5.4.3). Table 5.4.9.1–1 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

Table 5.4.9.1–1. Annual Radiological Impacts on the Public from MPF Operations at Pantex for All Three Pit Production Rates

Receptor	125 ppy	250 ppy	450 ppy
Population within 80 km			
Collective dose (person-rem)	1.2×10^{-7}	2.0×10^{-7}	3.6×10^{-7}
Percent of natural background radiation[a]	0.000000000088%	0.00000000014%	0.00000000025%
LCFs[b]	6.2×10^{-11}	1.0×10^{-10}	1.8×10^{-10}
Offsite MEI[c]			
Dose (mrem)	1.7×10^{-8}	2.8×10^{-8}	5.0×10^{-8}
Percent of regulatory dose limit	0.00000017%	0.00000028%	0.00000050%
Percent of natural background radiation[a]	0.0000000051%	0.0000000084%	0.000000015%
Cancer fatality risk[b]	8.5×10^{-15}	1.4×10^{-14}	2.5×10^{-14}

[a] The average annual dose from background radiation at Pantex is 335 mrem (see Section 4.4.9); the 422,287 people living within 80 km (50 mi) of Pantex in the year 2043 would receive an annual dose of 141,466 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 LCFs per person-rem.
[c] The offsite MEI is assumed to reside at the site boundary, 3,610 m (11,844 ft) north from the MPF an actual residence may not currently be present at this location.

As shown in the table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a LCF to this individual from operations would be less than or equal to 2.5×10^{-14} per year (i.e., about 1 chance in 40 trillion per year of a LCF). The projected number of fatal cancers to the population within 80 km (50 mi) would be less than or equal to 1.8×10^{-10} per year (i.e., about 1 chance in 5.6 billion per year of a LCF).

Impacts to Modern Pit Facility Workers. Estimates of annual radiological doses to workers involved with MPF operations are independent of geographical location. These dose estimates are solely a function of:

- The number of radiological workers, as determined in the development of the MPF staffing estimate for each throughput alternative. The current estimates were developed by application of a factor to the total workers for each workgroup based on operating experience in plutonium facilities. Approximately 60 percent of total operating staff are estimated to be radiological workers.

- The working dose rate at the glovebox surface for each unit operation or workstation. These dose rates were calculated based on the maximum mass (plutonium, americium) and form (metal, oxide) of material being handled. Standard "weapons grade" isotopic distribution, and americium content of 0.5 percent were assumed.

- The amount of time spent by direct operators/first line supervisors in the radiation area. This was determined from a time-motion estimate of direct "hands-in-gloves" labor required to perform each individual operation and the number of parts processed per year for a given pit production rate. Efficiency scaling factors were applied for various operations. For Foundry and Machining operations, this was assumed to be 50 percent; for Assembly and Post-Assembly & Testing, efficiencies were 90 percent.

As indicated above, the collective annual dose (mrem/yr) received by individual direct operators is calculated based on the number of operators required for the various production rates, the time spent in the radiation area, and the associated dose rates for each operation. The collective exposures for support group workers were added to these numbers and were calculated using empirical data that implies that exposure for these workers can be estimated as a percentage of direct operator exposure (e.g., Analytical Laboratory Technician ~25 percent of direct operator exposure). The average individual dose is calculated as the collective exposure divided by the estimated number of radiological workers for each throughput alternative.

The estimates of annual radiological doses to workers under each of the three pit production rates are provided in Table 5.4.9.1–2. As shown in the table, the annual doses to individual workers for all levels of production would be well below the DOE limit of 5,000 mrem (10 CFR 835.202) and the DOE-recommended control level of 1,000 mrem (10 CFR 835.1002). The projected number of fatal cancers in the workforce from annual operations involving 125 ppy would be 0.064 (or 1 chance in 16 that the worker population would experience a fatal cancer per year of operations). For rates of 250 ppy and 450 ppy, the projected number of fatal cancers would be 0.12 and 0.22, respectively (1 chance in 8 or 5, respectively, that the worker population would experience a fatal cancer per year of operations).

Table 5.4.9.1–2. Annual Radiological Impacts on MPF Workers at Pantex from Operations for All Three Pit Production Rates

Production Rate	125 ppy	250 ppy	450 ppy
Number of Radiological Workers	**550**	**800**	**1,100**
Individual Workers[a]			
Average individual dose, mrem/yr	290	390	510
Average worker cancer fatality risk[b]	1.2×10^{-4}	1.6×10^{-4}	2.0×10^{-4}
Worker Population			
Collective dose (person-rem)	160	310	560
Cancer fatality risk[b]	0.064	0.12	0.22

[a] The regulatory dose limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, the maximum annual dose to a worker would be kept below the DOE Control Level of 1,000 mrem/yr, as established in 10 CFR 835.1002. Further, DOE recommends that facilities adopt a more limiting 500-mrem/yr Administrative Control Level (DOE 1999e). To reduce doses to levels that are as low as reasonably achievable, an effective dose reduction plan would be enforced.

[b] Based on a cancer risk estimator of 0.0004 LCFs per person-rem.

Sensitivity Analysis

DOE could operate MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of MPF under any of the three capacities would approximately double the quantities of radioactive emissions from MPF presented for single-shift operation at each capacity. Thus, the calculated radiation dose and LCFs to the offsite MEI and the population living within 80 km (50 mi) of Pantex would approximately double.

Similarly, double-shift operation of MPF under any of the three capacities would approximately double the radiation dose to MPF workers presented for single-shift operation at each capacity. Thus, the calculated adverse health impacts to MPF workers would be approximately double.

5.4.9.2 Nonradiological Impacts

This section considers illness, injury, and fatality rates associated with construction and operation of the MPF on the Pantex workforce. Nonradiological impacts to workers were evaluated using occupational injury, illness, and fatality rates obtained from BLS, U.S. Department of Labor data. DOE values are historically lower than BLS values owing to the increased focus on safety fostered by complex-wide programs, including ISM and the VPP. Additionally, the small number of fatal accidents reported in the CAIRS makes associated calculated fatality rates statistically invalid.

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in injury, illness, and fatality trends currently observed at Pantex.

Modern Pit Facility Alternative

Construction Impacts

The potential risk of occupational injuries and fatalities to workers constructing the MPF would be expected to be bounded by injury and fatality rates for general industrial construction. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for both the peak workforce loading and for the duration of construction activities including site preparation (6¾ years). These values are shown below in Table 5.4.9.2–1.

No chemicals have been identified that would be a risk to members of the public from construction activities associated with any of the MPF operating capacities. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. Implementation of ISMS programs to construction activities would also decrease the potential for worker exposures by providing hazards identification and control measures for construction activities (WSRC 2002c).

Table 5.4.9.2–1. Injury, Illness, and Fatality Estimates for Construction of the MPF at Pantex

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Peak Annual Employment	770	850	1,100
Total Recordable Cases	66	73	95
Total Lost Workday Cases	32	35	46
Total Fatalities	0.16	0.17	0.023
Project Duration (6¾ years)			
Total Recordable Cases	228	254	328
Total Lost Workday Cases	110	122	157
Total Fatalities	0.54	0.60	0.78

Source: MPF Data 2003, BLS 2003b.

Operations Impacts

During normal (accident-free) operations, total facility staffing would range from approximately 988-1,797, depending on the operating capacity of the selected MPF. The potential risk of occupational injuries and fatalities to workers operating MPF would be expected to be bounded by injury and fatality rates for general chemical manufacturing. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for facility populations for each of the operating capacities. These values are shown below in Table 5.4.9.2–2.

Table 5.4.9.2–2. Injury, Illness, and Fatality Annual Estimates for Normal Operations of the MPF at Pantex

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Total Recordable Cases	43	59	78
Total Lost Workday Cases	22	30	40
Total Fatalities	0.04	0.05	0.07

Source: MPF Data 2003, BLS 2003b.

No chemical-related health impacts are associated with normal (accident-free) operations of the MPF at the three identified operating capacities. Initial screens for the hazard analysis did not result in the identification of any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by facility safety programs such as ISMS, work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness (WSRC 2002c).

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the Pantex Site illness and injury rates for facility associated activities. No chemical-related health impacts would be associated with this increase in operations.

5.4.10 Facility Accidents

This section presents the potential impacts on workers (both involved and non-involved) and the public due to potential accidents associated with operation of the MPF at Pantex. Additional details supporting the information presented here are provided in Appendix C.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.
- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.
- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, DOE predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident.

Emergency Preparedness

Each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

5.4.10.1 No Action Alternative

Under the No Action Alternative, all current activities would continue at existing levels. Potential accident scenarios for the No Action Alternative are addressed in existing documentation included by reference (DOE 1996c).

5.4.10.2 Modern Pit Facility Alternative

Radiological Impacts

DOE estimated radiological impacts to three receptors: (1) the MEI at the Pantex boundary; (2) the offsite population within 80 km (50 mi) of Pantex; and (3) a non-involved worker 1,000 m (3,281 ft) from the accident location. DOE did not evaluate total dose to non-involved workers because of the uncertain nature of worker locations at the time of the accident.

Tables 5.4.10.2–1 through 5.4.10.2–3 show the frequencies and consequences of the postulated set of accidents for the public (offsite MEI and the general population living within 80 km [50 mi] of the facility) and a hypothetical non-involved worker for the three pit production rates. The dose shown in the tables are calculated by the MACCS computer code based on accident data. The LCF values are calculated using a dose-to-LCF conversion factor. For the MEI and the population, the conversion factor is 0.0005 LCFs per rem or person-rem, respectively. For workers, the dose-to-risk conversion factor is 0.0004 LCFs per rem. If the dose to an MEI or worker exceeds 20 rem, the dose-to-risk conversion factor is doubled to 0.001 and 0.0008, respectively. Tables 5.4.10.2–4 through 5.4.10.2–6 show the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *Topical Report - Supporting Documentation for the Accident Impacts Presented in the Modern Pit Facility Environmental Impact Statement* (Tetra Tech 2003). The selection process, screening criteria used, and conservative estimates of material at risk and source term (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at the MPF. Thus, in the event that any other accident that was not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5.4.10.2–1. MPF Alternative Radiological Accident Frequency and Consequences at Pantex for 125 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	29.1	0.029	8,320	4.16	232	0.19
Fire in a Single Building						
1×10^{-4}	15	0.0075	3,920	1.96	140	0.11
Explosion in a Feed Casting Furnace						
1×10^{-2}	17.6	0.0088	4,590	2.3	164	0.13
Nuclear Criticality						
1×10^{-2}	6.4×10^{-5}	3.2×10^{-8}	0.012	6.0×10^{-6}	0.0006	2.4×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	1.2	0.00059	306	0.15	10.9	0.0044
Radioactive Material Spill						
1×10^{-2}	0.35	0.00018	91.9	0.046	3.28	0.0013

CRT = Cargo Restraint Transporter.
[a] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.
[b] Increased likelihood of LCF.
[c] Increased number of LCFs.

Table 5.4.10.2–2. MPF Alternative Radiological Accident Frequency and Consequences at Pantex for 250 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	30	0.03	8,570	4.29	239	0.19
Fire in a Single Building						
1×10^{-4}	15.5	0.0078	4,060	2.0	145	0.12
Explosion in a Feed Casting Furnace						
1×10^{-2}	17.6	0.0088	4,590	2.3	164	0.13
Nuclear criticality						
1×10^{-2}	6.4×10^{-5}	3.2×10^{-8}	0.012	6.0×10^{-6}	0.0006	2.4×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	1.2	0.00059	306	0.15	10.9	0.0044
Radioactive Material Spill						
1×10^{-2}	0.35	0.00018	91.9	0.046	3.28	0.0013

[a] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.
[b] Increased likelihood of LCF.
[c] Increased number of LCFs.

Table 5.4.10.2–3. MPF Alternative Radiological Accident Frequency and Consequences at Pantex for 450 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	57.7	0.058	16,500	8.25	460	0.37
Fire in a Single Building						
1×10^{-4}	30.2	0.03	7,880	3.94	281	0.23
Explosion in a Feed Casting Furnace						
1×10^{-2}	17.6	0.0088	4,590	2.3	164	0.13
Nuclear Criticality						
1×10^{-2}	6.4×10^{-5}	3.2×10^{-8}	0.012	6.0×10^{-6}	0.0006	2.4×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	2.34	0.0012	613	0.31	21.9	0.018
Radioactive Material Spill						
1×10^{-2}	0.35	0.00018	91.9	0.046	3.28	0.0013

[a] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.
[b] Increased likelihood of LCF.
[c] Increased number of LCFs.

The results of the accident analysis indicate potential consequences that exceed the DOE exposure guidelines of 25 rem for a member of the public at the nearest site boundary. The analyses in these cases for NEPA purposes are based on unmitigated releases of radioactive material to select a site for the MPF. Following the ROD and selection of a site, additional NEPA action would be taken that would identify specific mitigating features that would be incorporated in the MPF design to ensure compliance with DOE exposure guidelines. These could include procedural and equipment safety features, HEPA filtration systems, and other design features that would protect radioactive materials from accident conditions and contain any material that might be released. Upon completion of MPF NEPA actions, DOE would prepare safety analysis documentation such as a safety analysis report to further ensure that DOE exposure guidelines would not be exceeded. The results of the safety analysis report are reflected in facility and equipment design and defines an operating envelope and procedures to ensure public and worker safety. Once specific mitigation measures are incorporated into the MPF design and operating procedures, the potential consequences will not exceed the DOE exposure guidelines of 25 rem for a member of the public at the nearest site boundary for any of the site alternatives.

The accident with the highest risk to the offsite population (see Tables 5.4.10.2–4 through 5.410.2–6) is the explosion in a glovebox feed casting furnace for the 125 ppy, 250 ppy, and 450 ppy production cases. The increased number of LCFs in the offsite population would be 0.023 per year (i.e., about 1 chance in 43 per year of a LCF in the total population) for all three production cases. The highest risk of a LCF to an offsite MEI located at a distance of 3,615 m (11,860 ft) north of the accident would be 8.8×10^{-5} per year (i.e., about 1 chance in 11,300 per year of a LCF) for all three production cases. The highest risk of a LCF to a non-involved worker located 1,000 m (3,281 ft) from the accident would be 0.0013 per year (i.e., about 1 chance in 750 per year of a LCF) for all three production cases.

Table 5.4.10.2–4. Annual Cancer Risks Due to MPF Accidents at Pantex for 125 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	2.9×10^{-7}	4.2×10^{-5}	1.9×10^{-6}
Fire in a Single Building	7.5×10^{-7}	0.0002	1.1×10^{-5}
Explosion in a Feed Casting Furnace	8.8×10^{-5}	0.023	0.0013
Nuclear Criticality	3.2×10^{-10}	6.0×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	5.9×10^{-6}	0.0015	4.4×10^{-5}
Radioactive Spill Material	1.8×10^{-6}	0.00046	1.3×10^{-5}

[a] Increased likelihood of LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.

Table 5.4.10.2–5. Annual Cancer Risks Due to MPF Accidents at Pantex for 250 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	3.0×10^{-7}	4.3×10^{-5}	1.9×10^{-6}
Fire in a Single Building	7.8×10^{-7}	0.0002	1.2×10^{-5}
Explosion in a Feed Casting Furnace	8.8×10^{-5}	0.023	0.0013
Nuclear Criticality	3.2×10^{-10}	6.0×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	5.9×10^{-6}	0.0015	4.4×10^{-5}
Radioactive Spill Material	1.8×10^{-6}	0.00046	1.3×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.

Table 5.4.10.2–6. Annual Cancer Risks Due to MPF Accidents at Pantex for 450 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	5.8×10^{-7}	8.3×10^{-5}	3.7×10^{-6}
Fire in a Single Building	3.0×10^{-6}	0.0004	2.3×10^{-5}
Explosion in a Feed Casting Furnace	8.8×10^{-5}	0.023	0.0013
Nuclear Criticality	3.2×10^{-10}	6.0×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	1.2×10^{-5}	0.0031	0.00018
Radioactive Spill Material	1.8×10^{-6}	0.00046	1.3×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.

Hazardous Chemicals Impacts

DOE estimated the impacts of the potential release of the most hazardous chemicals used at the MPF. A chemical's vapor pressure, acceptable concentration (ERPG-2) and quantity available for release are factors used to rank a chemical's hazard. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Additional information on the evaporation and dispersion of each chemical is provided in Appendix C. Tables 5.4.10.2–7 through 5.4.10.2–9 provide information on each chemical and the frequency and consequences of an accidental release. The source term shown represents the amount of the chemical that is accidentally released. The American Industrial Hygiene Association defines ERPG-2 as the maximum airborne concentration below which 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. The distance from the release point to the points where the ERPG-2 concentration is reached in relation to the site boundary reflects the consequence of the chemical's release. As the distance to the ERPG-2 point increases, the potential number of persons onsite and offsite that may be exposed to concentrations in excess of ERPG-2 would be expected to increase. The distance to the nearest site boundary is 2.5 km (1.6 mi). None of the chemicals released in an accident would exceed ERPG-2 limits offsite.

Table 5.4.10.2–7. MPF Alternative Chemical Accident Frequency and Consequences at Pantex for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.5 km (ppm)	
Nitric acid	10,500	6	0.59	2.49	0.58	10^{-4}
Hydrofluoric acid	550	20	0.59	5.25	0.99	10^{-4}
Formic acid	1,500	10	0.16	0.37	0.87	10^{-4}

[a] Site boundary is at a distance of 2.5 km (1.5 mi) east.

Table 5.4.10.2–8. MPF Alternative Chemical Accident Frequency and Consequences at Pantex for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.5 km (ppm)	
Nitric acid	21,000	6	0.88	4.82	1.14	10^{-4}
Hydrofluoric acid	1,100	20	0.83	10.2	1.94	10^{-4}
Formic acid	3,000	10	0.22	0.72	0.17	10^{-4}

[a] Site boundary is at a distance of 2.5 km (1.5 mi) east.

Table 5.4.10.2–9. MPF Alternative Chemical Accident Frequency and Consequences at Pantex for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.5 km (ppm)	
Nitric acid	40,000	6	1.3	8.89	2.11	10^{-4}
Hydrofluoric acid	2,000	20	1.1	18.2	3.46	10^{-4}
Formic acid	5,500	10	0.3	1.28	0.3	10^{-4}

[a] Site boundary is at a distance of 2.5 km (1.5 mi) east.

Involved Worker Impacts

For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Prediction of potential health effects becomes increasingly difficult to quantify as the distance between the accident location and the receptor decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be acutely injured or killed by physical effects of the accident.

The number of workers that would be at the MPF during operations would range from 988-1,797 (including security guards). Each process facility within the MPF would have attached safe haven structures designed in accordance with a number of life safety, fire protection, and safeguards and security requirements. These structures are required for personnel protection during various accident scenarios and are made of reinforced concrete similar in design to the process building wall construction. They would be designed to accommodate 120 percent of the building occupancy for a number of hours and would require their own independent ventilation systems (WSRC 2002b).

The facility ventilation system would control dispersal of any airborne radiological debris from the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk of injury.

5.4.11 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as being Black or African American; American Indian or Alaska Native; Asian; Native Hawaiian and other Pacific Islander; or another non-White race; or persons of Hispanic or Latino ethnicity. Persons whose incomes are below the Federal poverty threshold are designated low-income.

At Pantex, the 80-km (50-mi) radius includes portions of Hartley, Moore, Hutchinson, Roberts, Oldham, Potter, Carson, Gray, Deaf Smith, Randall, Armstrong, Donley, Swisher, and Briscoe Counties in Texas. Table 5.4.11–1 provides the racial and ethnic composition of these counties based on the 2000 Census, as well as the number of people below the poverty level. Figure 5.4.11–1 shows the minority populations located with an 80-km (50-mi) radius of the site. Figure 5.4.11–2 shows the low-income populations located within the same 80-km (50-mi) radius. This study area corresponds to the region of potential radiological impacts. Figures 5.4.11–1 and 5.4.11–2 show the distribution of these populations throughout the area around the site.

In 2002, minority populations comprised 30.9 percent of the U.S. population and 43.7 percent of the Texas population. The percentage of minority populations in the area surrounding Pantex is 30.2 percent, less than that in the United States or Texas.

Low-income populations comprised 12.4 percent of the U.S. population, based on 1999 income, and 15.4 percent of the Texas population. Within the counties surrounding Pantex, 13.8 percent of the population lives below the poverty level.

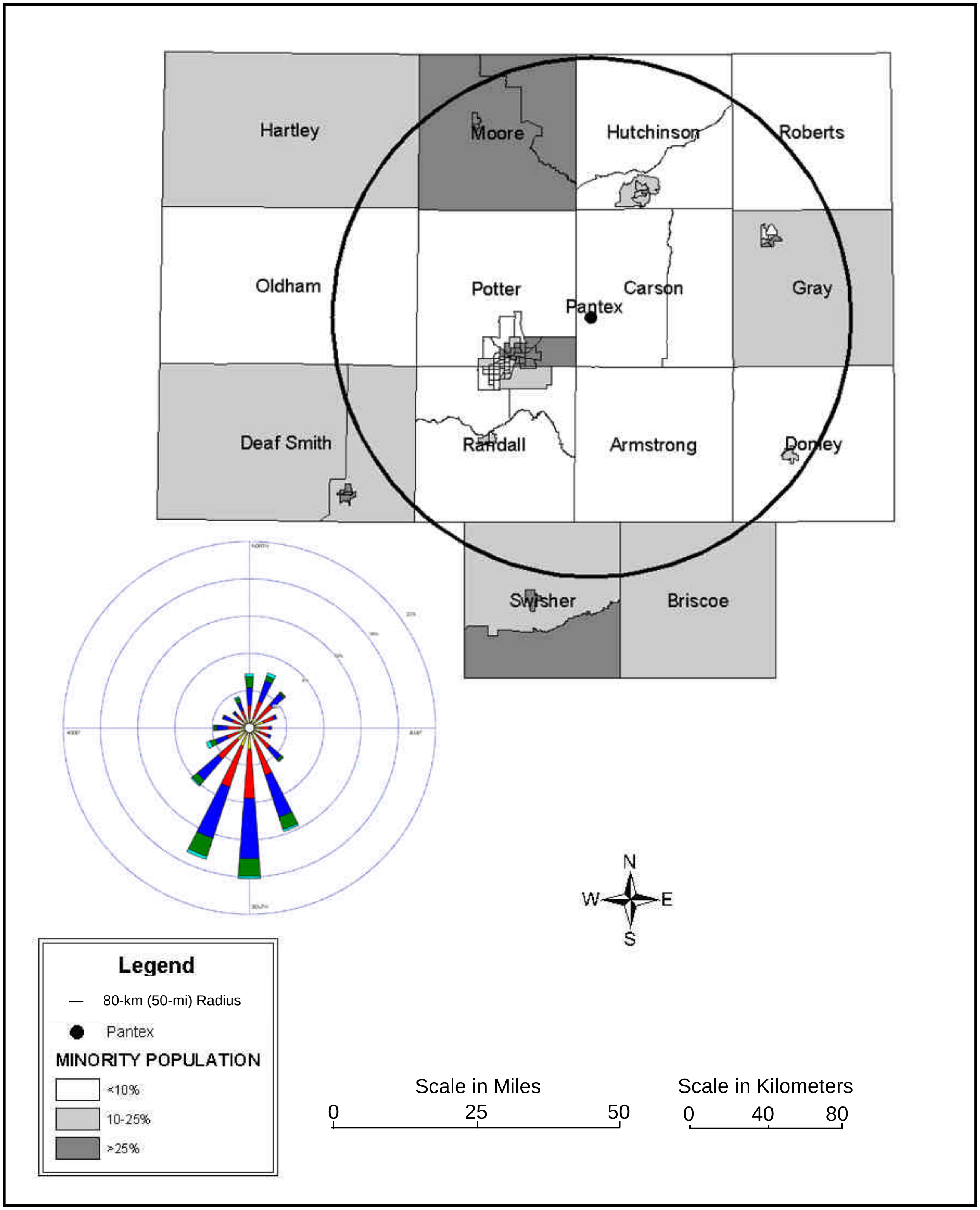

Figure 5.4.11–1. Distribution of the Minority Population Surrounding Pantex

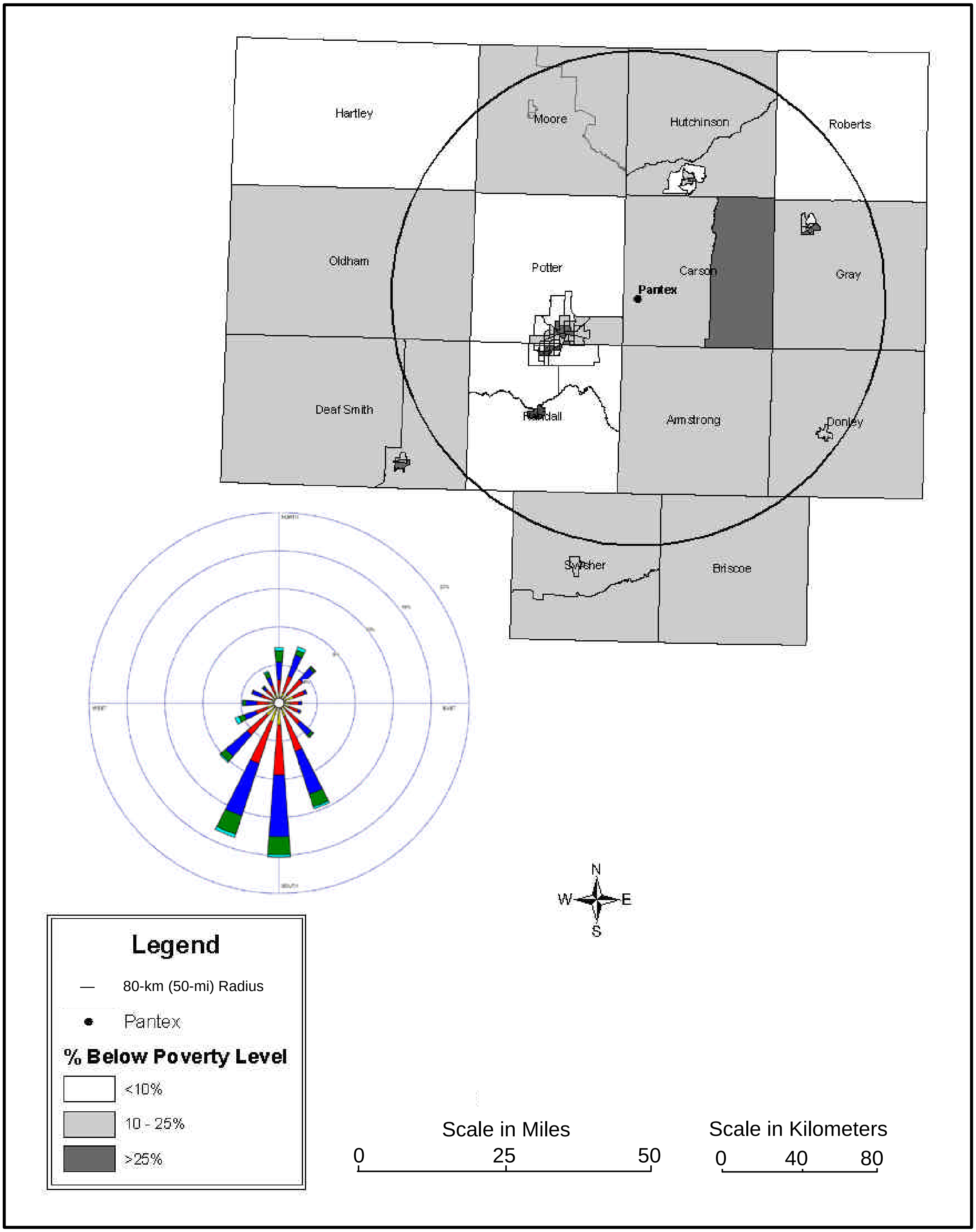

Figure 5.4.11–2. Distribution of the Low-Income Population Surrounding Pantex

Table 5.4.11–1. Racial, Ethnic, and Socioeconomic Composition Surrounding Pantex

Population Group	Population	Percent of Total
Hispanic or Latino	74,518	22.3
Black or African American	15,977	4.8
American Indian and Alaska Native	1,963	0.6
Asian	4,231	1.3
Native Hawaiian and Other Pacific Islander	68	0.0
Other Race	190	0.1
Two or More Races	3,710	1.1
White	233,753	69.9
Total	**334,410**	**100**

As shown in Section 5.4.9, Human Health and Safety, there are no large adverse impacts to any populations. Therefore, there would be no disproportionately high and adverse impacts to minority or low-income populations.

5.4.12 Transportation

Impacts to the human environment from transportation can result from two sources: operation of the vehicle and the presence of the cargo. Vehicle-related impacts could include increased emissions, traffic congestion, noise, and traffic accidents. Cargo-related impacts could include incident-free radiation dose to those on and near the highway and radiation dose or chemical exposure from the cargo when the containers are breached following an accident.

This EIS is primarily concerned with determining a candidate DOE site for the MPF. A second EIS would be prepared once a DOE site is identified for more detailed analysis. Accordingly, this EIS focuses on a limited suite of analyses that will most specifically aid decisionmakers in distinguishing transportation impacts among the five DOE sites under consideration. NNSA has selected for quantitative analysis incident-free radiation dose to workers and the public, accident radiation dose-risk (which includes the probability of the accident occurring) to all individuals affected by the accident, and traffic accident fatalities. In addition, the analysis presents a qualitative discussion on traffic impacts near the DOE facility under both construction and operations. Traffic impacts would result from commuting workers and construction deliveries.

Other potential analytical endpoints are roughly proportional to the analyzed endpoints and would yield similar relative distinction among the five DOE sites. Appendix D presents DOE's methodology in analyzing the selected analytical endpoints and provides some detail on the calculations, including the more important analytical parameters.

5.4.12.1 No Action Alternative

Under the No Action Alternative, transportation between Pantex and LANL would result in impacts that are assigned to LANL. See Section 5.2.12.1.

5.4.12.2 Modern Pit Facility Alternative

Construction Impacts

Construction of the MPF at Pantex would result in increased traffic due to commuting construction workers and deliveries of construction materials and equipment. Although this traffic increase would tend to increase congestion on local roads, the increase would be small compared to the average daily traffic levels reported in Section 4.4.10 and would be temporary.

Operations Impacts

Radiological transportation under the MPF Alternative for Pantex would include recycle of enriched uranium parts to and from the Y-12 (Oak Ridge, Tennessee), shipment of TRU waste to WIPP (near Carlsbad, New Mexico), and shipment of LLW to NTS (Nye County, Nevada). The pits would already reside at Pantex. DOE's analysis includes options for processing 125, 250, and 450 ppy. Table 5.4.12.2–1 presents the number of shipments for the MPF Alternative. Tables 5.4.12.2–2 and 5.4.12.2–3 present incident-free impacts from this transportation. Tables 5.4.12.2–4 and 5.4.12.2–5 present the accident impacts.

Table 5.4.12.2–1. Number of Shipments per Year at Pantex for the MPF Alternative

Transported Materials	125 ppy	250 ppy	450 ppy
EU Parts	10	20	36
TRU Waste	74	93	142
LLW	136	217	331
Total	**220**	**330**	**509**

EU = enriched uranium.

The addition of 988-1,797 new employees under the three capacity options would represent an increase in Pantex employment ranging from 33-59 percent, with a corresponding increase in commuting traffic. Although this traffic increase would tend to increase congestion on local roads, the increase is small compared to the average daily traffic levels reported in Section 4.4.10, and the roads have the capacity to absorb this additional traffic.

Sensitivity Analysis

Should DOE elect to operate a new 450 ppy facility at Pantex in two shifts, the impacts would increase. The incident-free doses for the 450 ppy facility reported in Tables 5.4.12.2–1 and 5.4.12.2–2 would increase by approximately the factor 1.8 because the numbers of shipments would increase. The accident values in Table 5.4.12.2–3 would also increase by a factor of 1.8 because of increased probability of the accident; however, the consequences of an accident, should one occur, would not change. The duration of traffic congestion during shift change would increase.

Table 5.4.12.2–2. Annual Incident-Free Transportation Impacts to Workers at Pantex for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
EU parts	0.12	4.9×10^{-5}	0.24	9.8×10^{-5}	0.44	1.8×10^{-4}
TRU waste	0.65	2.6×10^{-4}	0.81	3.3×10^{-4}	1.2	5.0×10^{-4}
LLW	3.5	1.4×10^{-4}	5.5	2.2×10^{-3}	8.4	3.4×10^{-3}
Total	**4.2**	**1.7 ´ 10^{-3}**	**6.6**	**2.6 ´ 10^{-3}**	**10**	**4.0 ´ 10^{-3}**

Table 5.4.12.2–3. Annual Incident-Free Transportation Impacts to the General Public at Pantex for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
EU parts	0.17	8.3×10^{-5}	0.33	1.7×10^{-4}	0.60	3.0×10^{-4}
TRU waste	1.1	5.4×10^{-4}	1.4	6.8×10^{-4}	2.1	1.0×10^{-3}
LLW	2.2	1.1×10^{-3}	3.5	1.7×10^{-3}	5.3	2.6×10^{-3}
Total	**3.4**	**1.7 ´ 10^{-3}**	**5.2**	**2.6 ´ 10^{-3}**	**8.0**	**4.0 ´ 10^{-3}**

Table 5.4.12.2–4. Annual Transportation Accident Radiological Impacts at Pantex for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs
EU parts	1.8×10^{-10}	9.0×10^{-14}	3.6×10^{-10}	1.8×10^{-13}	6.4×10^{-10}	3.2×10^{-13}
TRU waste	4.6×10^{-4}	2.3×10^{-7}	5.8×10^{-4}	2.9×10^{-7}	8.9×10^{-4}	2.9×10^{-7}
LLW	6.5×10^{-4}	3.2×10^{-7}	1.0×10^{-3}	5.2×10^{-7}	1.6×10^{-3}	5.2×10^{-7}
Total	**1.1 ´ 10^{-3}**	**5.5 ´ 10^{-7}**	**1.6 ´ 10^{-3}**	**8.1 ´ 10^{-7}**	**2.5 ´ 10^{-3}**	**8.1 ´ 10^{-7}**

Table 5.4.12.2–5. Annual Nonradiological Fatalities from Transportation Accidents at Pantex for the MPF Alternative

Transported Materials	125 ppy		250 ppy		450 ppy	
	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities
EU parts	4.2×10^{-3}	3.0×10^{-4}	8.4×10^{-3}	6.0×10^{-4}	0.015	1.1×10^{-3}
TRU waste	0.012	7.7×10^{-4}	0.015	9.6×10^{-4}	0.023	1.5×10^{-3}
LLW	0.041	2.6×10^{-4}	0.066	4.1×10^{-3}	0.10	6.3×10^{-3}
Total	**0.057**	**3.7 ´ 10^{-3}**	**0.089**	**5.7 ´ 10^{-3}**	**0.14**	**8.9 ´ 10^{-3}**

5.4.13 Waste Management

This section considers the burden that waste generation associated with construction and operations of MPF places on the Pantex waste treatment, storage, and disposal infrastructure. Impacts are evaluated based on routine waste generation, excluding wastes generated from environmental restoration or D&D activities. Impacts associated with transportation of radioactive waste from Pantex to offsite disposal facilities are provided in Section 5.3.12.

5.4.13.1 No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change to the current and planned Pantex waste management activities described in Section 4.4.11.

5.4.13.2 Modern Pit Facility Alternative

Construction Impacts

Construction of MPF would generate solid and liquid sanitary waste and liquid hazardous waste. Table 5.4.13.2–1 summarizes the total volume of waste generated over the 6 years of construction activity for the three proposed MPF operating capacities.

Table 5.4.13.2–1. Total Waste Generation from Construction of the MPF (m^3)

Waste Type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Hazardous waste	4.9	5.1	5.9
Sanitary waste	7,110	7,870	11,200
Sanitary wastewater	37,500	41,300	54,100

Source: MPF Data 2003.

MPF construction wastes would increase Pantex's annual routine hazardous waste generation by less than 1 percent. The hazardous waste would be sent offsite for treatment and disposal at a commercial facility. Commercial treatment is readily available and currently used to treat Pantex's hazardous waste. The onsite Hazardous Waste Treatment and Processing Facility (HWTPF) may also be used to treat hazardous waste generated from MPF construction activities.

Solid nonhazardous waste from MPF construction activities would result in a two- to threefold increase in the annual routine sanitary waste volume managed at Pantex. The waste would be disposed of onsite in the Construction Debris Landfill or at offsite facilities, such as the City of Amarillo Landfill. These disposal facilities, or their replacements, are expected to have adequate capacity to handle the projected amount of waste.

Sanitary wastewater generated during MPF construction would be treated in the onsite WWTF. DOE recently completed upgrades to this facility to provide flexibility to increase the treatment volume. The anticipated volume of sanitary wastes from MPF construction activities could be accommodated by the Pantex wastewater treatment system.

A detention pond would be constructed to manage stormwater runoff from the entire MPF site including the Construction Laydown Area and Concrete Batch Plant. The basin would be sized to limit stormwater discharge from the developed site to no greater than the pre-existing conditions, with a basin area of approximately 0.4 ha (1 ac) per 16 ha (40 ac) of developed land.

A Concrete Batch Plant would operate at the MPF site during the construction phase. The Concrete Batch Plant would include a basin to manage wastewater from equipment washout activities. The facility would be located on approximately 4 ha (10 ac) adjacent to the PIDAS. The Concrete Batch Plant would be disassembled and the area would be restored once MPF construction is completed.

Operations Impacts

Normal operation of the MPF would generate TRU waste, LLW, mixed LLW, hazardous waste, and sanitary waste. Table 5.4.13.2–2 summarizes the estimated waste generation rates for the three proposed MPF operating capacities.

Table 5.4.13.2–2. MPF Operations Annual Waste Generation (m^3)

Waste Type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
TRU waste	590	740	1,130
LLW	2,070	3,300	5,030
Mixed LLW—solid	1.5	2.0	3.5
Mixed LLW—liquid	0.2	0.4	0.7
Hazardous waste—solid	2.5	3.0	5.0
Hazardous waste—liquid	0.3	0.4	0.6
Sanitary waste	5,500	5,800	6,900
Sanitary wastewater	45,000	61,900	81,800

Source: MPF Data 2003.

Normal operations at Pantex do not generate TRU waste. While there are archived procedures to manage TRU waste if it were generated, there is no TRU waste management infrastructure at Pantex at this time. MPF operations would result in between 590-1,130 m^3 (20,836-39,906 ft^3) of TRU waste annually, depending on the operating capacity. TRU waste generated from plutonium pit manufacturing includes gloves, filters, and other operations/maintenance waste from the MPF gloveboxes. Americium process waste would be solidified and packaged as TRU waste. About 36 percent of the TRU waste would be mixed waste. The TRU waste would be transferred from the MPF process buildings to the Waste Staging/TRU Packaging Building, which would be located outside of the PIDAS. The Waste Staging/TRU Packaging Building would include a staging area with capacity for approximately 1,200 TRU waste drums (about 250 m^3 [8,800 ft^3] of TRU waste). A drum loading area equipped with overhead bridge cranes would load the waste drums into TRUPACT-II shipping containers and load the TRUPACT-II containers onto trucks for transport to WIPP. The size of the Waste Staging/TRU Packaging Building (approximately 1,950 m^2 [21,000 ft^3]) is not expected to vary with the MPF operating capacity. Section 6.5 discusses the availability of WIPP for disposal of TRU waste resulting from MPF operations.

LLW from MPF operations would include job control waste, failed equipment, and other general operations/maintenance waste. Any liquid LLW resulting from MPF operations would be solidified prior to leaving the facility. LLW generation for the three proposed MPF operating capacities would increase the annual routine LLW generation at Pantex by a factor of 25, 41, and 59, respectively. The LLW would be transferred to NTS for disposal. Due to the large increase in routine LLW generation, additional storage capacity would be needed to manage the waste until it can be shipped offsite for disposal. Section 5.4.12 describes the impacts for LLW transportation from Pantex to NTS.

MPF operations would generate small amounts of hazardous waste and mixed LLW. These wastes include lead acid batteries, lubricating oils/fluids, rags, and sorbents. The projected hazardous waste volumes from MPF operations represent about 2-4 percent of the annual routine waste volumes managed by Pantex. Commercial treatment is readily available and currently used to treat most Pantex hazardous wastes.

Pantex's routine mixed LLW generation is small. The majority of the mixed LLW is transferred offsite to commercial facilities for treatment and disposal. MPF operations would increase the annual routine mixed LLW generation by 20-48 percent over current Pantex operations. The waste would be managed in accordance with the Pantex Site Treatment Plan. The mixed LLW would be managed onsite at the HWTPF or shipped offsite to commercial facilities. The impact to the capacity of these onsite or commercial facilities would be small.

Nonhazardous waste from MPF operations includes sanitary solid waste and wastewater. Sanitary solid wastes would generally be disposed of at offsite facilities, such as the City of Amarillo Landfill. Some waste may be suitable for disposal onsite in the Construction Debris Landfill. Annual routine sanitary waste volumes would increase by a factor of 9-11 relative to current Pantex operations. This increase could accelerate the rate at which DOE consumed the available capacity of the onsite or offsite facilities.

Sanitary wastewater would be treated in the onsite WWTF. DOE recently completed upgrades to this facility to provide flexibility to increase the treatment volume. There would be adequate capacity to manage the sanitary wastewater from MPF operations.

MPF operations are not expected to generate radioactive wastewater. However, the potential does exist for generating radioactively contaminated water from the operation and maintenance of safety showers in contamination areas, the operation of decontamination stations, the mopping of floors in contamination areas, and the testing of fire sprinkler systems located in contamination areas. Wastewaters that could potentially be contaminated would be collected, sampled, and analyzed prior to discharge. Any contaminated wastewater would be solidified by processing through the liquid-process waste facilities for the plutonium purification process (MPF Data 2003).

Sensitivity Analysis

DOE could elect to operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the waste management infrastructure from those described above for the single-shift operation. The projected waste volumes from MPF operations would substantially increase Pantex's routine waste generation. Potential impacts include the need to expand onsite storage capacity for LLW and accelerate the rate at which onsite or offsite waste disposal capacity is consumed. See Section 6.5 for a discussion of the availability of WIPP for disposal of TRU waste resulting from MPF operations.

5.5 SAVANNAH RIVER SITE

The following sections discuss the environmental impacts associated with the No Action Alternative and the MPF Alternative at SRS. The environmental impacts are presented below for each of the following environmental resource areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, and waste management.

5.5.1 Land Use and Visual Resources

5.5.1.1 Land Use

The proposed concept for MPF is a multibuilding aboveground configuration. There would be three separate process buildings: Material Receipt, Unpacking, and Storage; Feed Preparation; and Manufacturing. They would be flanked by a number of smaller support facilities which would include: the Analytical Support Building, Production Support Building, Process Building Entry Control Facilities, Operations Support Facilities, Engineering Support Facility, PIDAS, Safe Havens, Standby Diesel Generator Buildings, Diesel Fuel Storage Tank, Chillers/Chemical Feed and Chilled Water Pump Buildings, Cooling Towers, Alternate Power Electrical Transformers, Truck Loading Docks, Liquid Nitrogen/Argon Storage Tanks, Chemical Storage Tanks, Bottled Gas Storage and Metering Buildings, HVAC Exhaust Stacks, Waste Staging/TRU Packaging Building, Commodities Warehouse, Roads and Parking Areas, and a Runoff Detention Area. In addition to these structures, a Construction Laydown Area and a Concrete Batch Plant would be built for the construction phase only. Upon construction completion, they would be removed and the area would be returned to its original state.

All buildings would be either one or two stories. The site would require two HVAC exhaust stacks; the tallest, standing 30 m (100 ft), would be located inside the PIDAS. Facility exhausts would be HEPA-filtered prior to discharge through the stacks.

Under the multibuilding configuration, production rates would dictate the size of the facilities proposed. The three potential facility capacities are 125, 250, and 450 ppy. Required acreage for each of the facility capacities during construction and operations is presented in Table 5.2.1.1–1.

The MPF reference location at SRS is a 32-ha (80-ac) tract immediately south of Road C near Burma Road. The site is flat and located on a topographic divide so surface drainage is both west toward Upper Three Runs and east toward Fourmile Branch streams. The reference location would be located on land categorized as Site Industrial (see Figure 4.5.1.1–3).

No Action Alternative

Under the No Action Alternative, no new buildings or facilities would be built and there would be no impact on land use at the site.

Modern Pit Facility Alternative

Construction Impacts

Depending on the facility capacity, an estimated 56-69 ha (138-171 ac) of land for buildings, walkways, building access, parking, buffer space, and construction-related workspace would be required to construct the MPF. The land required for the proposed MPF construction would represent approximately 0.07-0.09 percent of SRS's total land area of 803 km^2 (310 mi^2), an extremely small proportion. The 32-ha (80-ac) reference location has adequate space to accommodate the total facilities footprint and, NNSA believes that, should SRS be selected for the MPF site, the proposed facility design could be adapted to the space available or the site acreage reference location expanded to fit design.

Although there would be a change in land use, the proposed MPF is compatible and consistent with land use plans and the current land use designation, Site Industrial, for this area. No impacts to SRS land use plans or policies are expected.

Operations Impacts

Depending on the facility capacity, an estimated 44-56 ha (110-138 ac) of land for buildings, walkways, building access, parking, and buffer space would be required to operate the MPF. The reduction in required acreage from construction to operations represents the removal of the Construction Laydown Area and the Concrete Batch Plant upon construction completion. The land required for the proposed MPF operations would represent approximately 0.06-0.07 percent of SRS's total land area of 803 km^2 (310 mi^2), an extremely small proportion. As detailed above, DOE believes that, should SRS be selected for the MPF site, the proposed facility design could be adapted to the space available.

Although there would be a change in land use, the proposed MPF is compatible and consistent with land use plans and the current land use designation, Site Industrial, for this area. No impacts to SRS land use plans or policies are expected.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not have any additional effect on land use for this alternative.

5.5.1.2 Visual Resources

No Action Alternative

Under the No Action Alternative, there would be no impact on visual resources at SRS since no new facilities would be built.

Modern Pit Facility Alternative

Construction Impacts

Activities related to the construction of new buildings required for the MPF Alternative would result in a change to the visual appearance of the reference location due to the presence of construction equipment, new buildings in various stages of construction, and possibly increased dust. These changes would be temporary and, because of its interior location on the SRS site, would not be noticeable beyond the SRS boundary. Site visitors and employees observing MPF construction would find these activities similar to the past construction activities of other developed areas on the SRS. Thus, impacts on visual resources during construction would be minimal.

Operations Impacts

The MPF, which would include one- and two-story buildings, storage tanks, and two HVAC exhaust stacks, would change the appearance of the reference location. Views of the buildings, tanks, and exhaust stacks by visitors or employees using the SRS road network (Road C and Burma Road) would be limited by the forest vegetation and rolling terrain surrounding the location. Only the exhaust stacks would exceed the height of the forest vegetation. However, this change would be consistent with the currently developed areas of SRS.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not change the layout or physical features of the MPF reference location. Therefore, there would be no additional impacts to Visual Resources.

5.5.2 Site Infrastructure

This section describes the impact on site infrastructure at SRS for the No Action Alternative and the modifications that would be needed for the construction and operation of the MPF Alternative. These impacts are evaluated by comparing current site infrastructure to key facility resource needs for the No Action Alternative and the MPF Alternative.

5.5.2.1 No Action Alternative

Under the No Action Alternative, there would be no change to the site infrastructure at SRS. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

5.5.2.2 Modern Pit Facility Alternative

Construction Impacts

The projected demand on key site infrastructure resources associated with construction activities of the three proposed plant sizes (125, 250, or 450 ppy) for the MPF Alternative on an annual basis are shown in Table 5.5.2.2–1. Existing infrastructure at SRS would be adequate to support annual construction requirements for the proposed plant sizes for the projected 6-year construction period. Infrastructure requirements for construction would have a negligible impact on current site infrastructure resources.

Table 5.5.2.2–1. Annual Site Infrastructure Requirements for Construction of MPF at SRS

Proposed Alternatives	Electrical		Fuel		Process Gases
	Energy (MWh/yr)	Peak Load (Mwe)	Liquid (L/yr)	Coal (metric tons/yr)	Gases (m^3/yr)
Site capacity	4,400,000	330	Not limited[a]	Not limited[a]	Not limited[a]
Available site capacity	4,030,000	260	Not limited	Not limited	Not limited
No Action Alternative					
Total site requirement	370,000	70	28,400,000	210,000	
Percent of site capacity	8%	21%	Not limited	Not limited	Not limited
MPF Alternative					
125 ppy					
Total site requirement	370,000	73	30,000,000	210,000	
Percent of site capacity	10%	22%	Not limited	Not limited	Not limited
Change from No Action	1,000	3	1,520,000	0	2,200
Percent of available capacity	0.02%	1%	Not limited	Not limited	Not limited
Peak requirement	NA	NA	2,600,000	0	4,000
250 ppy					
Total site requirement	370,000	73.5	30,000,000	210,000	
Percent of site capacity	10%	22%	Not limited	Not limited	Not limited
Change from No Action	1,125	3.5	1,700,000	0	2,500
Percent of available capacity	0.03%	1%	Not limited	Not limited	Not limited
Peak requirement	NA	NA	2,900,000	0	4,200
450 ppy					
Total site requirement	370,000	74	30,000,000	210,000	
Percent of site capacity	10%	22%	Not limited	Not limited	Not limited
Change from No Action	1,333	4	2,170,000	0	3,200
Percent of available capacity	0.03%	2%	Not limited	Not limited	Not limited
Peak requirement	NA	NA	3,700,000	0	5,700

[a] Not limited due to offsite procurement.
NA = Not applicable.
Source: MPF Data 2003.

Operations Impacts

The estimated annual site infrastructure requirements for the pit production capacities of 125, 250, or 450 ppy are presented in Table 5.5.2.2–2. There would be negligible impacts to site infrastructure. Existing site infrastructure would be adequate to support all pit production capacities.

Sensitivity Analysis

Site infrastructure at SRS is more than adequate to meet the infrastructure requirements for surge use of two-shift operations. Impacts to site infrastructure from surge output are expected to be minor.

Table 5.5.2.2–2. Annual Site Infrastructure Requirements for Facility Operations Under MPF at SRS

Proposed Alternatives	Electrical		Fuel		Process Gases	
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Coal (metric tons/yr)	Nitrogen (m^3/yr)	Argon (m^3/yr)
Site capacity	**4,400,000**	**330**	**Not limited[c]**	**Not limited[c]**	**Not limited[c]**	**Not limited[c]**
Available site capacity	**4,030,000**	**260**	**Not limited**	**Not limited**	**Not limited**	**Not limited**
No Action Alternative						
Total site requirement	370,000	70	28,400,000	210,000	Not limited	Not limited[c]
Percent of site capacity	8%	21%	Not limited	Not limited	Not limited	Not limited
MPF Alternative						
125 ppy[a,b]						
Total site requirement	449,800	90.5	28,600,000	213,000	Not limited	Not limited
Percent of site capacity	10%	27%	Not limited	Not limited	Not limited	Not limited
Change from No Action	79,800	20.5	260,000	3,000[d]	224,000	4,200
Percent of available capacity	2%	8%	Not limited	Not limited	Not limited	Not limited
250 ppy[a,b]						
Total site requirement	483,750	93.5	28,700,000	214,000	Not limited	Not limited
Percent of site capacity	11%	28%	Not limited	Not limited	Not limited	Not limited
Change from No Action	114,000	23.5	360,000	4,200[d]	245,000	7,300
Percent of available capacity	3%	9%	Not limited	Not limited	Not limited	Not limited
450 ppy[a,b]						
Total site requirement	545,600	106.5	28,900,000	216,000	Not limited	Not limited
Percent of site capacity	12%	32%	Not limited	Not limited	Not limited	Not limited
Change from No Action	176,000	36.5	580,000	6,300[d]	303,250	11,800
Percent of available capacity	4%	14%	Not limited	Not limited	Not limited	Not limited

[a] Peak load is based on electrical demands of HVAC, lighting, and miscellaneous electrical systems. Peak load and annual electrical consumption estimates for the three pit production capacities are based on ratioing SRS FY99 Pit Manufacturing data (MPF Data 2002) to the multiple facility sizes. Estimates based on 24 hrs/day, 365 days per year.
[b] Diesel fuel estimates based on vendor fuel consumption data ratioed for expected diesel generator size. Diesel generator testing of 1 hour per week.
[c] Not limited due to offsite procurement.
[d] Used to generate steam.
Source: MPF Data 2003.

5.5.3 Air Quality and Noise

5.5.3.1 Nonradiological Releases

No Action Alternative

Construction Impacts

There would be no nonradiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of criteria and toxic pollutants would continue to be generated. These emissions are part of the baseline described in Chapter 4. No increases in emissions or air pollutant concentrations are expected under the No Action Alternative. Therefore, a PSD increment analysis is not required.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because SRS is located in an attainment area for all criteria pollutants; therefore, no conformity analysis is required.

Modern Pit Facility Alternative

Construction Impacts

Construction of new structures would result in temporary increases in air quality impacts from construction equipment, trucks, and employee vehicles. Exhaust emissions from these sources would result in releases of sulfur dioxide, nitrogen oxide, $PM_{10,}$ total suspended particulates, and carbon monoxide. The calculation of emissions from construction equipment was based on emission factors provided in the EPA document AP-42, “Compilation of Air Pollutant Emission Factors” (EPA 1995). For highway vehicles (worker commuting vehicles and delivery vehicle) emission factors were obtained from the EPA Mobile Source Emission Factor Model, MOBILE6.2 (EPA 2002).

Fugitive dust generated during the clearing, grading, and other earth-moving operations is dependent on a number of factors including silt and moisture content of the soil, wind speed, and area disturbed. A common procedure to estimate fugitive emissions from an entire construction site is to use the EPA emission factor of 2.69 metric tons/ha (1.20 tons/ac) per month of activity (EPA 1995). This emission factor represents total suspended particulates (i.e., particles less than 30 microns in diameter). A multiplication factor of 0.75 was used to correct the emission rate to one for PM_{10} (EPA 1995). Also, it was assumed that water would be applied to disturbed areas. This would reduce emission rates by about 50 percent. Facility construction would necessitate a Concrete Batch Plant at the building site. Particulate matter, consisting primarily of cement dust, would be the only regulated pollutant emitted in the concrete mixing process. Emission factors for the Concrete Batch Plant were obtained from AP-42 (EPA 1995).

The estimated maximum annual pollutant emissions resulting from construction activities are presented in Table 5.2.3.1–1. Actual construction emissions are expected to be less, since conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the SRS site boundary. Therefore, air quality impacts resulting from construction would be small.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.5.9, Human Health and Safety.

Operations Impacts

Pit manufacturing activities would result in the release of criteria and toxic pollutants into the surrounding air. The primary volume contributors are primarily nitrogen and argon, used to maintain inert atmospheres for glovebox operations. Carbon dioxide would be used as a cleaning agent and helium would be used for leak testing operations. Hydrogen and nitrogen dioxide are reaction products from aqueous purification operations (pyrochemical purification would produce lower amounts of hydrogen and nitrogen dioxide). The chemicals used for dye-penetrant testing of welds are assumed to be volatilized and released to the atmosphere. Organic solvents used for cleaning and chemicals used in the Analytical Laboratory for various analyses would not be expected to contribute any appreciable quantities of any other chemicals to the annual nonradioactive air emissions. Air emissions from periodic functional testing support systems (primarily standby diesel generators) include carbon monoxide, nitrogen dioxide, PM_{10}, sulfur dioxide, VOCs, and total suspended particulates (WSRC 2002e). The estimated emission rates (kg/yr) for nonradiological pollutants emitted under each of the three new facility scenarios are presented in Table 5.2.3.1–2. These emissions would be incremental to the SRS baseline. If SRS is selected as the preferred site, a PSD increment analysis would be performed under a project-specific tiered EIS to determine whether the pit manufacturing activities would cause a significant pollutant emission increase.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because SRS is located in an attainment area for all criteria pollutants. Therefore, although each alternative would emit criteria pollutants, a conformity review is not necessary.

The maximum concentrations ($\mu g/m^3$) at the SRS site boundary that would be associated with the release of criteria pollutants under each of the three plant capacity scenarios (i.e., 125, 250, and 450 ppy) were modeled and are presented in Table 5.5.3.1–1. These concentrations were compared to the most stringent (Federal or state) ambient air quality standards. For each of the three capacity scenarios, incremental concentration increases would be small. For most pollutants, there would be an incremental increase of less than 1 percent of the baseline. The greatest increase would occur for nitrogen dioxide under the 450 ppy scenario, but ambient concentrations would remain below the ambient air quality standard. Since estimated emissions are maximum potential emissions and all emergency generators would not operate at the same time, the estimated emissions and resulting concentrations are conservative.

Table 5.5.3.1–1. Criteria Pollutant Concentrations at the SRS Site Boundary for the MPF—Operations

Pollutant	Averaging Period	Most Stringent Standard or Guideline [a] (μg/m^3)	Maximum Incremental Concentration (μg/m^3)			
			Baseline [b]	MPF Alternative		
				125 ppy	250 ppy	450 ppy
Carbon monoxide	8-hour	10,000	6,800	2.1	2.9	4.7
	1-hour	40,000	10,100	3.0	4.1	6.8
Nitrogen dioxide	Annual	100	9	1.1	1.4	2.4
Sulfur dioxide	Annual	80	4	0.074	0.10	0.17
	24-hour	365	18	0.37	0.51	0.83
	3-hour	1,300	50	0.83	1.1	1.9
PM_{10}	Annual	50	19	0.029	0.040	0.066
	24-hour	150	41	0.15	0.20	0.33
Total Suspended Particulates	Annual	75	28	0.079	0.11	0.18

[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] The No Action Alternative is represented by the baseline. Aiken County ambient concentrations are listed.
NA = not available.
Source: MPF Data 2003, SC R61-62.5, St. 2, SCDHEC 2002.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.5.9, Human Health and Safety.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased releases of criteria pollutants. The increase in releases of criteria pollutants from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility releases. Similarly, the increase of criteria pollutants from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.5.3.1–1). A review of the maximum incremental concentrations in Table 5.5.3.1–1 indicates that if the maximum incremental concentration of each criteria pollutant for the 450 ppy facility were conservatively doubled for surge capacity, concentrations would still not approach the most stringent standards or guideline concentrations.

5.5.3.2 Radiological Releases

No Action Alternative

Construction Impact

There would be no radiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of radionuclides would continue to be emitted. These emissions are part of the baseline described in Chapter 4. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.5.9, Human Health and Safety.

Modern Pit Facility Alternative

Construction Impacts

No radiological releases to the environment are expected in association with construction activities. However, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site preparation activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the nature and extent of any contamination and would be required to remediate any contamination in accordance with established site procedures.

Operations Impacts

Radioactive air emissions from pit manufacturing activities would involve plutonium, americium, and enriched uranium. The pit manufacturing activities would be performed within gloveboxes or vaults for radiological containment; and include plutonium recovery using aqueous or pyrochemical processes, foundry, machining, assembly, post assembly operations, inspection and certification, waste handling, and preparing the final product (pits) for shipment. Analytical operations would normally be conducted in laboratories consisting of rooms with gloveboxes and hoods for radiological containment. Each laboratory module would be separated from occupied areas of the laboratory facility by airlocks. Sample transfers would occur using a vacuum tube transfer system from the Feed Preparation and Manufacturing Facilities to the Analytical Support Facility. The ventilation exhaust from process and laboratory facilities would be filtered through double banks of HEPA filters before being released to the air via a 30-m (100-ft) tall stack. HEPA filters are the best available control technology for particulate emissions and are capable of removing more than 99.99 percent of entrained particles from the exhaust air.

DOE estimated routine radionuclide air emissions for three different plant capacities: 125, 250, and 450 ppy (see Table 5.5.3.2–1). Releases under each of the three capacity scenarios would be small. Total radionuclide emissions at SRS would increase by less than 3.76×10^{-7} percent. To ensure that total emissions are not underestimated, DOE's method for estimating emissions was conservative. Therefore, actual emissions from pit manufacturing operations would be smaller.

DOE estimated the radiation doses to the offsite MEI individual and the offsite population surrounding SRS. As shown in Table 5.5.3.2–2, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The maximum estimated dose to the offsite population residing within an 80-km (50-mi) radius would also be very low. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.5.9, Human Health and Safety.

Table 5.5.3.2–1. Annual Radiological Air Emissions for the MPF at SRS—Operations

Isotope	Annual Emissions [a] (Ci/yr)			
	Baseline[b,c]	125 ppy	250 ppy	450 ppy
Americium-241	2.67×10^{-4}	2.08×10^{-7}	3.81×10^{-7}	7.61×10^{-7}
Plutonium-239	2.20×10^{-3}	7.72×10^{-6}	1.19×10^{-5}	2.05×10^{-5}
Plutonium-240	8.51×10^{-7}	2.01×10^{-6}	3.10×10^{-6}	5.35×10^{-6}
Plutonium-241	6.70×10^{-6}	1.48×10^{-4}	2.28×10^{-4}	3.94×10^{-4}
Uranium-234	3.26×10^{-4}	4.19×10^{-9}	5.58×10^{-9}	8.38×10^{-9}
Uranium-235	1.10×10^{-5}	1.32×10^{-10}	1.76×10^{-10}	2.64×10^{-10}
Uranium-236	7.17×10^{-10}	2.13×10^{-11}	2.84×10^{-11}	4.26×10^{-11}
Uranium-238	4.12×10^{-4}	1.18×10^{-12}	1.58×10^{-12}	2.36×10^{-12}
Tritium	4.74×10^{4}	---	---	---
Krypton-85	6.47×10^{4}	---	---	---
All other	**3.06×10^{-1}**	---	---	---
Total	**1.12×10^{5}**	**1.58×10^{-4}**	**2.43×10^{-4}**	**4.21×10^{-4}**

[a] Based on calendar year 2001 data.
[b] The No Action Alternative is represented by the baseline.
[c] Onsite emissions only.
Source: WSRC 2002f.

Table 5.5.3.2–2. Annual Doses Due to Radiological Air Emissions from MPF Operations at SRS

Receptor	125 ppy	250 ppy	450 ppy
Offsite MEI[a] (mrem/yr)	2.6×10^{-9}	4.3×10^{-9}	8.0×10^{-9}
Population within 80 km (50 mi) (person-rem per year)	4.2×10^{-7}	7.0×10^{-7}	1.3×10^{-6}

[a] The offsite MEI is assumed to reside at the site boundary.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased radiological air emissions. The increase in radiological air emissions from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility emissions. Similarly, the increase in radiological air emissions from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.5.3.2–1). A review of the annual radiological emissions in Table 5.5.3.2–1 indicates that if the emissions for the 450 ppy facility were conservatively doubled for surge capacity, concentrations remain very low. The additional dose represented by these emissions would be well below regulatory limits.

5.5.3.3 Noise

No Action Alternative

Construction Impacts

Under the No Action Alternative, continuing operations at SRS would not involve any new construction. Thus, there would be no impacts from construction noise on wildlife or the public.

Operations Impacts

The noise generating activities described in Section 4.5.3.4 would continue. These noise-generating activities are included in the SRS baseline and are not expected to change under the No Action Alternative.

Modern Pit Facility Alternative

Construction Impacts

Construction of new buildings would involve the movement of workers and construction equipment and would result in some temporary increase in noise levels near the area. Noise sources associated with construction would not include loud impulsive sources such as blasting. Although noise levels in construction areas could be as high as 110 dBA, these high local noise levels would not extend far beyond the boundaries of the construction site. Table 5.2.3.3–1 shows the attenuation of construction noise over relatively short distances. At 122 m (400 ft) from the construction site, construction noises would range from approximately 55-85 dBA. The *Environmental Impact Data Book* (Golden et al. 1980) suggests that noise levels higher than 80-85 dBA are sufficient to startle or frighten birds and small mammals. Thus, there would be little potential for disturbing wildlife outside a 122-m (400-ft) radius of the construction site. Given the distance to the site boundary (4.6 km [2.8 mi]) there would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Operations Impacts

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise impacts from pit manufacturing operations at the new buildings would be expected to be similar to those from existing operations. There would be an increase in equipment noise (e.g., heating and cooling systems, generators, vents, motors, material-handling equipment) from pit manufacturing activities. However, given the distance to the site boundary (about 4.6 km [2.8 mi]), noise emissions from equipment would not likely disturb the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources (e.g., public address systems and testing of radiation and fire alarms) could have onsite impacts, such as the disturbance of wildlife. But these noise sources would be intermittent and would not be expected to disturb wildlife outside of facility boundaries. Traffic noise associated with the operation of these facilities would occur onsite and along offsite local and regional transportation routes used to bring materials and workers to the site. Noise from traffic associated with the operation of these facilities would likely produce less than a 1-dBA increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance to the public. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Sensitivity Analysis

If any of the three facilities operated at surge capacity, a second shift would be added. However, because of the distance of the facilities to the site boundary, noise from second-shift operations would not be noticeable offsite. Second-shift worker traffic would slightly increase noise levels on local roads. However, most material deliveries would likely occur during normal business hours, so there would be no increase in noise from truck traffic during the second shift. Impacts would be similar for each of the three plant capacities analyzed. Second-shift workers would be exposed to the same level of noise first-shift workers. DOE would implement the same hearing protection programs for the second shift as used for the first. The second shift would not affect worker hearing.

5.5.4 Water Resources

Environmental impacts associated with the proposed alternatives at SRS could affect groundwater resources. No impacts to surface water are expected. At SRS, groundwater resources would likely be used to meet all construction and operations water requirements. Table 5.5.4–1 summarizes existing surface water and groundwater resources at SRS, the total SRS site-wide water resource requirements for each alternative, and the potential changes to water resources at SRS resulting from the proposed alternatives.

Table 5.5.4–1. Potential Changes to Water Resources from the MPF at SRS

Affected Resource Indicator	No Action[a]	MPF Alternative		
		125 ppy Single-Shift Operation	250 ppy Single-Shift Operation	450 ppy Single-Shift Operation
Construction - *Water Availability and Use*				
Water source	Groundwater	Groundwater	Groundwater	Groundwater
Total site-wide water operation requirement (million L/yr)	13,249	13,259.7	13,260.8	13,265.3
Percent change from No Action water use (13,249 million L/yr)	NA	0.81%	0.89%	0.12%
Water Quality				
Wastewater discharge into streams and rivers (million L/yr)	414[b]	416	416	421
Percent change from No Action wastewater discharges into streams and rivers	NA	0.48%	0.48%	1.69%
Operations - *Water Availability and Use*				
Water source	Groundwater	Groundwater	Groundwater	Groundwater
Total site-wide water operation requirement (million L/yr)	13,249	13,526.4	13,578.5	13,753.3
Percent change from No Action water use (13,249 million L/yr)	NA	2.1%	2.5%	3.8%
Water Quality				
Wastewater discharge into streams and rivers (million L/yr)	414[a]	459.0	475.9	495.8
Percent change from No Action Alternative wastewater discharge (414 million L/yr)	NA	10.9%	15.0%	19.8
Floodplain				
Actions in 100-year floodplain	NA	None	None	None
Actions in 500-year floodplain	No Information	No Information	No Information	No Information

[a] Source: DOE 1996c.
[b] Quantity listed is for the Central Sanitary Wastewater Treatment Facility.
All discharges to natural drainages require NPDES permits.
Source: MPF Data 2003.

5.5.4.1 Surface Water

No Action Alternative

No additional impacts on surface water resources are anticipated at SRS under the No Action Alternative beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Surface water would not be used to support the construction of the MPF at SRS as groundwater is the source of water at SRS. Therefore, there would be no impact to surface water availability from construction. Sanitary wastewater would be generated by construction personnel. As plans include use of portable toilets, no onsite discharge of sanitary wastewater would be minimized.

During construction, an estimated total of 37.48 million L (9.9 million gal), 41.26 million L (10.9 million gal), and 54.13 million L (14.3 million gal) of liquid wastes would be generated for the 125 ppy, 250 ppy, and 450 ppy facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal generation of liquid waste over that timeframe, it is estimated that approximately 6.25 million L/yr (1.65 million gal/yr), 6.88 million L/yr (1.82 million gal/yr), and 9.02 million L/yr (2.38 million gal/yr) of liquid waste would be generated for the 125, 250, and 450 ppy facilities, respectively. It is estimated that one-third of the liquid wastes generated during construction would be from sanitary wastewater, with the remaining amount attributed to concrete construction activities. Water runoff from construction would be handled according to SRS's NPDES permit for stormwater involving construction activities.

The potential for stormwater runoff from construction areas to impact downstream surface water quality is small. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) would be employed during construction to minimize suspended sediment and material transport, as well as potential water quality impacts. SRS would comply with Federal and state regulations to prevent, control, and handle potential spills from construction activities.

The MPF reference location at SRS is not within the 100-year floodplain. Therefore, no impact on the floodplain is anticipated. Information concerning the 500-year floodplain in the area of the reference location is not available.

Operations Impacts

No impacts on surface water resources are expected as a result of operations at SRS. No surface water would be used to support facility activities. Sanitary wastewater would be generated as a result of operations stemming from staff use of lavatory, shower, and breakroom facilities, and from miscellaneous potable and sanitary uses. It is estimated that 45.0 million L (11.9 million gal), 61.9 million L (16.4 million gal), and 81.8 million L (21.6 million gal) of sanitary wastewater would be generated for the 125 ppy, 250 ppy, and 450 ppy facilities, respectively.

These quantities would represent 10.9 percent, 15.0 percent, and 19.8 percent increases, respectively, in sanitary wastewater discharges from the Central Sanitary Wastewater Treatment Facility. SRS's current NPDES permit would require modification and approval concerning the increase in wastewater discharges. Sanitary wastewater would be treated, monitored, and discharged into site streams and the Savannah River, as required under SRS's NPDES permit. No industrial or other NPDES-regulated discharges to surface waters are anticipated.

The MPF would not generate any radioactive water emissions. However, there is a potential for generating radioactive contaminated water from the operation and maintenance of safety showers in contaminated areas, the operation of decontamination stations, the mopping of floors in contaminated areas, and the testing of fire sprinkler systems located in contaminated areas. Wastewater that has the potential for being radioactively contaminated would be collected, sampled, and analyzed prior to discharge. Radioactive wastewater would be converted to a solid and disposed of in accordance with DOE procedures. The water emissions that are sampled, analyzed, and determined to be contaminated can be converted to a solid by processing through the MPF liquid process waste facilities for the plutonium purification process.

Sensitivity Analysis

For a 450 ppy facility working a double shift, more wastewater would be generated by the increased number of workers. As the Central Sanitary Wastewater Treatment Facility would be at less than 50 percent of its capacity under the 450 ppy single shift, this facility would have adequate capacity to handle the increase in flow for the double shift.

5.5.4.2 Groundwater

No Action Alternative

No additional impacts on groundwater availability or quality are anticipated at SRS under the No Action Alternative beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and meeting the potable and sanitary needs of construction employees. The proposed use of portable toilets by construction personnel would greatly reduce water use over that normally required during construction. In addition, the water required for concrete mixing would likely be procured offsite. As a result, it is estimated that construction activities would require a total of approximately 71.92 million L (19 million gal), 79.49 million L (21 million gal), and 109.79 million L (29 million gal) of groundwater for the 125 ppy, 250 ppy, and 450 ppy capacity facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal usage over that timeframe, it is estimated that approximately 10.7 million L/yr (2.8 million gal/yr), 11.8 million L/yr (3.1 million gal/yr), and 16.3 million L/yr (4.3 million gal/yr) would be needed for the 125, 250, and 450 ppy facilities, respectively. The total site water requirement including these quantities would be feasible since SRS has absolute ownership of the groundwater resource underlying SRS land and has no limit on the amount of water withdrawn annually.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls, and countermeasure plans would be employed to minimize the chance of petroleum, oils, lubricants, and other materials used during construction being released to the surface or subsurface and to ensure that waste materials are properly disposed. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts

Activities at SRS for the MPF would use groundwater primarily to meet the potable and sanitary needs of facility support personnel and for cooling tower water makeup. A summary of water usage by category and total is listed in Table 5.5.4.2–1. The percent change in water consumption for the No Action Alternative ranges from 2.1-3.8 percent. SRS has absolute ownership of the groundwater resource underlying SRS land and has no restrictions on the amount of groundwater withdrawn annually. However, SRS withdrawal routinely exceeds 379,000 L/day (100,120 gal/day) of water, and therefore the withdrawal rate is reported to the South Carolina Water Resource Commission.

Table 5.5.4.2–1. Summary of Water Consumption During Operations at SRS (million L)

	125 ppy	250 ppy	450 ppy
Domestic Water	44.9	61.7	81.6
Cooling Tower Makeup	232.5	267.8	422.7
Total	**277.4**	**329.5**	**504.3**
Total needed for site operation	13,526.4	13,578.5	13,753.3
Percent Change from No Action Alternative	2.1%	2.5%	3.8%

Source: MPF Data 2003.

No sanitary or industrial effluent would be discharged to the subsurface. Therefore, no operational impacts on groundwater quality would be expected.

Routine chemical additives would be added to the domestic water to control bacteria and pH, as well as to cooling tower water makeup for bacteria and corrosion control. Table 5.5.4.2–2 summarizes the chemicals added. Use of these types of chemicals is standard and no adverse impacts would be expected.

Sensitivity Analysis

The double shift for 450 ppy would cause an increase in water use over the 450 ppy single shift, which is almost a 4 percent increase in water use at SRS. It is expected that the total increase in groundwater use for the 450 ppy double shift would not exceed 10 percent over the No Action Alternative amount. Because SRS has no restriction on the quantity of groundwater they may withdraw, an increase of this magnitude is feasible.

Table 5.5.4.2–2. Summary of Chemical Additives to Domestic Water and Cooling Tower Water Makeup (kg)

Chemical	125 ppy	250 ppy	450 ppy
Water Chemicals			
Sodium hypochlorite	90	124	164
Sodium hydroxide	58	80	106
Polyphosphate	180	247	327
Cooling Tower Makeup			
Betz Slimicide	120	130	210
Betz 25K series (corrosion inhibitor)	7,000	8,000	12,700

Source: MPF Data 2003.

5.5.5 Geology and Soils

5.5.5.1 No Action Alternative

Under the No Action Alternative, no additional impacts on geology and soils are anticipated at SRS. The environmental impacts and operations (current and planned) described in Chapter 4 would continue. Hazards from large-scale geologic conditions, such as earthquakes, and from other site geologic conditions with the potential to affect existing SRS facilities are summarized in Section 4.4.5 and further detailed in other SRS *National Environmental Policy Act* (NEPA) documents.

5.5.5.2 Modern Pit Facility Alternative

Construction Impacts

The construction of MPF is expected to disturb land adjacent to existing facilities at SRS. Table 5.2.5.2–1 shows the amount of disturbance for the three different plant sizes. The major differences in the three facility layouts are in the sizes of the detention basin, Construction Laydown Area, and the roads and parking. The area of disturbance was calculated by extending the MPF area 9 m (30 ft) from the surrounding roads and the borders of the construction area and Concrete Batch Plant.

While the soils that would be disturbed are classified as prime farmland, the disturbed area would not be converted from farming to other purposes as it is not presently farmed. The FPPA (7 USC 4201 *et seq.*) and associated regulations require agencies to make evaluations of the conversion of farmland to non-agricultural uses by Federal projects and programs. SRS is exempt from FPPA under section 1540(c)(4) since the acquisition of SRS property occurred prior to FPPA's effective date of June 22, 1982 (7 USC 4201 *et seq.*).

Aggregate and other geologic resources (e.g., sand) would be required to support construction activities at SRS, but these resources are abundant in the South Carolina area. In addition to MPF construction and upgrades, excavation to remove and replace some existing utility systems would also be conducted. The land area to be disturbed is relatively small, the impact on geologic and soil resources would be relatively minor. The potential exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the site's environmental restoration program and in accordance with appropriate requirements and agreements. Construction of the MPF would require a stormwater permit that would address erosion control measures to minimize the impacts of erosion.

As discussed in Section 4.5.5, faults located in the vicinity of the representative MPF site have the potential for earthquakes. While the risk for a large earthquake exists in association with the faults that are further away, the smaller potential earthquakes on the closer faults would result in the same or greater ground motion at the MPF site. Ground shaking could occur that would affect primarily the integrity of inadequately designed or nonreinforced structures, but not damaging or slightly damaging properly or specially designed or upgraded facilities.

Operations Impacts

The operation of the MPF at any of the three capacities would not be expected to result in impacts on geologic and soil resources. New, upgraded, and modified facilities would be evaluated, designed, and constructed in accordance with DOE Order 420.1, which requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Sensitivity Analysis

Utilizing the 450 ppy facility for two-shift operations, would not impact geologic or soil resources. A second shift of workers would use the same parking lot as the first shift. No increase in the size of the parking lot is foreseen.

5.5.6 Biological Resources

5.5.6.1 Terrestrial Resources

No Action Alternative

Under the No Action Alternative, impacts on terrestrial resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing SRS environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

The area identified for construction of MPF is located on a heavily wooded tract that is topographically flat (Salomone 2002) and in an area that supports a wide diversity of birds, mammals, reptiles, amphibians, and aquatic species.

Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of forest and associated wildlife habitat would be cleared or modified during MPF construction. During site-clearing activities, highly mobile wildlife species or wildlife species with large home ranges (such as deer and birds) would be able to relocate to adjacent undeveloped areas. However, successful relocation may not occur due to competition for resources to support the increased population and the carrying capacity limitations of areas outside the proposed development. Species relocation may result in additional pressure to lands already at or near carrying capacity. The impacts could include overgrazing (in the case of herbivores), stress, and over-wintering mortality. For less mobile species (reptiles, amphibians, and small mammals), direct mortality could occur during the actual construction event or ultimately result from habitat alteration. Acreage used for the development also would be lost as potential hunting habitat for raptors and other predators.

Operations Impacts

Impacts to terrestrial resources are very similar regardless of the level of pit production operations (potential pit production capacities of 125, 250, and 450 ppy including surge capacities). The major difference is the size of the modification or loss of forested communities and wildlife habitat. The acreage modified or lost would range from 44-56 ha (110-138 ac) depending upon pit production capacity. In addition to the areas to be disturbed, there would be a decrease in quality of the habitat immediately adjacent to the proposed development due to increased noise level, traffic, lights, and other human activity, both pre- and post-construction. The adjacent habitat also would experience a loss of quality from the reduction in size, segmentation of the habitat, and restriction on mobility for some species (Kelly and Rotenberry 1993).

There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect terrestrial resources. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential for any adverse affects to plant and animal communities (terrestrial resources) in the surrounding environment.

Sensitivity Analysis

There would be minimal impacts to terrestrial resources during the two-shift operations. Wildlife road strikes (vehicle and wildlife collisions) may increase during morning and evening shift changes due to more vehicle traffic coupled with decreased visibility and higher wildlife activity.

5.5.6.2 Wetlands

No Action Alternative

Under the No Action Alternative, there would be no impacts to wetlands because no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with MPF.

Modern Pit Facility Alternative

Construction Impacts

Of the known 300 isolated upland Carolina bays and wetland depressions at SRS, none are located on the MPF site (Salomone 2002). Therefore, there would be no direct impacts to wetlands. Implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan would avoid any indirect degradation to wetlands in the area. Should SRS be selected, the potential for wetland impacts exists, and the site-specific tiered-EIS would analyze those potential impacts.

Operations Impacts

There are no adverse impacts predicted to wetlands from implementation of any of the MPF production capacities. There would be no direct untreated effluent discharges to the environment. With implementation and adherence to administrative procedures, along with facility design and engineering controls, MPF operations are not expected to adversely affect any wetlands.

Sensitivity Analysis

There would be no impacts to wetlands during the two-shift operations.

5.5.6.3 Aquatic Resources

No Action Alternative

Under the No Action Alternative, impacts on aquatic resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and SRS operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

This site is located on a topographic divide, so surface drainage is both west toward Upper Three Runs and east toward Fourmile Branch. Upper Three Runs is considered to be a valuable aquatic resource, not only to SRS, but also to regional ecosystem biodiversity (Salomone 2002).

Construction Impacts

There are no perennial or seasonal aquatic habitats within the proposed MPF location. Thus, there would be no direct impacts to aquatic resources. Indirect effects to aquatic resources downslope and within the SRS watershed would be avoided by implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan.

Operations Impacts

There would be no direct discharge of untreated operational effluent from MPF operations. Stormwater runoff from new facilities, roadways, parking lots, and other impervious areas are not predicted to result in any indirect adverse impacts on area aquatic resources. The quality of runoff waters would be similar to runoff from other SRS built environments and the quantity would represent a very minor contribution to the watershed.

Sensitivity Analysis

There would be no impacts to aquatic resources during the two-shift operations.

5.5.6.4 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, impacts to threatened and endangered species and other special-interest species would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not associated with the MPF.

Modern Pit Facility Alternative

Section 7 of the *Endangered Species Act* requires all Federal agencies to ensure that actions they authorize, fund, or carry out do not jeopardize the continued existence of endangered or threatened species. Agencies must assess potential impacts and determine if proposed projects may affect federally-listed or proposed-for-listing species. Table 4.5.6.4–1 provides a list of Federal- and state-listed species and other species of special concern that occur or may occur at SRS. There are no known threatened or endangered species or species proposed for listing present at the proposed MPF site (Salomone 2002).

Construction Impacts

Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of forest and associated wildlife habitat would be cleared or modified during MPF construction. Should SRS be selected for the construction and operation of the MPF, then DOE, prior to any habitat modifying activities, would conduct site-specific surveys at the appropriate time and assess, in concert with the USFWS, the potential impacts to special-interest species. It is highly probable that several special-interest species are present or use the area for foraging or hunting. Acreage temporarily modified from construction would be lost as potential habitat, foraging areas, or hunting habitat for special interest species until the area revegetates. Revegetation would probably occur within a 1-3 year timeframe depending upon site maintenance and climate conditions.

Operations Impacts

Depending upon pit production capacity, acreage permanently modified or lost as habitat, foraging areas, or as a prey base for species of special interest would range from 44-56 ha (110-138 ac). There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect special-interest species. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential impacts to any individual within a special-interest species population.

Sensitivity Analysis

There would be no impacts to threatened and endangered species during the two-shift operations.

5.5.7 Cultural and Paleontological Resources

5.5.7.1 Cultural Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to prehistoric, historic, or Native American cultural resources. The cultural resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Under the MPF Alternative, a block of land would be disturbed during construction. The size of the disturbed area would vary by the output of the facility, and would include SRS buildings and structures (inside the PIDAS fence), security fencing and perimeter roads, support buildings and parking, a detention basin, a Concrete Batch Plant, a Construction Laydown Area, and a 9-m (30-ft) wide buffer zone surrounding the facility. For purposes of analyzing impacts to cultural resources, the three sizes of disturbed areas would be 62 ha (152 ac) (125 ppy), 63 ha (156 ac) (250 ppy), and 74 ha (182 ac) (450 ppy).

The presence of cultural resources that would be impacted during construction of the MPF at the reference location or any other location at SRS is unknown. However, the reference location at SRS is located in Archaeological Zone 2 (moderate archaeological potential) and very close to Zone 1 (high archaeological potential). This location has not been previously disturbed by construction. Thus, there is a high probability that cultural resources are located within the reference location and would be impacted by the construction of the MPF. The probability that resources would be disturbed by construction of the MPF at another location within SRS is dependent on what archaeological zone the facility would be located in and whether that location has been previously disturbed. Although the number of resources that would be impacted is unknown, the probability for resource impacts would increase with an increase in the number of acres disturbed.

Because the exact location of the MPF at SRS is not yet determined, cultural resources arising from infrastructure construction (such as water, sewer, gas, electricity, access roads) are not analyzed here, but will be in the site-specific tiered EIS. However, like the facility itself, the greater the number of acres disturbed, the greater the possibility for impacts to cultural resources.

Prior to any ground-disturbing activity, DOE would identify and evaluate any cultural resources that could potentially be impacted by construction of the MPF. Methods for identification could include field survey, shovel tests, archival research, and consultation with interested Native American tribes. DOE would determine the possibility for impacts to the resources and implement appropriate measures to avoid, reduce, or mitigate the impacts. Identification, evaluation, determination of impact, and implementation of measures would be conducted in consultation with the South Carolina SHPO and in accordance with the *Archaeological Resources Management Plan of the Savannah River Archaeological Research Program* (SRARP 1989). If previously unknown cultural resources, such as subsurface resources, are discovered during construction, activities in the area of the discovery would stop and the discovery would be evaluated and treated appropriately, as determined by DOE in consultation with the South Carolina SHPO.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on cultural resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations, would have no impact on cultural resources.

5.5.7.2 Paleontological Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to paleontological resources. The paleontological resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Paleontological resources at SRS are comprised exclusively of marine invertebrate fossils. These types of fossils are relatively widespread and common, and have a relatively low research potential or scientific value, except for deposits containing giant oysters. Thus, it is probable that paleontological resources would be impacted due to construction of the MPF or the associated infrastructure at the reference location. This is also true for any other area at SRS. The probability for impacts to paleontological resources would increase with an increase in the number of acres disturbed.

Paleontological resources would be included in the scope of any cultural resource inventories conducted prior to the beginning of construction. If previously unknown paleontological resources are discovered during construction, activities in the area of the discovery would stop and the discovery would be treated appropriately, as determined by DOE.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on paleontological resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on paleontological resources.

5.5.8 Socioeconomics

5.5.8.1 Regional Economy Characteristics

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at SRS. Therefore, there would be no impacts to the ROI employment, income, or labor force.

Modern Pit Facility Alternative

Construction Impacts

Facility– 125 ppy. Construction of the facility to produce 125 ppy would require a total of 2,650 man-years of labor. During peak construction, 770 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 550 indirect jobs would be created, for a total of 1,320 jobs. This represents less than 1 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 7 percent of the ROI labor force, it is estimated that many of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 60 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $32,300 for the construction industry, direct income would increase by

$24.9 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $41.7 million ($24.9 million direct and $16.8 million indirect).

Facility–250 ppy. Construction of the facility to produce 250 ppy would require a total of 2,950 man-years of labor. During peak construction, 850 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 610 indirect jobs would be created, for a total of 1,460 jobs. This represents less than 1 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 7 percent of the ROI labor force, it is estimated that many of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 140 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $32,300 for the construction industry, direct income would increase by $27.5 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $46.1 million ($27.5 million direct and $18.6 million indirect).

Facility–450 ppy. Construction of the facility to produce 450 ppy would require a total of 3,800 man-years of labor. During peak construction, 1,100 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 790 indirect jobs would be created, for a total of 1,890 jobs. This represents less than 1 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 7 percent of the ROI labor force, it is estimated that many of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 390 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $32,300 for the construction industry, direct income would increase by $35.5 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $59.6 million ($35.5 million direct and $24.1 million indirect).

Operations Impacts

Facility–125 ppy. Operation of the facility to produce 125 ppy would require 988 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 450 indirect jobs would be created, for a total of 1,440 jobs. This represents less than 1 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would likely be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

The ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $40,600 for the government services industry, direct income would increase by $40.1 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $57.7 million ($40.1 million direct and $17.6 million indirect).

Facility–250 ppy. Operation of the facility to produce 250 ppy would require 1,358 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 620 indirect jobs would be created, for a total of 1,980 jobs. This represents approximately 1 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would likely be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $40,600 for the government services industry, direct income would increase by $55.1 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $79.3 million ($55.1 million direct and $24.2 million indirect).

Facility–450 ppy. Operation of the facility to produce 450 ppy would require 1,797 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 820 indirect jobs would be created, for a total of 2,620 jobs. This represents approximately 1.3 percent of the total ROI labor force.

Due to the large ROI labor force, it is estimated that most of the direct jobs would likely be filled by current workers in the ROI. In addition, this ROI labor force would be sufficient to fill any indirect jobs generated.

ROI income would increase less than 1 percent as a result of the new jobs created. Based on the ROI average earnings of $40,600 for the government services industry, direct income would increase by $73.0 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $105 million ($73 million direct and $32 million indirect).

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income.

5.5.8.2 Population and Housing

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at SRS. Therefore, there would be no impacts to the ROI population or housing market.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 140 new residents would be expected in the ROI, including workers and their families. This is less than a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–250 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 350 new residents would be expected in the ROI, including workers and their families. This is less than a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–450 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,000 new residents would be expected in the ROI, including workers and their families. This is less than a 1 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Operations Impacts

Facility–125, 250, or 450 ppy. There would be no impact to the ROI population, housing markets, or community services because all of the new jobs would likely be filled by workers already residing in the ROI, and no in-migration would occur.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. However, the existing labor force would likely be able to fill these jobs. Therefore, there would be no additional impacts to the ROI population or housing.

5.5.8.3 Community Services

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at SRS. Therefore, there would be no impacts to ROI community services.

Modern Pit Facility Alternative

Construction Impacts

Facility–125, 250, or 450 ppy. The increase in population would not increase demand on local community services. Comparable levels of service could be maintained without increased staffing.

Operations Impacts

Facility–125, 250, or 450 ppy. There would be no impact to ROI community services because all of the new jobs would likely be filled by workers already residing in the ROI.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. However, the existing labor force would likely be able to fill these jobs. Therefore, there would be no additional impacts to ROI community services.

5.5.9 Human Health and Safety

5.5.9.1 Radiological Impacts

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in SRS operations.

Construction Impacts

Under the No Action Alternative, there would be no radiological impacts on members of the public or workers because this alternative would not involve any construction.

Operations Impacts

Under this alternative, the radiological releases to the environment from SRS would continue at the same rates described in Section 4.5.9. The associated impacts on the general public living within 80 km (50 mi) of SRS and the offsite MEI would continue at the levels shown in Table 4.5.9.1–2. As shown in that table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The fatal cancer risk to the offsite MEI due to radiological releases from SRS operations is estimated to be 9×10^{-8}, while 0.005 excess fatal cancers are projected in the population living within 80 km (50 mi) of SRS from normal SRS operations.

Under this alternative, the radiation dose received by SRS workers would continue at the rates described in Section 4.5.9. These worker radiation doses at SRS are presented for the year 2000 in Table 4.5.9.1–3. The number of projected fatal cancers among SRS workers from normal operations in 2000 is 0.065.

Modern Pit Facility Alternative

Construction Impacts

No radiological risks would be incurred by members of the public from construction activities. Construction workers could be at a small radiological risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site, including that associated with residual contamination at the facilities being upgraded. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as reasonably achievable.

Operations Impacts

Impacts to the Public. DOE expects minimal public health impacts from the radiological consequences of MPF operations. Public radiation doses would likely occur from airborne releases only (Section 5.5.3). Table 5.5.9.1–1 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

Table 5.5.9.1–1. Annual Radiological Impacts on the Public from MPF Operations at SRS for All Three Pit Production Rates

Receptor	125 ppy	250 ppy	450 ppy
Population within 80 km			
Collective dose (person-rem)	4.2×10^{-7}	7.0×10^{-7}	1.3×10^{-6}
Percent of natural background radiation[a]	0.00000000013%	0.00000000022%	0.00000000041%
LCFs[b]	2.1×10^{-10}	3.5×10^{-10}	6.5×10^{-10}
Offsite MEI			
Dose (mrem)	2.6×10^{-9}	4.3×10^{-9}	8.0×10^{-9}
Percent of regulatory dose limit	0.000000026%	0.000000043%	0.000000080%
Percent of natural background radiation[a]	0.00000000089%	0.0000000015%	0.0000000027%
Cancer fatality risk[b]	1.3×10^{-15}	2.2×10^{-15}	4.0×10^{-15}

[a] The average annual dose from background radiation at SRS is 293 mrem (see Section 4.3.9); the 1,085,852 people living within 80 km (50 mi) of SRS in the year 2043 would receive an annual dose of 318,155 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 LCFs per person-rem.
[c] The offsite MEI is assumed to reside at the site boundary, 10,800 m (35,435 ft) southwest from the MPF. An actual residence may not currently be present at this location.

As shown in the table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a LCF to this individual from operations would be less than or equal to 4.0×10^{-15} per year (i.e., about 1 chance in 250 trillion per year of a LCF). The projected number of fatal cancers to the population within 80 km (50 mi) would be less than or equal to 6.5×10^{-10} per year (i.e., about 1 chance in 1.5 billion per year of a LCF).

Impacts to Modern Pit Facility Workers. Estimates of annual radiological doses to workers involved with MPF operations are independent of geographical location. These dose estimates are solely a function of:

- The number of radiological workers, as determined in the development of the MPF staffing estimate for each throughput alternative. The current estimates were developed by application of a factor to the total workers for each work group based on operating experience in plutonium facilities. Approximately 60 percent of total operating staff are estimated to be radiological workers.

- The working dose rate at the glovebox surface for each unit operation or workstation. These dose rates were calculated based on the maximum mass (plutonium, americium) and form (metal, oxide) of material being handled. Standard "weapons grade" isotopic distribution, and americium content of 0.5 percent were assumed.

- The amount of time spent by direct operators/first line supervisors in the radiation area. This was determined from a time-motion estimate of direct "hands-in-gloves" labor required to perform each individual operation and the number of parts processed per year for a given pit production rate. Efficiency scaling factors were applied for various operations. For Foundry and Machining operations, this was assumed to be 50 percent; for Assembly and Post-Assembly & Testing, efficiencies were 90 percent.

As indicated above, the collective annual dose (mrem/yr) received by individual direct operators is calculated based on the number of operators required for the various production rates, the time spent in the radiation area, and the associated dose rates for each operation. The collective exposures for support group workers were added to these numbers and were calculated using empirical data that implies that exposure for these workers can be estimated as a percentage of direct operator exposure (e.g., Analytical Laboratory Technician ~25 percent of direct operator exposure). The average individual dose is calculated as the collective exposure divided by the estimated number of radiological workers for each throughput alternative.

The estimates of annual radiological doses to workers under each of the three pit production rates are provided in Table 5.5.9.1–2. As shown in the table, the annual doses to individual workers for all levels of production would be well below the DOE limit of 5,000 mrem (10 CFR 835.202) and the DOE-recommended control level of 1,000 mrem (10 CFR 835.1002). The projected number of fatal cancers in the workforce from annual operations involving 125 ppy would be 0.064 (or 1 chance in 16 that the worker population would experience a fatal cancer per year of operations). For annual pit production rates of 250 and 450, the projected number of fatal cancers would be 0.12 and 0.22, respectively (1 chance in 8 or 5, respectively, that the worker population would experience a fatal cancer per year of operations).

Table 5.5.9.1–2. Annual Radiological Impacts on MPF Workers at SRS from Operations for All Three Pit Production Rates

Production Rate	**125 ppy**	**250 ppy**	**450 ppy**
Number of Radiological Workers	**550**	**800**	**1,100**
Individual Workers[a]			
Average individual dose, mrem/yr	290	390	510
Average worker cancer fatality risk[b]	1.2×10^{-4}	1.6×10^{-4}	2.0×10^{-4}
Worker Population			
Collective dose (person-rem)	160	310	560
Cancer fatality risk[b]	0.064	0.12	0.22

[a] The regulatory dose limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, the maximum annual dose to a worker would be kept below the DOE Control Level of 1,000 mrem/yr, as established in 10 CFR 835.1002. Further, DOE recommends that facilities adopt a more limiting 500-mrem/yr Administrative Control Level (DOE 1999e). To reduce doses to levels that are as low as reasonably achievable, an effective dose reduction plan would be enforced.
[b] Based on a cancer risk estimator of 0.0004 LCFs per person-rem.

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the MPF under any of the three capacities would approximately double the quantities of radioactive emissions from the MPF presented for single-shift operation at each capacity. Thus, the calculated radiation dose and LCFs to the offsite MEI and the population living within 80 km (50 mi) of SRS would approximately double.

Similarly, double-shift operation of the MPF under any of the three capacities would approximately double the radiation dose to MPF workers presented for single-shift operation at each capacity. Thus, the calculated adverse health impacts to MPF workers would be approximately double.

5.5.9.2 Nonradiological Impacts

This section considers illness, injury, and fatality rates associated with construction and operation of the MPF on the SRS workforce. Nonradiological impacts to workers were evaluated using occupational injury, illness, and fatality rates obtained from BLS, U.S. Department of Labor data. DOE values are historically lower than BLS values owing to the increased focus on safety fostered by complex-wide programs, including ISM and the VPP. Additionally, the small number of fatal accidents reported in the CAIRS makes associated calculated fatality rates statistically invalid.

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in injury, illness, and fatality trends currently observed at SRS.

Modern Pit Facility Alternative

Construction Impacts

The potential risk of occupational injuries and fatalities to workers constructing the MPF would be expected to be bounded by injury and fatality rates for general industrial construction. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for both the peak workforce loading and for the duration of construction activities including site preparation (6¾ years). These values are shown below in Table 5.5.9.2–1.

Table 5.5.9.2–1. Injury, Illness, and Fatality Estimates for Construction of MPF at SRS

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Peak Annual Employment	770	850	1,100
Total Recordable Cases	66	73	95
Total Lost Workday Cases	32	35	46
Total Fatalities	0.16	0.17	0.023
Project Duration (6¾ years)			
Total Recordable Cases	228	254	328
Total Lost Workday Cases	110	122	157
Total Fatalities	0.54	0.60	0.78

Source: MPF Data 2003, BLS 2002b.

No chemicals have been identified that would be a risk to members of the public from construction activities associated with any of the MPF operating capacities. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. Implementation of ISMS programs to construction activities would also decrease the potential for worker exposures by providing hazards identification and control measures for construction activities (WSRC 2002c).

Operations Impacts

During normal (accident-free) operations, total facility staffing would range from approximately 988-1,797, depending on the operating capacity of the selected MPF. The potential risk of occupational injuries and fatalities to workers operating the MPF would be expected to be bounded by injury and fatality rates for general chemical manufacturing. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for facility populations for each of the operating capacities. These values are shown below in Table 5.5.9.2–2.

Table 5.5.9.2–2. Injury, Illness, and Fatality Annual Estimates for Normal Operations of MPF at SRS

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Total Recordable Cases	43	59	78
Total Lost Workday Cases	22	30	40
Total Fatalities	0.04	0.05	0.07

Source: MPF Data 2003, BLS 2002b.

No chemical-related health impacts are associated with normal (accident-free) operations of MPF at the three identified operating capacities. Initial screens for the hazard analysis did not result in the identification of any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by facility safety programs such as ISMS, work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness (WSRC 2002c).

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the SRS illness and injury rates for facility associated activities. No chemical-related health impacts would be associated with this increase in operations.

5.5.10 Facility Accidents

This section presents the potential impacts on workers (both involved and non-involved) and the public due to potential accidents associated with the operation of the MPF at SRS. Additional details supporting the information presented here are provided in Appendix C.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.

- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.

- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, DOE predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident.

Emergency Preparedness

Each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

5.5.10.1 No Action Alternative

Under the No Action Alternative, all current activities would continue at existing levels. Potential accident scenarios for the No Action Alternative are addressed in existing documentation included by reference (DOE 1996c).

5.5.10.2 Modern Pit Facility Alternative

Radiological Impacts

DOE estimated radiological impacts to three receptors: (1) the MEI at the SRS boundary; (2) the offsite population within 80 km (50 mi) of SRS; and (3) a non-involved worker 1,000 m (3,281 ft) from the accident location. DOE did not evaluate total dose to non-involved workers because of the uncertain nature of worker locations at the time of the accident.

Tables 5.5.10.2–1 through 5.5.10.2–3 show the frequencies and consequences of the postulated set of accidents for the public (offsite MEI and the general population living within 80 km [50 mi] of the facility) and a hypothetical non-involved worker for the three pit production rates. The dose shown in the tables are calculated by the MACCS computer code based on accident data. The LCF values are calculated using a dose-to-LCF conversion factor. For the MEI and the population the conversion factor is 0.0005 LCFs per rem or person-rem respectively. For workers, the dose-to-risk conversion factor is 0.0004 LCFs per rem. If the dose to an MEI or worker exceeds 20 rem, the dose-to-risk conversion factor is doubled to 0.001 and 0.0008 respectively. Tables 5.5.10.2–4 through 5.5.10.2–6 show the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *Topical Report - Supporting Documentation for the Accident Impacts Presented in the Modern Pit Facility Environmental Impact Statement* (Tetra Tech 2003). The selection process, screening criteria used, and conservative estimates of material at risk and source term (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at the MPF. Thus, in the event that any other accident that was not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5.5.10.2–1. MPF Alternative Radiological Accident Frequency and Consequences at SRS for 125 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	3.16	0.0016	13,100	6.55	207	0.17
Fire in a Single Building						
1×10^{-4}	1.64	0.00082	5,930	3.0	127	0.1
Explosion in a Feed Casting Furnace						
1×10^{-2}	1.92	0.00096	6,950	3.5	149	0.12
Nuclear Criticality						
1×10^{-2}	3.4×10^{-6}	1.7×10^{-9}	0.013	6.3×10^{-6}	0.00061	2.4×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	0.13	6.4×10^{-5}	463	0.23	9.92	0.004
Radioactive Material Spill						
1×10^{-2}	0.038	1.9×10^{-5}	139	0.07	2.98	0.0012

[a] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.5.10.2–2. MPF Alternative Radiological Accident Frequency and Consequences at SRS for 250 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	3.26	0.0016	13,500	6.75	213	0.17
Fire in a Single Building						
1×10^{-4}	1.7	0.00085	6,150	3.07	132	0.11
Explosion in a Feed Casting Furnace						
1×10^{-2}	1.92	0.00096	6,950	3.47	149	0.12
Nuclear Criticality						
1×10^{-2}	3.4×10^{-6}	1.7×10^{-9}	0.013	6.3×10^{-6}	0.00061	2.4×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	0.13	6.4×10^{-5}	463	0.23	9.92	0.004
Radioactive Material Spill						
1×10^{-2}	0.038	1.9×10^{-5}	139	0.07	3.0	0.0012

[a] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.5.10.2–3. MPF Alternative Radiological Accident Frequency and Consequences at SRS for 450 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	6.27	0.0031	26,000	13	411	0.33
Fire in a Single Building						
1×10^{-4}	3.3	0.0017	11,900	5.96	255	0.2
Explosion in a Feed Casting Furnace						
1×10^{-2}	1.92	0.00096	6,950	3.47	149	0.12
Nuclear Criticality						
1×10^{-2}	3.4×10^{-6}	1.7×10^{-9}	0.013	6.3×10^{-6}	0.00061	2.4×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	0.26	1.3×10^{-4}	927	0.46	19.8	0.0079
Radioactive Material Spill						
1×10^{-2}	0.038	1.9×10^{-5}	139	0.07	2.98	0.0012

[a] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.5.10.2–4. Annual Cancer Risks Due to MPF Accidents at SRS for 125 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.6×10^{-8}	6.6×10^{-5}	1.7×10^{-6}
Fire in a Single Building	8.2×10^{-8}	0.0003	1.0×10^{-5}
Explosion in a Feed Casting Furnace	9.6×10^{-6}	0.035	0.0012
Nuclear Criticality	1.7×10^{-11}	6.3×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	6.4×10^{-7}	0.0023	4.0×10^{-5}
Radioactive Spill Material	1.9×10^{-7}	0.0007	1.2×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.

Table 5.5.10.2–5. Annual Cancer Risks Due to MPF Accidents at SRS for 250 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.6×10^{-8}	6.8×10^{-5}	1.7×10^{-6}
Fire in a Single Building	8.5×10^{-8}	0.00031	1.1×10^{-5}
Explosion in a Feed Casting Furnace	9.6×10^{-6}	0.035	0.0012
Nuclear Criticality	1.7×10^{-11}	6.3×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	6.4×10^{-7}	0.0023	4.0×10^{-5}
Radioactive Spill Material	1.9×10^{-7}	0.0007	1.2×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.

Table 5.5.10.2–6. Annual Cancer Risks Due to MPF Accidents at SRS for 450 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	3.1×10^{-8}	0.00013	3.3×10^{-6}
Fire in a Single Building	1.7×10^{-7}	0.0006	2.0×10^{-5}
Explosion in a Feed Casting Furnace	9.6×10^{-6}	0.035	0.0012
Nuclear Criticality	1.7×10^{-11}	6.3×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	1.3×10^{-6}	0.0046	7.9×10^{-5}
Radioactive Spill Material	1.9×10^{-7}	0.0007	1.2×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.

The accident with the highest risk to the offsite population (see Tables 5.5.10.2–4 through 5.5.10.2–6) is the explosion in a feed casting furnace for the 125 ppy, 250 ppy and 450 ppy production cases. The increased number of LCF in the offsite population would be 0.035 per year (i.e., about 1 chance in 28 per year of a LCF in the total population) for all three production cases. The highest risk of a LCF to an offsite MEI located 10,840 m (35,564 ft) southwest from the accident would be 9.6×10^{-6} per year (i.e., about 1 chance in 104,000 per year of a LCF) for all three production cases. The highest risk of a LCF to a non-involved worker located 1,000 m

(3,281 ft) from the accident would be 0.0012 per year (i.e., about 1 chance in 800 per year of a LCF) for all three production cases.

Hazardous Chemicals Impacts

DOE estimated the impacts of the potential release of the most hazardous chemicals used at the MPF. A chemical's vapor pressure, acceptable concentration (ERPG-2), and quantity available for release are factors used to rank a chemical's hazard. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Additional information on the evaporation and dispersion of each chemical is provided in Appendix C. Tables 5.5.10.2–7 through 5.5.10.2–9 provide information on each chemical and the frequency and consequences of an accidental release. The source term shown represents the amount of the chemical that is accidentally released. The American Industrial Hygiene Association defines ERPG-2 as the maximum airborne concentration below which 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. The distance from the release point to the point where the ERPG-2 concentration is reached in relation to the site boundary reflects the consequence of the chemical's release. As the distance to the ERPG-2 point increases, the potential number of persons onsite and offsite that may be exposed to concentrations in excess of ERPG-2 would be expected to increase. The distance to the nearest site boundary is 8.7 km (5.4 mi). None of the chemicals released in the accident would exceed ERPG-2 limits offsite.

Table 5.5.10.2–7. MPF Alternative Chemical Accident Frequency and Consequences at SRS for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 8.7 km (ppm)	
Nitric acid	10,500	6	0.44	1.27	0.017	10^{-4}
Hydrofluoric acid	550	20	0.49	3.35	0.03	10^{-4}
Formic acid	1,500	10	0.13	0.19	0	10^{-4}

[a] Site boundary is at a distance of 8.7 km (5.4 mi) west.

Table 5.5.10.2–8. MPF Alternative Chemical Accident Frequency and Consequences at SRS for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 8.7 km (ppm)	
Nitric acid	21,000	6	0.62	2.45	0.032	10^{-4}
Hydrofluoric acid	1,100	20	0.66	6.51	0.06	10^{-4}
Formic acid	3,000	10	0.18	0.37	0	10^{-4}

[a] Site boundary is at a distance of 8.7 km (5.4 mi) west.

Table 5.5.10.2–9. MPF Alternative Chemical Accident Frequency and Consequences at SRS for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 8.7 km (ppm)	
Nitric acid	40,000	6	0.86	4.52	0.06	10^{-4}
Hydrofluoric acid	2,000	20	0.83	11.5	0.11	10^{-4}
Formic acid	5,500	10	0.24	0.66	0.0084	10^{-4}

[a] Site boundary is at a distance of 8.7 km (5.4 mi) west.

Involved Worker Impacts

For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Prediction of potential health effects becomes increasingly difficult to quantify as the distance between the accident location and the receptor decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be acutely injured or killed by physical effects of the accident.

The number of workers that would be at the MPF during operations would range from 988-1,797 (125-450 ppy) (including security guards). Each process facility within the MPF would have attached safe haven structures designed in accordance with a number of life safety, fire protection, and safeguards and security requirements. These structures are required for personnel protection during various accident scenarios and are made of reinforced concrete similar in design to the process building wall construction. They would be designed to accommodate 120 percent of the building occupancy for a number of hours and would require their own independent ventilation systems (WSRC 2002b).

The facility ventilation system would control dispersal of any airborne radiological debris from the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk of injury.

5.5.11 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as being Black or African American; American Indian and Alaska Native; Asian; Native Hawaiian and other Pacific Islander; or another non-White race; or persons of Hispanic or Latino ethnicity. Persons whose incomes are below the Federal poverty threshold are designated low-income.

At SRS, the 80-km (50-mi) radius includes portions of McCormick, Edgefield, Saluda, Aiken, Lexington, Barnwell, Bamberg, Orangeburg, Allendale, and Hampton Counties in South Carolina, and Warren, McDuffie, Columbia, Richmond, Jefferson, Burke, Emanuel, Jenkins, and Screven Counties in Georgia. Table 5.5.11–1 provides the racial and ethnic composition of these counties based on the 2000 Census, as well as the number of people below the poverty level.

Figures 5.5.11–1 and 5.5.11–2 show the distribution of these populations throughout the area around the site. Figure 5.5.11–1 shows the minority populations located with an 80-km (50-mi) radius of the site. Figure 5.5.11–2 shows the low-income populations located within the same 80-km (50-mi) radius. This study area corresponds to the region of potential radiological impacts.

Table 5.5.11–1. Racial, Ethnic, and Socioeconomic Composition Surrounding SRS

Population Group	Population	Percent of Total
Hispanic or Latino	21,156	2.2
Black or African American	338,908	34.6
American Indian and Alaska Native	2,850	0.3
Asian	9,991	1.0
Native Hawaiian and Other Pacific Islander	437	0.0
Other Race	962	0.1
Two or More Races	9,152	0.9
White	595,084	60.8
Total	**978,540**	**100**

In 2002, minority populations comprised 30.9 percent of the U.S. population, 37.4 percent of the Georgia population, and 33.9 percent of the South Carolina population. The percentage of minority populations in the area surrounding SRS is 39.1 percent, more than that in the United States and the states of South Carolina and Georgia.

Based on 1999 income, low-income populations comprised 12.4 percent of the U.S. population, 13.0 percent of the Georgia population, and 14.1 percent of the South Carolina population. Within the counties surrounding LANL, 15.9 percent of the population lives below the poverty level.

As shown in Section 5.5.9, Human Health and Safety, there are no large adverse impacts to any populations. Therefore, there would be no disproportionately high and adverse impacts to minority or low-income populations.

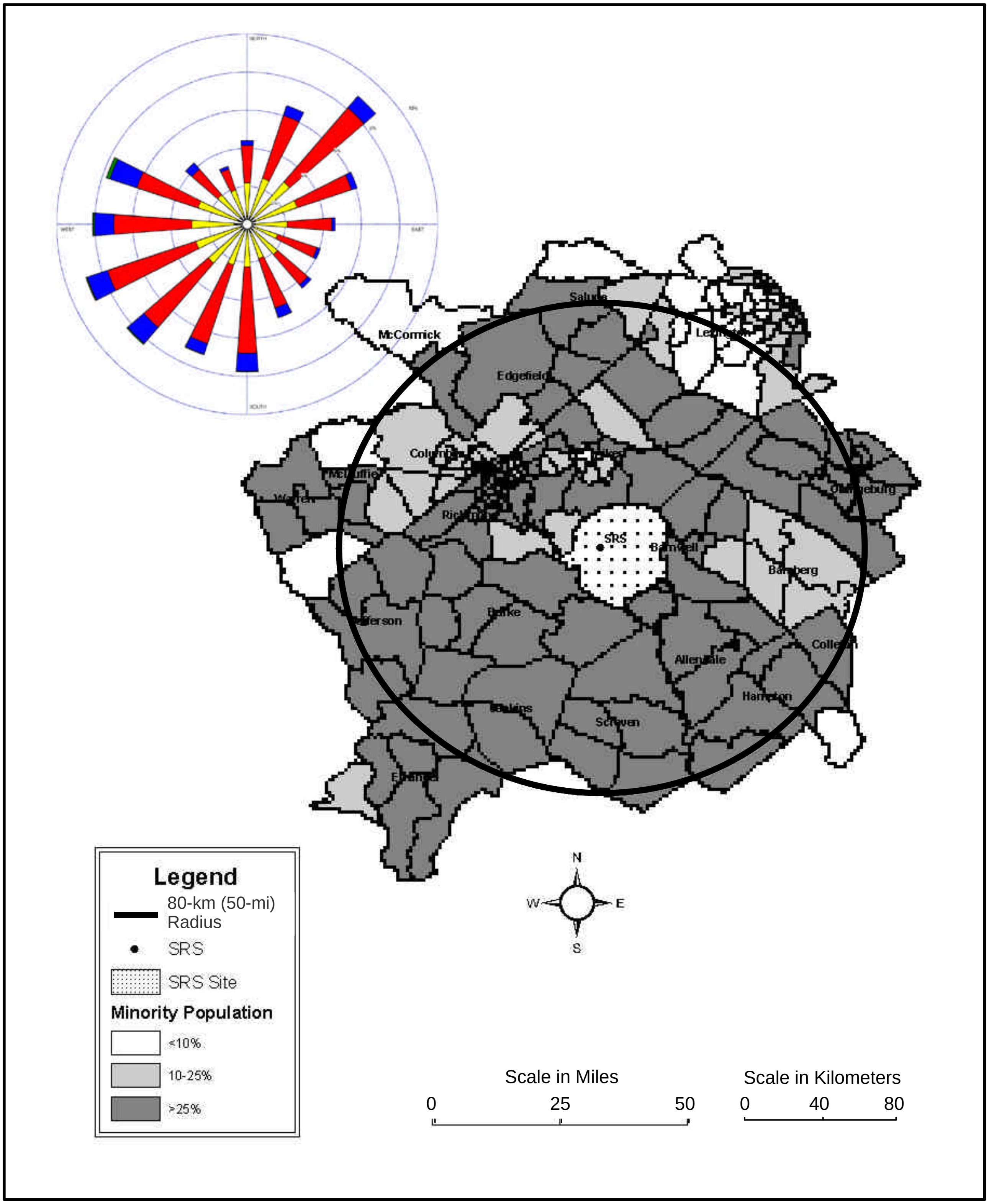

Figure 5.5.11–1. Distribution of the Minority Population Surrounding SRS

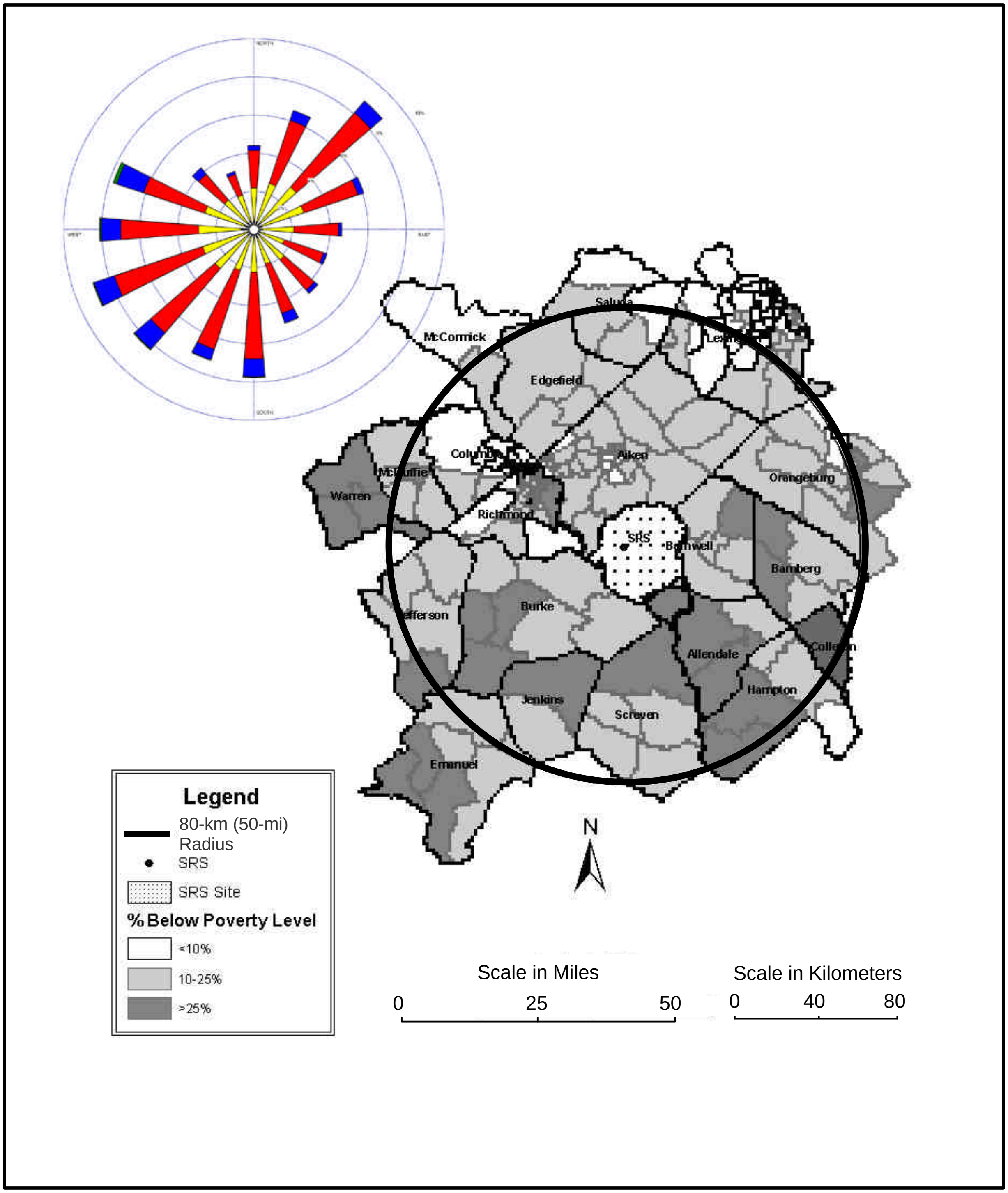

Figure 5.5.11–2. Distribution of the Low-Income Population Surrounding SRS

5.5.12 Transportation

Impacts to the human environment from transportation can result from two sources: operation of the vehicle and the presence of the cargo. Vehicle-related impacts could include increased emissions, traffic congestion, noise, and traffic accidents. Cargo-related impacts could include incident-free radiation dose to those on and near the highway and radiation dose or chemical exposure from the cargo when the containers are breached following an accident.

This EIS is primarily concerned with determining a candidate DOE site for MPF. A second EIS would be prepared once a DOE site is identified for more detailed analysis. Accordingly, this EIS focuses on a limited suite of analyses that will most specifically aid decisionmakers in distinguishing transportation impacts among the five DOE sites under consideration. NNSA has selected for quantitative analysis incident-free radiation dose to workers and the public, accident radiation dose-risk (which includes the probability of the accident occurring) to all individuals affected by the accident, and traffic accident fatalities. In addition, the analysis presents a qualitative discussion on traffic impacts near the DOE facility under both construction and operations. Traffic impacts would result from commuting workers and construction deliveries. Other potential analytical endpoints are roughly proportional to the analyzed endpoints and would yield similar relative distinction among the five DOE sites.

Appendix D presents NNSA's methodology in analyzing the selected analytical endpoints and provides some detail on the calculations, including the more important analytical parameters.

5.5.12.1 No Action Alternative

There are no activities at SRS under the No Action Alternative that are related to the Proposed Action.

5.5.12.2 Modern Pit Facility Alternative

Construction Impacts

Construction of the MPF at SRS would result in increased traffic due to commuting construction workers and deliveries of construction materials and equipment. Although this traffic increase would tend to increase congestion on local roads, the increase would be small compared to the average daily traffic levels reported in Section 4.5.10 and would be temporary.

Operations Impacts

Radiological transportation under the MPF Alternative for SRS would include transport of pits from Pantex (near Amarillo, Texas) to SRS, recycle of enriched uranium parts to and from the Y-12 (Oak Ridge, Tennessee), return of pits and enriched uranium parts to Pantex, and shipment of TRU waste to WIPP (near Carlsbad, New Mexico). LLW would be disposed of at SRS. The NNSA's analysis includes options for 125, 250, and 450 ppy. Table 5.5.12.2–1 presents the number of shipments for the MPF Alternative. Tables 5.5.12.2–2 and 5.5.12.2–3 present incident-free impacts from this transportation. Tables 5.5.12.2–4 and 5.5.12.2–5 present the accident impacts.

Table 5.5.12.2–1. Numbers of Shipments per Year at SRS for the MPF

Transported Materials	125 ppy	250 ppy	450 ppy
Pits	14	28	50
EU parts	10	20	36
TRU waste	74	93	142
Total	**98**	**141**	**228**

EU = enriched uranium.

Table 5.5.12.2–2. Annual Incident-Free Transportation Impacts to Workers at SRS for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.23	9.1×10^{-5}	0.46	1.8×10^{-4}	0.82	3.3×10^{-4}
EU parts	0.054	2.2×10^{-5}	0.11	4.3×10^{-5}	0.19	7.8×10^{-5}
TRU waste	2.8	1.1×10^{-3}	3.5	1.4×10^{-3}	5.3	2.1×10^{-3}
Total	**3.1**	**1.2 ´ 10^{-3}**	**4.1**	**1.6 ´ 10^{-3}**	**6.4**	**2.5 ´ 10^{-3}**

Table 5.5.12.2–3. Annual Incident-Free Transportation Impacts to the General Public at SRS for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.35	1.7×10^{-4}	0.70	3.5×10^{-4}	1.2	6.2×10^{-4}
EU parts	0.091	4.5×10^{-5}	0.18	9.1×10^{-5}	0.33	1.6×10^{-4}
TRU waste	5.3	2.7×10^{-3}	6.7	3.3×10^{-3}	10.0	5.1×10^{-3}
Total	**5.8**	**2.9 ´ 10^{-3}**	**7.6**	**3.8 ´ 10^{-3}**	**12.0**	**5.9 ´ 10^{-3}**

Table 5.5.12.2–4. Annual Transportation Accident Radiological Impacts at SRS for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs
Pits	4.9×10^{-7}	2.5×10^{-10}	9.9×10^{-7}	4.9×10^{-10}	1.8×10^{-6}	8.8×10^{-10}
EU parts	9.3×10^{-12}	4.7×10^{-14}	1.9×10^{-10}	9.3×10^{-14}	3.4×10^{-10}	1.7×10^{-13}
TRU waste	0.011	5.4×10^{-6}	0.013	6.7×10^{-6}	0.021	1.0×10^{-5}
Total	**0.011**	**5.4 ´ 10^{-6}**	**0.013**	**6.7 ´ 10^{-6}**	**0.021**	**1.0 ´ 10^{-5}**

Table 5.5.12.2-5. Annual Nonradiological Fatalities From Transportation Accidents at SRS for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities
Pits	0.010	5.5×10^{-4}	0.020	1.1×10^{-3}	0.036	1.9×10^{-3}
EU parts	3.3×10^{-3}	1.1×10^{-4}	6.5×10^{-3}	2.2×10^{-4}	0.012	4.0×10^{-4}
TRU waste	0.086	3.6×10^{-3}	0.11	4.5×10^{-3}	0.16	6.8×10^{-3}
Total	**0.099**	**4.2 ´ 10^{-3}**	**0.13**	**5.8 ´ 10^{-3}**	**0.21**	**9.2 ´ 10^{-3}**

The addition of 988-1,797 new employees under the three capacity options would represent an increase in SRS employment ranging from 8.2-15 percent, with a corresponding increase in commuting traffic. Although this additional traffic increase would tend to increase congestion on local roads, the increase is small compared to the overall average daily traffic level reported in Section 4.5.10.

Sensitivity Analysis

Should NNSA elect to operate a new 450 ppy facility at SRS in two shifts, the impacts would increase. The incident-free doses for the 450 ppy facility reported in Tables 5.5.12.2–2 and 5.5.12.2–3 would increase by approximately the factor 1.8 because the numbers of shipments would increase. The accident values in Table 5.5.12.2–4 would also increase by a factor of 1.8 because of increased probability of the accident; however, the consequences of an accident, should one occur, would not change. The duration of traffic congestion during shift change would increase.

5.5.13 Waste Management

This section considers the burden that waste generation associated with construction and operation of the MPF places on the SRS waste treatment, storage, and disposal infrastructure. Impacts are evaluated based on routine waste generation, excluding wastes generated from environmental restoration or D&D activities. Impacts associated with transportation of radioactive waste from SRS to offsite disposal facilities are provided in Section 5.5.12.

5.5.13.1 No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change to the current and planned SRS waste management activities described in Section 4.5.11.

5.5.13.2 Modern Pit Facility Alternative

Construction Impacts

Construction of MPF would generate solid and liquid sanitary waste and liquid nonhazardous waste. Table 5.5.13.2–1 summarizes the total volume of waste generated over the 6 years of construction activity for the three proposed MPF operating capacities.

Table 5.5.13.2–1. Total Waste Generation from Construction of the MPF (m^3)

Waste type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Hazardous waste	4.9	5.1	5.9
Sanitary waste	7,110	7,870	11,200
Sanitary wastewater	37,500	41,300	54,100

Source: MPF Data 2003.

MPF construction activities would increase annual sanitary waste generation by 54-84 percent, relative to current SRS operations. The waste would be disposed in an onsite structural fill or the Three Rivers Regional Landfill, located within SRS boundaries. If there were sufficient demand, DOE may pursue a permit for an onsite construction and debris landfill, replacing the Burma Road Landfill that was filled to capacity in 2001. This combination of disposal facilities would provide adequate capacity to handle the projected amount of waste.

MPF construction activities would increase the annual routine hazardous waste generation by less than 2 percent over current SRS operations. The hazardous waste would be sent offsite for treatment and disposal at a commercial facility. Commercial treatment is readily available and currently used to treat most SRS hazardous wastes.

Sanitary wastewater generated during MPF construction would be treated in the Centralized Sanitary Wastewater Treatment Facility. The anticipated volume of sanitary wastes would not be expected to have any effect on the existing capacity of the SRS sanitary sewer system.

A detention pond would be constructed to manage stormwater runoff from the entire MPF site including the Construction Laydown Area and Concrete Batch Plant. The basin would be sized to limit stormwater discharge from the developed site to no greater than the pre-existing conditions, with a basin area of approximately 0.4 ha (1 ac) per 16 ha (40 ac) of developed land.

A Concrete Batch Plant would operate at the MPF site during the construction phase. The Concrete Batch Plant would include a basin to manage wastewater from equipment washout activities. The facility would be located on approximately 4 ha (10 ac) adjacent to the PIDAS. The Concrete Batch Plant would be disassembled and the area would be restored once MPF construction is completed.

Operations Impacts

Normal operation of the MPF would generate TRU waste, LLW, mixed LLW, hazardous waste, and sanitary waste. Table 5.5.13.2–2 summarizes the estimated waste generation rates for the three proposed MPF operating capacities.

Table 5.5.13.2–2. MPF Operations Annual Waste Generation (m^3)

Waste type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
TRU waste	590	740	1,130
LLW	2,070	3,300	5,030
Mixed LLW—solid	1.5	2.0	3.5
Mixed LLW—liquid	0.2	0.4	0.7
Hazardous waste—solid	2.5	3.0	5.0
Hazardous waste—liquid	0.3	0.4	0.6
Sanitary waste	5,500	5,800	6,900
Sanitary wastewater	45,000	61,900	81,800

Source: MPF Data 2003.

SRS currently manages an inventory of approximately 11,000 m^3 (388,500 ft^3) of legacy TRU waste (WSRC 2002a). The projected TRU waste volumes for the three proposed MPF operating capacities represent an increase by a factor of 7.1, 8.8, and 14, respectively, in the annual routine TRU waste generation at SRS. TRU waste generated from plutonium pit manufacturing includes gloves, filters, and other operations/maintenance waste from the MPF gloveboxes. Americium process waste would be solidified and packaged as TRU waste. About 36 percent of the TRU waste would be mixed waste. The TRU waste would be transferred from the MPF process buildings to the Waste Staging/TRU Packaging Building, which would be located outside of the PIDAS. The Waste Staging/TRU Packaging Building would include a staging area with capacity for approximately 1,200 TRU waste drums (about 250 m^3 [8,800 ft^3] of TRU waste). A drum loading area equipped with overhead bridge cranes would load the waste drums into TRUPACT-II shipping containers and load the TRUPACT-II containers onto trucks for transport to WIPP. The size of the Waste Staging/TRU Packaging Building (approximately 1,950 m^2 [21,000 ft^2]) is not expected to vary with the MPF operating capacity. Section 6.5 discusses the availability of WIPP for disposal of TRU waste resulting from MPF operations.

LLW from MPF operations would include job control waste, failed equipment, and other general operations/maintenance waste. Any liquid LLW resulting from MPF operations would be solidified prior to leaving the facility. LLW generation for the three proposed MPF operating capacities would increase the annual LLW generation at SRS by 37, 58, and 92 percent, respectively. The LLW would be transferred to E-Area for disposal. Offsite disposal could also be used for LLW that is not technically or economically suitable for disposal at SRS. The estimated capacity of the E-Area facilities is approximately 245,600 m^3 (8,673,400 ft^3) and the projected volumes for disposal are about 118,900 m^3 (4,199,000 ft^3) (DOE 2000g). The remaining capacity would be adequate to dispose of all the projected LLW from MPF operations (104,000-251,000 m^3 [3,672,760-8,864,000 ft^3] from the 125 ppy operating capacity but not from the 250 ppy and 450 ppy operating capacities). Expansion of the currently planned LLW disposal facilities at SRS by 38,300-124,300 m^3 (1,352,600-4,389,700 ft^3) would be required for the 250 and 450 ppy operating capacities.

MPF operations would generate small amounts of hazardous waste and mixed LLW. These wastes include lead acid batteries, lubricating oils/fluids, rags, and sorbents. The projected hazardous waste volumes from MPF operations represent 4.3-8.5 percent of the annual routine volumes currently managed at SRS. Commercial treatment is readily available and currently used to treat most SRS hazardous wastes.

Operation of the MPF would increase annual routine mixed LLW generation at SRS by about 1 percent relative to current site operations. Depending on the characteristics of the mixed LLW, it would be transferred to onsite treatment facilities or shipped to commercial or DOE treatment and disposal facilities.

Nonhazardous waste from MPF operations includes sanitary solid waste and wastewater. The solid waste would be disposed in an onsite structural fill or the Three Rivers Regional Landfill, located within SRS boundaries. If there were sufficient demand, DOE may pursue a permit for an onsite construction and debris landfill, replacing the Burma Road Landfill that was filled to capacity in 2001. Although MPF operations would increase annual sanitary waste generation by 250-320 percent relative to current SRS operations, the combination of disposal facilities is expected to provide adequate disposal capacity.

Sanitary wastewater generated during MPF operations would be treated in the Centralized Sanitary Wastewater Treatment Facility. The anticipated volume of sanitary wastes would not be expected to have any effect on the existing capacity of the SRS sanitary sewer system.

MPF operations are not expected to generate radioactive wastewater. However, the potential does exist for generating radioactively contaminated water from the operation and maintenance of safety showers in contamination areas, the operation of decontamination stations, the mopping of floors in contamination areas, and the testing of fire sprinkler systems located in contamination areas. Wastewaters that could potentially be contaminated would be collected, sampled, and analyzed prior to discharge. Any contaminated wastewater would be solidified by processing through the liquid-process waste facilities for the plutonium purification process (MPF Data 2003).

Sensitivity Analysis

DOE could elect to operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the waste management infrastructure from those described above for the single-shift operation. Although this would substantially increase the SRS routine waste generation, the volumes resulting from double-shift operation are not expected to exceed the available capacities of the waste management facilities, except for the currently planned onsite LLW disposal. The remaining capacity of the planned E-Area disposal facilities would not be adequate to dispose of all the projected LLW from MPF double-shift operation. Some expansion of the currently planned LLW disposal facilities at SRS would be required. See Section 6.5 for a discussion of the availability of WIPP for disposal of TRU waste resulting from MPF operations.

5.6 CARLSBAD SITE

The following section discusses the environmental impacts associated with the No Action Alternative and the MPF Alternative at the Carlsbad Site. The environmental impacts are presented below for each of the following environmental resource areas: land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, and waste management.

5.6.1 Land Use and Visual Resources

5.6.1.1 Land Use

The proposed concept for the MPF is a multibuilding aboveground configuration. There would be three separate process buildings: Material Receipt, Unpacking, and Storage; Feed Preparation; and Manufacturing. They would be flanked by a number of smaller support facilities which would include: the Analytical Support Building, Production Support Building, Process Building Entry Control Facilities, Operations Support Facilities, Engineering Support Facility, PIDAS, Safe Havens, Standby Diesel Generator Buildings, Diesel Fuel Storage Tank, Chillers/Chemical Feed and Chilled Water Pump Buildings, Cooling Towers, Alternate Power Electrical Transformers, Truck Loading Docks, Liquid Nitrogen/Argon Storage Tanks, Chemical Storage Tanks, Bottled Gas Storage and Metering Buildings, HVAC Exhaust Stacks, Waste Staging/TRU Packaging Building, Commodities Warehouse, Roads and Parking Areas, and a Runoff Detention Area. In addition to these structures, a Construction Laydown Area and a Concrete Batch Plant would be built for the construction phase only. Upon construction completion, they would be removed and the area would be returned to its original state.

All buildings would be either one or two stories. The site would require two HVAC exhaust stacks; the tallest, standing 30-m (100-ft), stack would be located inside the PIDAS. Facility exhausts would be HEPA-filtered prior to discharge through the stacks.

Under the multibuilding configuration, production rates would dictate the size of the facilities proposed. The three potential facility capacities are 125, 250, and 450 ppy. Required acreage for each of the facility capacities during construction and operations is presented in Table 5.2.1.1–1.

The MPF reference location for the Carlsbad Site is in the southern half of Section 21 of Township 22 South and Range 31 East, within the Off Limits Area, just east of the DOE Exclusive Use Area (see Figure 4.6.1.1–2). There are approximately 130 ha (321 ac) available for development in this location. As previously stated, the primary land usage in this area is grazing.

It should be noted that the reference location is one preliminary potential location to place the MPF. There may actually be more than one potential location for MPF placement at the Carlsbad Site. In a more site-specific EIS, the actual location would be chosen and analyzed.

It may also be noted that land outside of the WIPP site boundary at the Carlsbad Site may have potential for MPF placement. However, the NNSA notes that future land withdrawal action by

Congress would be required in order to proceed with the construction of a MPF at the Carlsbad Site either on land within the WIPP site boundary or on land in the vicinity that is outside of the existing WIPP site boundary. Additionally, the existing rights to the land outside of the WIPP site boundary, several of which are held by private interests, would need to be considered. It should be noted that the reference location is one preliminary potential location to place the MPF. There may actually be more than one potential location for MPF placement at the Carlsbad Site. In a more site-specific EIS, the actual location would be chosen and analyzed.

It may also be noted that land outside of the WIPP site boundary at the Carlsbad site may have potential for MPF placement. However, the NNSA notes that future land withdrawal action by Congress will be required to proceed with the construction of a MPF at the Carlsbad Site either on land within the WIPP site boundary or on land in the vicinity that is outside of the existing WIPP site boundary. Additionally, the existing rights to the land outside of the WIPP site boundary, several of which are held by private interests, would need to be considered.

No Action Alternative

Under the No Action Alternative, no new buildings or facilities would be built and current operations would not change. The reference location would continue to be used for grazing. There would be no impact on land use at the WIPP site.

Modern Pit Facility Alternative

Construction Impacts

Depending on the facility capacity, an estimated 56-69 ha (138-171 ac) of land for buildings, walkways, building access, parking, buffer space, and construction-related workspace would be required to construct the MPF. The land required for the proposed MPF construction would represent approximately 1.4-1.7 percent of WIPP’s total land area of 41 km^2 (16 mi^2), a relatively small proportion.

Although there would be a change in land use, the proposed MPF is compatible with current land use plans for this area. No impacts to WIPP land use plans or policies are expected.

Operations Impacts

Depending on the facility capacity, an estimated 44-56 ha (110-138 ac) of land for buildings, walkways, building access, parking, and buffer space would be required to operate the MPF. The reduction in required acreage from construction to operations represents the removal of the Construction Laydown Area and the Concrete Batch Plant upon construction completion. The land required for the proposed MPF operations would represent approximately 1.1-1.3 percent of WIPP’s total land area of 41 km^2 (16 mi^2), a relatively small proportion.

Although there would be a change in land use, the proposed MPF is compatible with current land use plans for this area. No impacts to the Carlsbad Site land use plans or policies are expected.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not have any additional effect on land use for this alternative.

5.6.1.2 Visual Resources

No Action Alternative

Under the No Action Alternative, there would be no impact on visual resources at the Carlsbad Site since no new facilities would be built.

Modern Pit Facility Alternative

Construction Impacts

Activities related to the construction of new buildings required for the MPF Alternative would result in a change to the visual appearance of the reference location due to the presence of construction equipment, new buildings in various stages of construction, and possibly increased dust. These changes would be temporary and visible by the general public only from southern and western viewpoints beyond site boundaries. Thus, impacts on visual resources during construction would be similar to those observed during the construction of previously developed areas of the site.

Operations Impacts

The MPF, which would include one- and two-story buildings, storage tanks, and two HVAC exhaust stacks, would change the appearance of the reference location. However, this change would be consistent with the currently developed areas of the WIPP site. New construction would not change the current Class IV BLM Visual Resource Management rating of the WIPP site.

Sensitivity Analysis

Doubling shifts for any of the three proposed facility capacities would not change the layout or physical features of the MPF reference location. Therefore, there would be no additional impacts to Visual Resources.

5.6.2 Site Infrastructure

This section describes the impact on site infrastructure at the Carlsbad Site for the No Action Alternative and the modifications that would be needed for the construction and operations of the MPF Alternative. These impacts are evaluated by comparing current site infrastructure to key facility resource needs for the No Action Alternative and the MPF Alternative.

5.6.2.1 No Action Alternative

Under the No Action Alternative, there would be no change to the site infrastructure at the Carlsbad Site. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

5.6.2.2 Modern Pit Facility Alternative

Construction Impacts

The projected demand on key site infrastructure resources associated with construction activities of the three proposed plant sizes (125, 250, or 450 ppy) for the MPF Alternative on an annual basis are shown in Table 5.6.2.2–1. Existing infrastructure at the Carlsbad Site would be adequate to support annual construction requirements for the proposed plant sizes for the projected 6-year construction period. Infrastructure requirements for construction would have a minor impact on current site infrastructure.

Operations Impacts

The estimated annual site infrastructure requirements for the pit production capacities of 125, 250, or 450 ppy are presented in Table 5.6.2.2–2.

The existing power grid is capable of supplying sufficient electrical power to operate the MPF. Two new transformers also would be needed to upgrade the existing system to provide redundant electrical power to the MPF.

Currently, the Carlsbad Site does not use natural gas or coal which are necessary for the production of steam for heating. Natural gas supplies to meet MPF requirements for steam are readily available near the Carlsbad Site, even though natural gas is not currently used onsite. Impacts to liquid fuel and process gases would be negligible.

Sensitivity Analysis

Since the Carlsbad Site does not have sufficient electrical power capacity to support 450 ppy, surge use of two-shift operations could not be accommodated at the Carlsbad Site. Therefore, additional electrical capacity would need to be provided. Natural gas or coal capacity would have to be adequate to support surge operations. Impacts to liquid fuel and process gases are expected to be negligible.

Table 5.6.2.2–1. Annual Site Infrastructure Requirements for Construction of MPF at the Carlsbad Site

Proposed Alternatives	Electrical		Fuel		Process Gases
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Gases (m^3/yr)
Site capacity	**175,200**	**20**	**Not limited[a]**	**0**	**Not limited[a]**
Available site capacity	**155,441**	**16.2**	**Not limited**	**0**	**Not limited**
No Action Alternative					
Total site requirement	19,759	3.8	113,600	0	Not limited
Percent of site capacity	11%	19%	Not limited	0	Not limited
MPF Alternative					
125 ppy					
Total site requirement	20,700	6.8	1,600,000	0	Not limited
Percent of site capacity	12%	34%	Not limited	0	Not limited
Change from No Action	1,000	3	1,520,000	0	2,200
Percent of available capacity	0.6%	19%	Not limited	0	Not limited
Peak requirement	NA	NA	2,600,000	0	4,000
250 ppy					
Total site requirement	20,900	7.3	1,800,000	0	Not limited
Percent of site capacity	12%	37%	Not limited	0	Not limited
Change from No Action	1,125	3.5	1,700,000	0	2,500
Percent of available capacity	0.7%	22%	Not limited	0	Not limited
Peak requirement	NA	NA	2,900,000	0	4,200
450 ppy					
Total site requirement	21,000	7.8	2,280,000	0	Not limited
Percent of site capacity	12%	39%	Not limited	0	Not limited
Change from No Action	1,333	4	2,170,000	0	3,200
Percent of available capacity	0.9%	25%	Not limited	0	Not limited
Peak requirement	NA	NA	3,700,000	0	5,700

[a] Not limited due to offsite procurement.
NA = Not Applicable
Source: MPF Data 2003.

Table 5.6.2.2–2. Annual Site Infrastructure Requirements for Facility Operations Under MPF at the Carlsbad Site

Proposed Alternatives	Electrical		Fuel		Process Gases	
	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Natural Gas (m^3/yr)	Nitrogen (m^3/yr)	Argon (m^3/yr)
Site capacity	**175,200**	**20**	**Not limited[c]**	**0**	**Not limited[c]**	**Not limited[c]**
Available site capacity	**155,441**	**16.2**	**Not limited**	**0**	**Not limited**	**Not limited**
No Action Alternative						
Total site requirement	19,759	3.8	113,600	0	Not limited	Not limited
Percent of site capacity	11%	19%	Not limited	0	Not limited	Not limited
MPF Alternative						
125 ppy[a,b]						
Total site requirement	99,000	24.3	373,000	4,400,000	Not limited	Not limited
Percent of site capacity	57%	122%	Not limited	NA	Not limited	Not limited
Change from No Action	79,800	20.5	260,000	4,400,000[d]	224,000	4,200
Percent of available capacity	51%	127%	Not limited	NA	Not limited	Not limited
250 ppy[a,b]						
Total site requirement	133,000	27.3	471,000	4,990,000	Not limited	Not limited
Percent of site capacity	76%	137%	Not limited	NA	Not limited	Not limited
Change from No Action	114,000	23.5	360,000	4,990,000[d]	245,000	7,300
Percent of available capacity	73%	145%	Not limited	NA	Not limited	Not limited
450 ppy[a,b]						
Total site requirement	195,000	40.3	697,000	7,730,000	Not limited	Not limited
Percent of site capacity	112%	202%	Not limited	NA	Not limited	Not limited
Change from No Action	176,000	36.5	580,000	7,730,000[d]	303,000	11,800
Percent of available capacity	113%	225%	Not limited	NA	Not limited	Not limited

[a] Peak load is based on electrical demands of HVAC, lighting, and miscellaneous electrical systems. Peak load and annual electrical consumption estimates for the three pit production capacities are based on ratioing SRS FY99 Pit Manufacturing data (MPF Data 2003) to the multiple facility sizes. Estimates based on 24 hrs/day, 365 days per year.
[b] Diesel fuel estimates based on vendor fuel consumption data ratioed for expected diesel generator size. Diesel generator testing of 1 hour per week.
[c] Not limited due to offsite procurement.
[d] Natural gas requirement for the generation of steam. Steam is used for heating.
NA = Not Applicable.

Source: MPF Data 2003.

5.6.3 Air Quality and Noise

5.6.3.1 Nonradiological Releases

No Action Alternative

Construction Impacts

There would be no nonradiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of criteria and toxic pollutants would continue to be generated. These emissions are part of the baseline described in Chapter 4. No increases in emissions or air pollutant concentrations are expected under the No Action Alternative. Therefore, a PSD increment analysis is not required.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because WIPP is located in an attainment area for all criteria pollutants; therefore, no conformity analysis is required.

Modern Pit Facility Alternative

Construction Impacts

Construction of new structures would result in temporary increases in air quality impacts from construction equipment, trucks, and employee vehicles. Exhaust emissions from these sources would result in releases of sulfur dioxide, nitrogen oxide, PM_{10}, total suspended particulates, and carbon monoxide. The calculation of emissions from construction equipment was based on emission factors provided in the EPA document AP-42, "Compilation of Air Pollutant Emission Factors" (EPA 1995). For highway vehicles (worker commuting vehicles and delivery vehicle) emission factors were obtained from the EPA Mobile Source Emission Factor Model, MOBILE6.2 (EPA 2002).

Fugitive dust generated during the clearing, grading, and other earth-moving operations is dependent on a number of factors including silt and moisture content of the soil, wind speed, and area disturbed. A common procedure to estimate fugitive emissions from an entire construction site is to use the EPA emission factor of 2.69 metric tons/ha (1.20 tons/ac) per month of activity (EPA 1995). This emission factor represents total suspended particulates (i.e., particles less than 30 microns in diameter). A multiplication factor of 0.75 was used to correct the emission rate to one for PM_{10} (EPA 1995). Also, it was assumed that water would be applied to disturbed areas. This would reduce emission rates by about 50 percent. Facility construction would necessitate a Concrete Batch Plant at the building site. Particulate matter, consisting primarily of cement dust, would be the only regulated pollutant emitted in the concrete mixing process. Emission factors for the Concrete Batch Plant were obtained from AP-42 (EPA 1995).

The estimated maximum annual pollutant emissions resulting from construction activities are presented in Table 5.2.3.1–1. Actual construction emissions are expected to be less, since conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The temporary increases in pollutant emissions due to construction activities are too small to result in violations of the NAAQS beyond the existing WIPP site boundary at the Carlsbad Site. Therefore, air quality impacts resulting from construction would be small.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.6.9, Human Health and Safety.

Operations Impacts

Pit manufacturing activities would result in the release of criteria and toxic pollutants into the surrounding air. The primary volume contributors are nitrogen and argon, used to maintain inert atmospheres for glovebox operations. Carbon dioxide would be used as a cleaning agent and helium would be used for leak testing operations. Hydrogen and nitrogen dioxide are reaction products from aqueous purification operations (pyrochemical purification would produce lower amounts of hydrogen and nitrogen dioxide). The chemicals used for dye-penetrant testing of welds are assumed to be volatilized and released to the atmosphere. Organic solvents used for cleaning and chemicals used in the Analytical Laboratory for various analyses would not be expected to contribute any appreciable quantities of any other chemicals to the annual nonradioactive air emissions. Air emissions from periodic functional testing support systems (primarily standby diesel generators) include carbon monoxide, nitrogen dioxide, PM_{10}, sulfur dioxide, VOCs, and total suspended particulates (WSRC 2002e). The estimated emission rates (kg/yr) for nonradiological pollutants emitted under each of the three new facility scenarios are presented in Table 5.2.3.1–2. These emissions would be incremental to the Carlsbad Site baseline. If the Carlsbad Site is selected as the preferred site, a PSD increment analysis would be performed under a project-specific tiered EIS to determine whether the pit manufacturing activities would cause a significant pollutant emission increase.

As part of its evaluation of the impact of air emissions, DOE consulted the Guidance on *Clean Air Act* Conformity requirements (DOE 2000d). DOE determined that the General Conformity rule does not apply because the Carlsbad Site is located in an attainment area for all criteria pollutants. Therefore, although each alternative would emit criteria pollutants, a conformity review is not necessary.

The maximum concentrations ($\mu g/m^3$) at the Carlsbad Site boundary that would be associated with the release of criteria pollutants under each of the three plant capacity scenarios (i.e., 125, 250, and 450 ppy) were modeled and are presented in Table 5.6.3.1–1. These concentrations were compared to the most stringent (Federal or state) ambient air quality standards. For each of the three capacity scenarios, incremental concentration increases would be small. For most pollutants, there would be an incremental increase of less than 1 percent of the baseline. The greatest increase would occur for nitrogen dioxide under the 450 ppy scenario, but ambient concentrations would remain below the ambient air quality standard. Since estimated emissions are maximum potential emissions and all emergency generators would not operate at the same time, the estimated emissions and resulting concentrations are conservative.

Table 5.6.3.1–1. Criteria Pollutant Concentrations at the Existing WIPP Site Boundary for the Carlsbad Site for the MPF—Operations

Pollutant	Averaging Period	Most Stringent Standard or guideline [a] (μg/m^3)	Maximum Incremental Concentration (μg/m^3)			
			Baseline [b]	MPF		
				125 ppy	250 ppy	450 ppy
Carbon monoxide	8-hour	7,800	NA	4.5	6.2	10
	1-hour	11,700	NA	6.4	8.8	14
Nitrogen dioxide	Annual	73.7	NA	2.3	3.2	5.2
	24-hour	147	NA	11.1	16	26
Sulfur dioxide	Annual	41	NA	0.16	0.22	0.35
	24-hour	205	NA	0.79	1.1	1.8
	3-hour	1,030	NA	1.8	2.4	4.0
PM_{10}	Annual	50	NA	0.063	0.085	0.14
	24-hour	150	NA	0.31	0.43	0.70
Total Suspended Particulates	Annual	60	NA	0.17	0.23	0.38
	24-hour	150	NA	0.84	1.2	1.9

[a] The more stringent of the Federal and state standards will be presented if both exist for the averaging period.
[b] The No Action Alternative is represented by the baseline. Aiken County ambient concentrations are listed.
NA = not available.
Source: MPF Data 2003, 20 NMAC 2.3.

The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from nonradiological air emissions are presented in Section 5.6.9, Human Health and Safety.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased releases of criteria pollutants. The increase in releases of criteria pollutants from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility releases. Similarly, the increase of criteria pollutants from the 250 ppy plant operating at surge capacity are bounded by the 450 ppy plant releases (see Table 5.6.3.1–1). A review of the maximum incremental concentrations in Table 5.6.3.1–1 indicates that if the maximum incremental concentration of each criteria pollutant for the 450 ppy facility were conservatively doubled for surge capacity, concentrations would still not approach the most stringent standards or guideline concentrations.

5.6.3.2 Radiological Releases

No Action Alternative

Construction Impacts

There would be no radiological releases to the environment because this alternative would not involve construction.

Operations Impacts

Under the No Action Alternative, small quantities of radionuclides would continue to be emitted. These emissions are part of the baseline described in Chapter 4. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.6.9, Human Health and Safety.

Modern Pit Facility Alternative

Construction Impacts

No radiological releases to the environment are expected in association with construction activities. However, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site preparation activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the nature and extent of any contamination and would be required to remediate any contamination in accordance with established site procedures.

Operations Impacts

Radioactive air emissions from pit manufacturing activities would involve plutonium, americium, and enriched uranium. The pit manufacturing activities would be performed within gloveboxes or vaults for radiological containment; and include plutonium recovery using aqueous or pyrochemical processes, foundry, machining, assembly, post assembly operations, inspection and certification, waste handling, and preparing the final product (pits) for shipment. Analytical operations would normally be conducted in laboratories consisting of rooms with gloveboxes and hoods for radiological containment. Each module would be separated from occupied areas of the laboratory facility by airlocks. Sample transfers would occur using a vacuum tube transfer system from the Feed Preparation and Manufacturing Facilities to the Analytical Support Facility. The ventilation exhaust from process and laboratory facilities would be filtered through double banks of HEPA filters before being released to the air via a 30-m (100-ft) tall stack. HEPA filters are the best available control technology for particulate emissions and are capable of removing more than 99.99 percent of entrained particles from the exhaust air.

DOE estimated routine radionuclide air emissions for three different plant capacities: 125, 250, and 450 ppy (see Table 5.6.3.2–1). While radionuclide emissions at WIPP would noticeably increase under each of the three capacity scenarios, the total amount released would be small. To ensure that total emissions are not underestimated, DOE's method for estimating emissions was conservative. Therefore, actual emissions from pit manufacturing operations would be smaller.

Table 5.6.3.2–1. Annual Radiological Air Emissions for the MPF at the Carlsbad Site—Operations

Isotope	Annual Emissions (Ci/yr)			
	Baseline[a,b]	125 ppy	250 ppy	450 ppy
Americium-241	5.05×10^{-19}	2.08×10^{-7}	3.81×10^{-7}	7.61×10^{-7}
Plutonium-239	NA	7.72×10^{-6}	1.19×10^{-5}	2.05×10^{-5}
Plutonium-240	NA	2.01×10^{-6}	3.10×10^{-6}	$5.6.35 \times 10^{-6}$
Plutonium-241	NA	1.48×10^{-4}	2.28×10^{-4}	3.94×10^{-4}
Total Plutonium	$\mathbf{1.04 \times 10^{-18}}$	$\mathbf{1.58 \times 10^{-4}}$	$\mathbf{2.43 \times 10^{-4}}$	$\mathbf{4.20 \times 10^{-4}}$
Uranium-234	8.00×10^{-17}	4.19×10^{-9}	5.58×10^{-9}	8.38×10^{-9}
Uranium-235	4.57×10^{-18}	1.32×10^{-10}	1.76×10^{-10}	2.64×10^{-10}
Uranium-236	NA	2.13×10^{-11}	2.84×10^{-11}	4.26×10^{-11}
Uranium-238	7.84×10^{-17}	1.18×10^{-12}	1.58×10^{-12}	2.36×10^{-12}
Total Uranium	$\mathbf{1.63 \times 10^{-16}}$	$\mathbf{4.34 \times 10^{-9}}$	$\mathbf{5.79 \times 10^{-9}}$	$\mathbf{8.69 \times 10^{-9}}$
Total	$\mathbf{1.64 \times 10^{-16}}$	$\mathbf{1.58 \times 10^{-4}}$	$\mathbf{2.43 \times 10^{-4}}$	$\mathbf{4.21 \times 10^{-4}}$

[a] The No Action Alternative is represented by the baseline.
[b] Onsite emissions only.
NA = not available.
Source: WSRC 2002f.

DOE estimated the radiation doses to the offsite MEI and the offsite population surrounding the Carlsbad Site. As shown in Table 5.6.3.2–2, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The maximum estimated dose to the offsite population residing within an 80-km (50-mi) radius would also be very low. The impacts on the public and on a hypothetical non-involved worker in the vicinity of the processing facilities resulting from radiological air emissions are presented in Section 5.6.9, Human Health and Safety.

Table 5.6.3.2–2. Annual Doses Due to Radiological Air Emissions from MPF Operations at the Carlsbad Site

Receptor	125 ppy	250 ppy	450 ppy
Maximally Exposed Offsite Individual[a] (mrem/yr)	2.3×10^{-8}	3.6×10^{-8}	6.5×10^{-8}
Population within 80 km (50 mi) (person-rem per year)	4.2×10^{-8}	6.8×10^{-8}	1.2×10^{-7}

[a] The offsite MEI is assumed to reside at the site boundary.

Sensitivity Analysis

As discussed in Chapter 3, each plant could operate two shifts, increasing the number of pits produced per year. This increased capacity would result in increased radiological air emissions. The increase in radiological air emissions from the 125 ppy plant operating at surge capacity would be bounded by the 250 ppy facility emissions. Similarly, the increase in radiological air emissions from the 250 ppy plant operating at surge capacity would be bounded by the 450 ppy plant releases (see Table 5.6.3.2–1). A review of the annual radiological emissions in Table 5.6.3.2–1 indicates that if the emissions for the 450 ppy facility were conservatively doubled for surge capacity, concentrations would remain very low. The additional dose represented by these emissions would be well below regulatory limits.

5.6.3.3 Noise

No Action Alternative

Construction Impacts

Under the No Action Alternative, continuing operations at the Carlsbad Site would not involve any new construction. Thus, there would be no impacts from construction noise on wildlife or the public.

Operations Impacts

The noise-generating activities described in Section 4.6.3.5 would continue. These noise-generating activities are included in the Carlsbad Site baseline and are not expected to change under the No Action Alternative.

Modern Pit Facility Alternative

Construction Impacts

Construction of new buildings would involve the movement of workers and construction equipment and would result in some temporary increase in noise levels near the area. Noise sources associated with construction would not include loud impulsive sources such as blasting. Although noise levels in construction areas could be as high as 110 dBA, these high local noise levels would not extend far beyond the boundaries of the construction site. Table 5.2.3.3–1 shows the attenuation of construction noise over relatively short distances. At 122 m (400 ft) from the construction sites, construction noises would range from approximately 55-85 dBA. The *Environmental Impact Data Book* (Golden et al. 1980) suggests that noise levels higher than 80-85 dBA are sufficient to startle or frighten birds and small mammals. Thus, there would be little potential for disturbing wildlife outside a 122-m (400-ft) radius of the construction site. Given the distance to the site boundary (4.6 km [2.8 mi]), there would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Operations Impacts

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise impacts from pit manufacturing operations at the new buildings would be expected to be similar to those from existing operations. There would be an increase in equipment noise (e.g., heating and cooling systems, generators, vents, motors, material-handling equipment) from pit manufacturing activities. However, given the distance to the site boundary (about 4.6 km [2.8 mi]), noise emissions from equipment would not likely disturb the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources (e.g., public address systems and testing of radiation and fire alarms) could have onsite impacts, such as the disturbance of wildlife. But these noise sources would be intermittent and would not be expected to disturb wildlife outside of facility boundaries. Traffic noise associated with the operation of these facilities would occur onsite and along offsite local and regional transportation routes used to bring materials and workers to the site. Noise from traffic associated with the operation of these facilities would likely produce less than a 1-dBA increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance to the public. Impacts would be similar for each of the three plant capacities analyzed (e.g., 125, 250, and 450 ppy) for the MPF.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (29 CFR 1926.52). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Sensitivity Analysis

If any of the three facilities operated at surge capacity, a second shift would be added. However, because of the distance of the facilities to the site boundary, noise from second-shift operations would not be noticeable offsite. Second-shift worker traffic would slightly increase noise levels on local roads. However, most material deliveries would likely occur during normal business hours, so there would be no increase in noise from truck traffic during the second shift. Impacts would be similar for each of the three plant capacities analyzed. Workers on second shift would be exposed to the same level of noise as workers on the first shift. DOE would implement the same hearing protection programs for the second shift as used for the first. The second shift would not affect worker hearing.

5.6.4 Water Resources

Environmental impacts associated with the proposed alternatives at the Carlsbad Site could affect groundwater resources. No impacts to surface water are expected. At the Carlsbad Site, groundwater resources would be used to meet all construction and operations water requirements. Table 5.6.4–1 summarizes existing groundwater resources at the Carlsbad Site, the total site-wide water resource requirements for each alternative, and the potential changes to water resources at the Carlsbad Site resulting from the proposed alternatives.

Table 5.6.4–1. Potential Changes to Water Resources from the MPF at the Carlsbad Site

Affected Resource Indicator	No Action[a]	MPF Alternative		
		125 ppy Single-Shift Operation	250 ppy Single-Shift Operation	450 ppy Single-Shift Operation
Construction – *Water Availability and Use*				
Water source	Ground	Ground	Ground	Ground
Total site water operation requirement (million L/yr)	25.96	36.7	37.8	42.3
Percent change from No Action water use (25.96 million L/yr)	NA	41.2%	45.5%	62.8%
Water Quality				
Wastewater discharge into sewage lagoon and treatment facility	0.082	1.12	1.23	1.59
Percent change from No Action Alternative wastewater discharge	NA	1,265%	1,400%	1,839%
Operations – *Water Availability and Use*				
Water source	Ground	Ground	Ground	Ground
Total site-wide water operation requirement (million L/yr)	25.96	303.4	355.5	530.3
Percent change from No Action water use (13,249 million L/yr)	NA	1,068.6%	1,269.3%	1,942.6%
Water Quality				
Wastewater discharge into sewage lagoon and treatment facility (million L/yr)	0.082	45.08	61.98	81.88
Percent change from No Action Alternative wastewater discharge (0.082 million L/yr)	NA	54,878.0%	75,487.8%	99,756.1%
Floodplain				
Actions in 100-year floodplain	NA	None	None	None
Actions in 500-year floodplain	NA	None	None	None

All discharges to natural drainages require NPDES permits.
[a] Source: DOE 1997b.
Source: MPF Data 2003.

5.6.4.1 Surface Water

No Action Alternative

Under this alternative, additional impacts on surface water resources are anticipated at the Carlsbad Site beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Surface water would not be used to support the construction of the MPF at the Carlsbad Site, as groundwater is the source of water at the Carlsbad Site. Therefore, there would be no impact to surface water availability from construction. Sanitary wastewater would be generated by construction personnel. As plans include use of portable toilets, onsite discharge of sanitary wastewater would be minimized.

During construction, an estimated total of 37.48 million L (9.9 million gal), 41.26 million L (10.9 million gal), and 54.13 million L (14.3 million gal) of liquid wastes would be generated for the 125 ppy, 250 ppy, and 450 ppy facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal generation of liquid waste over that timeframe, it is estimated that approximately 6.25 million L/yr (1.65 million gal/yr), 6.88 million L/yr (1.82 million gal/yr), and 9.02 million L/yr (2.38 million gal/yr) of liquid waste would be generated for the 125, 250, and 450 ppy facilities, respectively. It is estimated that one-third of the liquid waste generated during construction would be from sanitary wastewater, with the remaining amount attributed to concrete construction activities. A NPDES permit for stormwater involving construction activities needs to be obtained to handle water runoff from construction at WIPP.

The potential for stormwater runoff from construction areas to impact downstream surface water quality is small. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) would be employed during construction to minimize suspended sediment and material transport, as well as potential water quality impacts. The Carlsbad Site would comply with Federal and state regulations to prevent, control, and handle potential spills from construction activities. However, the reference location at the Carlsbad Site is not located near any surface water; therefore, no impacts to surface water from potential construction-related spills would be expected.

The MPF reference location at the Carlsbad Site does not lie within the 100-year floodplain and the site is protected from flooding by the diversion of water away from the site by a system of peripheral interceptor diversions. Therefore, no impacts on the 100-year floodplain are anticipated. No information on the 500-year floodplain is available.

Operations Impacts

No impacts on surface water resources are expected as a result of operations at the Carlsbad Site. No surface water would be used to support facility activities, and there would be no discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of operations stemming from staff use of lavatory, shower, and breakroom facilities, and from miscellaneous potable and sanitary uses. It is estimated that 45.0 million L (11.9 million gal), 61.9 million L (16.4 million gal), and 81.8 million L (21.6 million gal) of sanitary wastewater would be generated for the 125 ppy, 250 ppy, and 450 ppy facilities, respectively. These quantities would represent 54,878 percent, 75,488 percent, and 99,756 percent increases, respectively, in sanitary wastewater discharges. WIPP's current discharge plan would require modification and approval concerning the increase in wastewater discharges. Sanitary wastewater would be treated, monitored, and discharged into the existing WIPP sewage lagoon at the Carlsbad Site, as required under the discharge plan. The lagoon would require modifications to handle additional volume. No industrial or other regulated discharges to surface waters are anticipated.

The MPF would not generate any radioactive water emissions. However, there is a potential for generating radioactive contaminated water from the operation and maintenance of safety showers in contaminated areas, the operation of decontamination stations, the mopping of floors in contaminated areas, and the testing of fire sprinkler systems located in contaminated areas. Wastewater that has the potential for being radioactively contaminated would be collected, sampled, and analyzed prior to discharge. Radioactive wastewater would be converted to a solid and disposed of in accordance with DOE procedures. The water emissions that are sampled, analyzed, and determined to be contaminated can be converted to a solid by processing through the MPF liquid process waste facilities for the plutonium purification process.

Sensitivity Analysis

For a 450 ppy facility working a double shift, more wastewater would be generated by the increased number of workers. The sanitary wastewater treatment system would require appropriate modifications to handle the increase in flow.

5.6.4.2 Groundwater

No Action Alternative

Under this alternative, additional impacts on groundwater availability or quality are anticipated at the Carlsbad Site beyond the effects of existing and projected activities. The environment and operations (current and planned) described in Chapter 4 (Affected Environment) would continue.

Modern Pit Facility Alternative

Construction Impacts

Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and meeting the potable and sanitary needs of construction employees. The proposed use of portable toilets by construction personnel would greatly reduce water use over that normally required during construction. In addition, the water required for concrete mixing would likely be procured offsite. As a result, it is estimated that construction activities would require a total of approximately 71.92 million L (19 million gal), 79.49 million L (21 million gal), and 109.79 million L (29 million gal) of groundwater for the 125 ppy, 250 ppy, and 450 ppy capacity facilities, respectively. It is expected that construction should take approximately 6 years. Assuming an equal usage over that timeframe, it is estimated that approximately 10.7 million L (2.8 million gal), 11.8 million L (3.1 million gal), and 16.3 million L (4.3 million gal) would be needed for the 125, 250, and 450 ppy facilities, respectively. The total site water requirement including these quantities would be within WIPP's maximum water allotment of 75.7 million L (20 million gal). It is anticipated that this water would be derived from WIPP's groundwater distribution system via a temporary service connection or trucked to the point-of-use, especially during the early stages of construction.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls and countermeasure plans would be employed to minimize the chance of petroleum, oils, lubricants, and other materials used during construction to be released to the surface or subsurface and to ensure that waste materials are properly disposed. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts

Activities at the Carlsbad Site under the MPF would use groundwater primarily to meet the potable and sanitary needs of facility personnel, as well as for miscellaneous building mechanical uses. A summary of water needs for the MPF by category and total is listed in Table 5.6.4.2–1. The percent change in water consumption for the No Action Alternative ranges from 1,068.6-1,942.6 percent. The current contract between the city of Carlsbad and DOE allows WIPP to obtain up to 75.7 million L/yr (20 million gal/yr) of groundwater. As shown in the table, any of the three production levels would exceed this amount. Because the city of Carlsbad owns rights to a total of 8.6 billion L (2.3 billion gal) of groundwater in the wellfield that currently supplies WIPP (and an additional 12.6 billion L (3.3 billion gal) in an undeveloped wellfield nearby), it appears that sufficient capacity may exist for the increased consumption for the MPF. However, DOE would need to negotiate with the city of Carlsbad to increase its water use over the currently agreed upon amount.

Table 5.6.4.2–1. Summary of Water Consumption During Operations at the Carlsbad Site (million L)

	125 ppy	**250 ppy**	**450 ppy**
Domestic Water	44.9	61.7	81.6
Cooling Tower Makeup	232.5	267.8	422.7
Total	**277.4**	**329.5**	**504.3**
Total needed for site operation	303.4	355.5	530.3
Percent Change from No Action Alternative	1,068.6%	1,269.3%	1,942.6%

Source: MPF Data 2003.

No sanitary or industrial effluent would be discharged to the subsurface. Therefore, no operational impacts on groundwater quality would be expected.

Routine chemical additives would be added to the domestic water to control bacteria and pH, as well as the cooling tower water makeup for bacteria and corrosion control. Table 5.6.4.2–2 summarizes the chemicals added. Use of these types of chemicals is standard and no adverse impacts would be expected.

Table 5.6.4.2–2. Summary of Chemical Additives to Domestic Water and Cooling Tower Water Makeup (kg)

Chemical	125 ppy	250 ppy	450 ppy
Water Chemicals			
Sodium hypochlorite	90	124	164
Sodium hydroxide	58	80	106
Polyphosphate	180	247	327
Cooling Tower Makeup			
Betz Slimicide	120	130	210
Betz 25K series (corrosion inhibitor)	7,000	8,000	12,700

Source: MPF Data 2003.

Sensitivity Analysis

The double shift for 450 ppy would cause a significant increase in water use over the 450 ppy single shift, which is already a 20-fold increase in water use at the site. However, as mentioned above, the city of Carlsbad owns rights to a total of 8.6 billion L (2.3 billion gal) of groundwater in the wellfield that currently supplies WIPP. This total amount of water available to the city is approximately 16 million times the amount of water required for the 450 ppy single shift. DOE would need to negotiate with the city of Carlsbad to supply the required capacity for the 450 ppy double-shift alternative.

5.6.5 Geology and Soils

5.6.5.1 No Action Alternative

Under the No Action Alternative, no additional impacts on geology and soils are anticipated at the Carlsbad Site due the MPF. The environmental impacts and operations (current and planned) described in Chapter 4 would continue. Hazards from large-scale geologic conditions, such as earthquakes, and from other site geologic conditions with the potential to affect existing WIPP facilities at the Carlsbad Site are summarized in Section 4.4.5 and further detailed in the *Waste Isolation Pilot Plant Disposal Phase Final Supplement Environmental Impact Statement* (DOE 1997b).

5.6.5.2 Modern Pit Facility Alternative

Construction Impacts

The construction of the MPF is expected to disturb land adjacent to existing WIPP facilities at the Carlsbad Site. Table 5.2.5.2–1 shows the amount of disturbance for the three different plant sizes. The major differences in the three facility layouts are in the sizes of the detention basin, construction laydown area, and the roads and parking. The area of disturbance was calculated by extending the MPF acreage requirement 9 m (30 ft) from the surrounding roads and the borders of the construction area and Concrete Batch Plant.

Aggregate and other geologic resources (e.g., sand) would be required to support construction activities at the Carlsbad Site, but these resources are abundant in the surrounding area. In addition to new facility construction and upgrades, excavation to remove and replace some existing utility systems would also be conducted. The land area to be disturbed is relatively small; the impact on geologic and soil resources would be relatively minor. The potential exists for fossils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any buried media in accordance with appropriate requirements and agreements. Construction of the MPF would require a stormwater permit that would address erosion control measures to minimize the impacts of erosion.

As discussed in Section 4.5.5, faults located in the vicinity of the Carlsbad Site have little potential for earthquakes. Ground shaking affecting primarily the integrity of inadequately designed or nonreinforced structures might occur, but shaking capable of damaging or slightly damaging properly or specially designed or upgraded facilities is not expected.

Operations Impacts

The operation of the MPF at any of the three capacities would not be expected to result in impacts on geologic and soil resources. New, upgraded, and modified facilities would be evaluated, designed, and constructed in accordance with DOE Order 420.1, which requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Sensitivity Analysis

Utilizing the 450 ppy facility for two-shift operations would not impact geologic or soil resources. A second shift of workers would use the same parking lot as the first shift. No increase in the size of the parking lot is foreseen.

5.6.6 Biological Resources

5.6.6.1 Terrestrial Resources

No Action Alternative

Under the No Action Alternative, impacts on terrestrial resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing Carlsbad Site environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

The area identified for construction of the MPF consists primarily of shrubs and grasses as the most prominent components of the local flora. The blend of plant communities with shin oak/dune habitat that somewhat dominates the grassland affords a composition of factors that results in the diverse wildlife population of the Los Medaños. Wildlife are characterized by a wide variety of amphibians, reptiles, mammals, and birds.

Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of primarily grass and shrub habitat would be cleared or modified during MPF construction. During site-clearing activities, highly mobile wildlife species or wildlife species with large home ranges (such as deer and birds) would be able to relocate to adjacent undeveloped areas. However, successful relocation may not occur due to competition for resources to support the increased population and the carrying capacity limitations of areas outside the proposed development. Species relocation may result in additional pressure to lands already at or near carrying capacity. The impacts could include overgrazing (in the case of herbivores), stress, and over-wintering mortality. For less mobile species (reptiles, amphibians, and small mammals), direct mortality could occur during the actual construction event or ultimately result from habitat alteration. Acreage used for the development also would be lost as potential hunting habitat for raptors and other predators.

Operations Impacts

Impacts to terrestrial resources are very similar regardless of the level of pit production operations (potential pit production capacities of 125, 250, and 450 ppy including surge capacities). The major difference is the size of the modification or loss of grass and shrub plant communities and wildlife habitat. The acreage modified or lost would range from 44-56 ha (110-138 ac) depending upon pit production capacity.

In addition to the areas to be disturbed, there would be a decrease in the quality of habitat immediately adjacent to the proposed development due to increased noise level, traffic, lights, and other human activity, both pre- and post-construction. The adjacent habitat also would experience a loss of quality from the reduction in size, segmentation of the habitat, and restriction on mobility for some species (Kelly and Rotenberry 1993).

There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect terrestrial resources. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential for any adverse affects to plant and animal communities (terrestrial resources) in the surrounding environment.

Sensitivity Analysis

There would be minimal impacts to terrestrial resources during the two-shift operations. Wildlife road strikes (vehicle and wildlife collisions) may increase during morning and evening shift changes due to more vehicle traffic coupled with decreased visibility and higher wildlife activity.

5.6.6.2 Wetlands

Under all alternatives, there would be no impacts to wetlands because no wetlands are present within the Carlsbad Site.

5.6.6.3 Aquatic Resources

No Action Alternative

Under the No Action Alternative, impacts on aquatic resources would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment of the Carlsbad Site and WIPP operations would continue to be an accurate portrayal of the site conditions and current and planned activities not connected with the MPF.

Modern Pit Facility Alternative

Construction Impacts

There are no perennial or seasonal aquatic habitats within the proposed MPF location. Thus, there would be no direct impacts to aquatic resources. Indirect effects to aquatic resources, primarily a few small intermittent creeks or puddles created after spring or summer rains that are used by amphibians within the Carlsbad Site watershed, would be avoided by implementation of standard construction practices to minimize site runoff and erosion along with implementation of a stormwater pollution prevention plan.

Operations Impacts

There would be no direct discharge of untreated operational effluent from MPF operations. Stormwater runoff from new facilities, roadways, parking lots, and other impervious areas are not predicted to result in any indirect adverse impacts on area aquatic resources. The quality of runoff waters would be similar to runoff from other existing built environments and the quantity would represent a very minor contribution to the watershed.

Sensitivity Analysis

There would be no impacts to aquatic resources during the two-shift operations.

5.6.6.4 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, impacts to threatened and endangered species and other special-interest species would not occur since no new facilities would be built and no new operations would be conducted. The Chapter 4 description of the existing environment and operations would continue to be an accurate portrayal of the site conditions and current and planned activities not associated with the MPF.

Modern Pit Facility Alternative

Section 7 of the *Endangered Species Act* requires all Federal agencies to ensure that actions they authorize, fund, or carry out do not jeopardize the continued existence of endangered or threatened species. Agencies must assess potential impacts and determine if proposed projects may affect federally-listed or proposed-for-listing species. None of the species presented in Table 4.6.6.4–1 that identifies Federal- and state-listed species and other special-interest species in the region are known to be present at WIPP.

Construction Impacts

Depending upon the MPF capacity, approximately 62-74 ha (152-182 ac) of grass and shrub vegetation and habitat would be cleared or modified during MPF construction. Should the Carlsbad Site be selected for construction and operation of the MPF, then the DOE, prior to any habitat modifying activities, would conduct site-specific surveys at the appropriate time and assess, in concert with the USFWS, the potential impacts to special-interest species. Acreage temporarily modified from construction would be lost as potential habitat, foraging areas, or hunting habitat for special-interest avian, mammalian, and reptile species until the area revegetates. Revegetation would probably occur within a 1-3 year timeframe depending upon site maintenance and climate conditions.

Operations Impacts

Depending upon pit production capacity, acreage permanently modified or lost as habitat, foraging areas, or as a prey base for species of special-interest would range from 44-56 ha (110-138 ac). There would be no direct untreated effluent discharges to the environment and air emissions would be controlled to levels that would not be expected to adversely affect special-interest species. With implementation and adherence to administrative procedures, along with facility design and engineering controls for pit production, MPF operations would minimize the potential impacts to any individual within a special-interest species population.

Sensitivity Analysis

There would be no impacts to threatened and endangered species during the two-shift operations for surge production.

5.6.7 Cultural and Paleontological Resources

5.6.7.1 Cultural Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to prehistoric, historic, or Native American cultural resources. The cultural resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Under this alternative, a block of land would be disturbed during construction of the MPF. The size of the disturbed area would vary by the output of the facility, and would include the plant buildings and structures (inside the PIDAS fence), security fencing and perimeter roads, support buildings and parking, a detention basin, a Concrete Batch Plant, a Construction Laydown Area, and a 9-m (30-ft) wide buffer zone surrounding the facility. For purposes of analyzing impacts to cultural resources, the three sizes of disturbed areas would be 62 ha (152 ac) (125 ppy), 63 ha (156 ac) (250 ppy), and 74 ha (182 ac) (450 ppy).

The reference location at the Carlsbad Site is within the central 10 km^2 (4 mi^2) of the site that was previously surveyed for cultural resources in the late 1970s. Archaeological sites were recorded throughout this area at that time. Due to the movement of dune fields in this area, it is likely that there are resources within or near the reference location that were not recorded during the 1970s survey. In addition, resources that were recorded in the 1970s survey may now seem to have disappeared, when they are merely covered with sand. Because of the changing dune fields, the presence of resources that would be impacted during construction of MPF at the reference location or any other location at the Carlsbad Site is currently unknown. However, results of unrelated surveys throughout the region indicate that this general area likely contains a medium to high density of resources, relative to the other DOE sites under consideration. The fact that the reference location and many other locations in and around the Land Withdrawal Area have not been disturbed by construction increases the likelihood of resources being located within the area that could be disturbed by MPF construction. Thus, there is a high probability that resources could be impacted during MPF construction at the reference location or any other undisturbed locations at the Carlsbad Site. Although the number of resources that would be impacted is unknown, the probability for resource impacts would increase with an increase in the number of acres disturbed.

Because the exact location of the MPF at the Carlsbad Site is not yet determined, cultural resources arising from infrastructure construction (such as water, sewer, gas, electricity, access roads) are not analyzed in this EIS. Should the Carlsbad Site be selected, it would be analyzed in a site-specific tiered-EIS. However, like the facility itself, the greater the number of acres disturbed, the greater the possibility for impacts to cultural resources.

Prior to any ground-disturbing activity, DOE would identify and evaluate any cultural resources that could potentially be impacted by the construction of the MPF. Methods for identification could include field survey, shovel tests, archival research, and consultation with interested Native American tribes. DOE would determine the possibility for impacts to the resources and implement appropriate measures to avoid, reduce, or mitigate the impacts. Identification, evaluation, determination of impact, and implementation of measures would be conducted in consultation with the New Mexico SHPO and in accordance with the *WIPP Land Management Plan* (DOE 2002a). If previously unknown cultural resources, such as subsurface resources, are discovered during construction, activities in the area of the discovery would stop and the discovery would be evaluated and treated appropriately, as determined by DOE in consultation with the New Mexico SHPO.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on cultural resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have not impact on cultural resources.

5.6.7.2 Paleontological Resources

No Action Alternative

Under the No Action Alternative, there would be no new facility and operations would remain at current and planned levels. Since there would be no construction activities and operations would remain unchanged, there would be no impact to paleontological resources. The paleontological resource environment would remain as described in Chapter 4 (Affected Environment).

Modern Pit Facility Alternative

Construction Impacts

Because of the location of Pleistocene-aged lakes, springs, and seeps near the Carlsbad Site, it is likely that paleontological resources are located on the WIPP site. There has been only one recorded discovery of fossilized remains at WIPP, found 1 km (0.6 mi) away from the reference location. Thus, there is a possibility that paleontological resources would be impacted due to construction of the MPF or the associated infrastructure at the reference location. This is also true for any other area at or near the Carlsbad Site. The probability for impacts to paleontological resources would increase with an increase in the number of acres disturbed.

Paleontological resources would be included in the scope of any cultural resource inventories conducted prior to the beginning of construction. If previously unknown paleontological resources are discovered during construction, activities in the area of the discovery would stop and the discovery would be treated appropriately, as determined by DOE.

Operations Impacts

Operation of the MPF at any of the three capacity levels would have no impact on paleontological resources.

Sensitivity Analysis

Utilization of the 450 ppy facility for two-shift operations would have no impact on paleontological resources.

5.6.8 Socioeconomics

5.6.8.1 Regional Economy Characteristics

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at the Carlsbad Site. Therefore, there would be no impacts to ROI employment, income, labor force, population, housing, or community services in the area.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. Construction of the facility to produce 125 ppy would require a total of 2,650 man-years of labor. During peak construction, 770 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 280 indirect jobs would be created, for a total of approximately 1,050 jobs. This represents approximately 2 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that the majority of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 660 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase 1.3 percent as a result of the new jobs created. Based on the ROI average earnings of $27,600 for the construction industry, direct income would increase by $21.3 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $27.8 million ($21.3 million direct and $6.5 million indirect).

Facility–250 ppy. Construction of the facility to produce 250 ppy would require a total of 2,950 man-years of labor. During peak construction, 850 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 300 indirect jobs would be created, for a total of 1,150 jobs. This represents approximately 2.4 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that the majority of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 740 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase 1.4 percent as a result of the new jobs created. Based on the ROI average earnings of $27,600 for the construction industry, direct income would increase by $23.5 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $30.7 million ($23.5 million direct and $7.2 million indirect).

Facility–450 ppy. Construction of the facility to produce 450 ppy would require a total of 3,800 man-years of labor. During peak construction, 1,100 workers would be employed at the site. In addition to the direct jobs created by the construction of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 390 indirect jobs would be created, for a total of approximately 1,490 jobs. This represents approximately 3 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI and the fact that the construction industry only employs approximately 6 percent of the ROI labor force, it is estimated that the majority of the direct jobs would be filled by workers migrating into the ROI, at least temporarily during the construction period. Approximately 990 construction workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase 1.8 percent as a result of the new jobs created. Based on the ROI average earnings of $27,600 for the construction industry, direct income would increase by $30.4 million at peak construction. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $39.7 million ($30.4 million direct and $9.3 million indirect).

Operations Impacts

Facility–125 ppy. Operation of the facility to produce 125 ppy would require 988 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 240 indirect jobs would be created, for a total of approximately 1,230 jobs. This represents approximately 2.5 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 720 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase 1.9 percent as a result of the new jobs created. Based on the ROI average earnings of $32,500 for the government services industry, direct income would increase by $32.1 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $42.2 million ($32.1 million direct and $10.1 million indirect).

Facility–250 ppy. Operation of the facility to produce 250 ppy would require 1,358 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 330 indirect jobs would be created, for a total of approximately 1,690 jobs. This represents approximately 3.5 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 1,090 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase 2.6 percent as a result of the new jobs created. Based on the ROI average earnings of $32,500 for the government services industry, direct income would increase by $44.1 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $57.9 million ($44.1 million direct and $13.8 million indirect).

Facility–450 ppy. Operation of the facility to produce 450 ppy would require 1,797 workers. In addition to the direct jobs created by the operation of the facility, additional jobs would be created in other supporting industries. It is estimated that approximately 430 indirect jobs would be created, for a total of 2,230 jobs. This represents approximately 4.5 percent of the total ROI labor force.

Due to the low unemployment rate in the ROI, it is estimated that some of the direct jobs would be filled by workers migrating into the ROI. Approximately 1,530 workers from outside the ROI would be required to fill these positions. The current ROI labor force would be sufficient to fill the indirect jobs.

ROI income would increase 3.5 percent as a result of the new jobs created. Based on the ROI average earnings of $32,500 for the government services industry, direct income would increase by $58.4 million annually. This would also generate additional indirect income in supporting industries. The total impact to the ROI income would be approximately $76.7 million ($58.4 million direct and $18.3 million indirect).

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income.

5.6.8.2 Population and Housing

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at the Carlsbad Site. Therefore, there would be no impacts to the ROI population or housing market.

Modern Pit Facility Alternative

Construction Impacts

Facility–125 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,700 new residents would be expected in the ROI, including workers and their families. This is a 1.6 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–250 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,900 new residents would be expected in the ROI, including workers and their families. This is a 1.8 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility– 450 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 2,600 new residents would be expected in the ROI, including workers and their families. This is a 2.4 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Operations Impacts

Facility–125 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 1,900 new residents would be expected in the ROI, including workers and their families. This is a 1.7 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–250 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 2,800 new residents would be expected in the ROI, including workers and their families. This is a 2.6 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Facility–450 ppy. The influx of new workers would increase the ROI population and create new housing demand. A total of 3,900 new residents would be expected in the ROI, including workers and their families. This is a 3.7 percent increase over the current population. The current housing market would likely be sufficient to absorb this increase in the ROI population.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. This would lead to additional increases in ROI employment and income. There would be additional impacts to the ROI population and additional stress on the local housing market because most of these workers would come from outside the ROI.

5.6.8.3 Community Services

No Action Alternative

Under the No Action Alternative, there would be no change in the workforce currently at the Carlsbad Site. Therefore, there would be no impacts to the ROI population or community services in the area.

Modern Pit Facility Alternative

Construction Impacts

Facility–125, 250, or 450 ppy. The increase in population could put an increased demand on local community services. Additional teachers, doctors, police, and fire protection may be required. However, the population is not expected to increase more than 2.4 percent. Comparable levels of service would likely be maintained without significant increases.

Operations Impacts

Facility–125, 250, or 450 ppy. The increase in population could put an increased demand on local community services. Additional teachers, doctors, police, and fire protection may be required. However, the population is not expected to increase more than 3.7 percent. Comparable levels of service would likely be maintained without significant increases.

Sensitivity Analysis

If the facility were operated on a two-shift system, additional employees would be required for the second shift. There would be additional impacts to the ROI population and additional stress on the local community services because most of these workers would come from outside the ROI.

5.6.9 Human Health and Safety

5.6.9.1 Radiological Impacts

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in the Carlsbad Site operations.

Construction Impacts

Under the No Action Alternative, there would be no radiological impacts on members of the public or workers because this alternative would not involve any construction.

Operations Impacts

Under this alternative, the radiological releases to the environment from WIPP would continue at the same rates described in Section 4.6.9. The associated impacts on the general public living within 80 km (50 mi) of WIPP and the offsite MEI would continue at the levels shown in Table 4.6.9.1–2. As shown in that table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The fatal cancer risk to the offsite MEI due to radiological releases from WIPP operations is estimated to be 2.5×10^{-12}.

Under this alternative, the radiation dose received by WIPP workers would continue at the rates described in Section 4.6.9. These worker radiation doses at WIPP are presented for the year 2001 in Table 4.6.9.1–3. The number of projected fatal cancers among WIPP workers from normal operations in 2001 is 4.4×10^{-4}.

Modern Pit Facility Alternative

Construction Impacts

No radiological risks would be incurred by members of the public from construction activities. Construction workers could be at a small radiological risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site, including that associated with residual contamination at the facilities being upgraded. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as reasonably achievable.

Operations Impacts

Impacts to the Public. DOE expects minimal public health impacts from the radiological consequences of MPF operations. Public radiation doses would likely occur from airborne releases only (Section 5.6.3). Table 5.6.9.1–1 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

As shown in the table, the expected annual radiation dose to the offsite MEI would be much smaller than the limit of 10 mrem/yr set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a LCF to this individual from operations would be less than or equal to 3.3×10^{-14} per year (i.e., about 1 chance in 31 trillion per year of a LCF). The projected number of fatal cancers to the population within 80 km (50 mi) would be less than or equal to 6.2×10^{-11} per year (i.e., about 1 chance in 16 billion per year of a LCF).

Table 5.6.9.1–1. Annual Radiological Impacts on the Public from MPF Operations at the Carlsbad Site for All Three Pit Production Rates

Receptor	125 ppy	250 ppy	450 ppy
Population within 80 km			
Collective dose (person-rem)	4.2×10^{-8}	6.8×10^{-8}	1.2×10^{-7}
Percent of natural background radiation[a]	0.00000000012%	0.00000000020%	0.00000000035%
LCFs[b]	2.1×10^{-11}	3.4×10^{-11}	6.2×10^{-11}
Offsite MEI[c]			
Dose (mrem)	2.3×10^{-8}	3.6×10^{-8}	6.5×10^{-8}
Percent of regulatory dose limit	0.000000230%	0.000000360%	0.000000650%
Percent of natural background radiation[a]	0.00000000780%	0.0000000122%	0.0000000220%
Cancer fatality risk[b]	1.2×10^{-14}	1.8×10^{-14}	3.3×10^{-14}

[a] The average annual dose from background radiation at the Carlsbad Site is 295 mrem (see Section 4.3.9); the 117,796 people living within 80 km (50 mi) of the Carlsbad Site in the year 2043 would receive an annual dose of 34,750 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 LCFs per person-rem.
[c] The offsite MEI is assumed to reside at the site boundary, 3,990 m (13,091 ft) northwest from the MPF. An actual residence may not currently be present at this location.

Impacts to MPF Workers. Estimates of annual radiological doses to workers involved with MPF facility operations are independent of geographical location. These dose estimates are solely a function of:

- The number of radiological workers, as determined in the development of the MPF staffing estimate for each throughput alternative. The current estimates were developed by application of a factor to the total workers for each workgroup based on operating experience in plutonium facilities. Approximately 60 percent of total operating staff are estimated to be radiological workers.
- The working dose rate at the glovebox surface for each unit operation or workstation. These dose rates were calculated based on the maximum mass (plutonium, americium) and form (metal, oxide) of material being handled. Standard "weapons grade" isotopic distribution, and americium content of 0.5 percent were assumed.
- The amount of time spent by direct operators/first line supervisors in the radiation area. This was determined from a time-motion estimate of direct "hands-in-gloves" labor required to perform each individual operation and the number of parts processed per year for a given pit production rate. Efficiency scaling factors were applied for various operations. For Foundry and Machining operations, this was assumed to be 50 percent; for Assembly and Post-Assembly & Testing, efficiencies were 90 percent.

As indicated above, the collective annual dose (mrem/yr) received by individual direct operators is calculated based on the number of operators required for the various production rates, the time spent in the radiation area, and the associated dose rates for each operation. The collective exposures for support group workers were added to these numbers and were calculated using empirical data that implies that exposure for these workers can be estimated as a percentage of direct operator exposure (e.g., Analytical Laboratory Technician ~25 percent of direct operator exposure). The average individual dose is calculated as the collective exposure divided by the estimated number of radiological workers for each throughput alternative.

The estimates of annual radiological doses to workers under each of the three pit production rates are provided in Table 5.6.9.1–2. As shown in the table, the annual doses to individual workers for all levels of production would be well below the DOE limit of 5,000 mrem (10 CFR 835.202) and the DOE-recommended control level of 1,000 mrem (10 CFR 835.1002). The projected number of fatal cancers in the workforce from annual operations involving 125 ppy would be 0.064 (or 1 chance in 16 that the worker population would experience a fatal cancer per year of operations). For annual pit production rates of 250 and 450, the projected number of fatal cancers would be 0.12 and 0.22, respectively (or 1 chance in 8 or 5, respectively, that the worker population would experience a fatal cancer per year of operations).

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the MPF under any of the three capacities would approximately double the quantities of radioactive emissions from the MPF presented for single-shift operation at each capacity. Thus, the calculated radiation dose and LCFs to the offsite MEI and the population living within 80 km (50 mi) of the Carlsbad Site would be approximately double.

Table 5.6.9.1–2. Annual Radiological Impacts on MPF Workers at the Carlsbad Site from Operations for All Three Pit Production Rates

Production Rate	125 ppy	250 ppy	450 ppy
Number of Radiological Workers	**550**	**800**	**1,100**
Individual Workers[a]			
Average individual dose, mrem/yr	290	390	510
Average worker cancer fatality risk[b]	1.2×10^{-4}	1.6×10^{-4}	2.0×10^{-4}
Worker Population			
Collective dose (person-rem)	160	310	560
Cancer fatality risk[b]	0.064	0.12	0.22

[a] The regulatory dose limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, the maximum annual dose to a worker would be kept below the DOE Control Level of 1,000 mrem/yr, as established in 10 CFR 835.1002. Further, DOE recommends that facilities adopt a more limiting 500-mrem/yr Administrative Control Level (DOE 1999e). To reduce doses to levels that are as low as is reasonably achievable, an effective dose reduction plan would be enforced.
[b] Based on a cancer risk estimator of 0.0004 LCFs per person-rem.

Similarly, double-shift operation of the MPF under any of the three capacities would approximately double the radiation dose to MPF workers presented for single-shift operation at each capacity. Thus, the calculated adverse health impacts to MPF workers would be approximately double.

5.6.9.2 Nonradiological Impacts

This section considers illness, injury, and fatality rates associated with construction and operation of MPF on the Carlsbad Site workforce. Nonradiological impacts to workers were evaluated using occupational injury, illness, and fatality rates obtained from BLS, U.S.

Department of Labor data. DOE values are historically lower than BLS values owing to the increased focus on safety fostered by complex-wide programs, including ISM and the VPP. Additionally, the small number of fatal accidents reported in the CAIRS makes associated calculated fatality rates statistically invalid.

No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change in injury, illness, and fatality trends currently observed at the Carlsbad Site.

Modern Pit Facility Alternative

Construction Impacts

The potential risk of occupational injuries and fatalities to workers constructing the MPF would be expected to be bounded by injury and fatality rates for general industrial construction. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for both the peak workforce loading and for the duration of construction activities including site preparation (6¾ years). These values are shown below in Table 5.6.9.2–1.

Table 5.6.9.2–1. Injury, Illness, and Fatality Estimates for Construction of the MPF at the Carlsbad Site

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Peak Annual Employment	770	850	1,100
Total Recordable Cases	66	73	95
Total Lost Workday Cases	32	35	46
Total Fatalities	0.16	0.17	0.023
Project Duration (6¾ years)			
Total Recordable Cases	228	254	328
Total Lost Workday Cases	110	122	157
Total Fatalities	0.54	0.60	0.78

Source: MPF Data 2003, BLS 2002b.

No chemicals have been identified that would be a risk to members of the public from construction activities associated with any of the MPF operating capacities. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. Implementation of ISMS programs to construction activities would also decrease the potential for worker exposures by providing hazards identification and control measures for construction activities (WSRC 2002c).

Operations Impacts

During normal (accident-free) operations, total facility staffing would range from approximately 988-1,797, depending on the operating capacity of the selected MPF. The potential risk of occupational injuries and fatalities to workers operating the MPF would be expected to be bounded by injury and fatality rates for general chemical manufacturing. Using BLS data for 1997-2001, Total Recordable Cases, Lost Workday Cases, and Fatalities were estimated for facility populations estimated for each of the operating capacities. These values are shown below in Table 5.6.9.2–2.

Table 5.6.9.2–2. Injury, Illness, and Fatality Annual Estimates for Normal Operations of the MPF at the Carlsbad Site

Injury, Illness, and Fatality Categories	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Total Recordable Cases	43	59	78
Total Lost Workday Cases	22	30	40
Total Fatalities	0.04	0.05	0.07

Source: MPF Data 2003, BLS 2002b.

No chemical-related health impacts are associated with normal (accident-free) operations of the MPF at the three identified operating capacities. Initial screens for the hazard analysis did not result in the identification of any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by facility safety programs such as ISMS, work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness (WSRC 2002c).

Sensitivity Analysis

DOE could operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the WIPP illness and injury rates for facility associated activities. No chemical-related health impacts would be associated with this increase in operations.

5.6.10 Facility Accidents

This section presents the potential impacts on workers (both involved and non-involved) and the public due to potential accidents associated with operation of the MPF at the Carlsbad Site. Additional details supporting the information presented here are provided in Appendix C.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.
- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.
- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, DOE predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident.

Emergency Preparedness

Each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

5.6.10.1 No Action Alternative

Under the No Action Alternative, all current activities would continue at existing levels. Potential accident scenarios for the No Action Alternative are addressed in existing documentation included by reference (DOE 1996c).

5.6.10.2 Modern Pit Facility Alternative

Radiological Impacts

DOE estimated radiological impacts to three receptors: (1) the offsite MEI at the WIPP boundary; (2) the offsite population within 80 km (50 mi) of WIPP; and (3) a non-involved worker 1,000 m (3,281 ft) from the accident location. DOE did not evaluate total dose to non-involved workers because of the uncertain nature of worker locations at the time of the accident.

Tables 5.6.10.2–1 through 5.6.10.2–3 show the frequencies and consequences of the postulated set of accidents for the public (offsite MEI and the general population living within 80 km [50 mi] of the facility) and a hypothetical non-involved worker for the three pit production rates. The dose shown in the tables are calculated by the MACCS computer code based on accident data. The LCF values are calculated using a dose-to-LCF conversion factor. For the MEI and the population the conversion factor is 0.0005 LCFs per rem or person-rem, respectively. For workers, the dose-to-risk conversion factor is 0.0004 LCFs per rem. If the dose to an MEI or worker exceeds 20 rem, the dose-to-risk conversion factor is doubled to 0.001 and 0.0008, respectively. Tables 5.6.10.2–4 through 5.6.10.2–6 show the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *Topical Report - Supporting Documentation for the Accident Impacts Presented in the Modern Pit Facility Environmental Impact Statement* (Tetra Tech 2003). The selection process, screening criteria used, and conservative estimates of material at risk and source term (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at the MPF. Thus, in the event that any other accident that was not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5.6.10.2–1. MPF Alternative Radiological Accident Frequency and Consequences at the Carlsbad Site for 125 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	50.3	0.05	3,000	1.5	331	0.27
Fire in a Single Building						
1×10^{-4}	26.5	0.027	1,380	0.69	206	0.17
Explosion in a Feed Casting Furnace						
1×10^{-2}	31.1	0.031	1,620	0.81	241	0.19
Nuclear Criticality						
1×10^{-2}	9.9×10^{-5}	5.0×10^{-8}	0.0046	2.3×10^{-6}	0.00076	3.0×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	2.1	0.001	108	0.054	16.1	0.0064
Radioactive Material Spill						
1×10^{-2}	0.62	0.00031	32.3	0.016	4.83	0.0019

CRT = Cargo Restraint Transporter.
[a] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of the Carlsbad Site.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.6.10.2–2. MPF Alternative Radiological Accident Frequency and Consequences at the Carlsbad Site for 250 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	51.8	0.052	3,090	1.55	341	0.27
Fire in a Single Building						
1×10^{-4}	27.5	0.028	1,430	0.72	214	0.17
Explosion in a Feed Casting Furnace						
1×10^{-2}	31.1	0.031	1,620	0.81	241	0.19
Nuclear Criticality						
1×10^{-2}	9.9×10^{-5}	5.0×10^{-8}	0.0046	2.3×10^{-6}	0.00076	3.0×10^{-7}
Fire-induced Release in the CRT Storage Room						
1×10^{-2}	2.1	0.001	108	0.054	16.1	0.0064
Radioactive Material Spill						
1×10^{-2}	0.62	0.00031	32.3	0.016	4.83	0.0019

[a] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of the Carlsbad Site.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

Table 5.6.10.2–3. MPF Alternative Radiological Accident Frequency and Consequences at the Carlsbad Site for 450 ppy

Frequency (per year)	Offsite MEI		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire						
1×10^{-5}	99.8	0.1	5,950	2.98	657	0.53
Fire in a Single Building						
1×10^{-4}	53.3	0.053	2,770	1.39	414	0.33
Explosion in a Feed Casting Furnace						
1×10^{-2}	31.1	0.031	1,620	0.81	241	0.19
Nuclear Criticality						
1×10^{-2}	9.9×10^{-5}	5.0×10^{-8}	0.0046	2.3×10^{-6}	0.00076	3.0×10^{-7}
Fire-induced release in the CRT Storage Room						
1×10^{-2}	4.14	0.0021	216	0.11	322	0.026
Radioactive Material Spill						
1×10^{-2}	0.62	0.0031	32.3	0.016	4.83	0.0019

[a] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of the Carlsbad Site.
[b] Increased likelihood of a LCF.
[c] Increased number of LCFs.

The accident with the highest risk to the offsite population (see Tables 5.6.10.2–4 through 5.6.10.2–6) is the explosion in a glovebox feed casting furnace for the 125 ppy, 250 ppy and 450 ppy production cases. The increased number of LCFs in the offsite population would be 0.0081 per year (i.e., about 1 chance in 120 per year of a LCF in the total population) for all three production cases. The highest risk of a LCF to an offsite MEI located 3,222 m (10,571 ft) north-northwest from the accident would be 0.00031 per year (i.e., about 1 chance in 3,200 per year of a LCF) for all three production cases. The highest risk of a LCF to a non-involved worker located 1,000 m (3,281 ft) from the accident would be 0.0019 per year (i.e., about 1 chance in 525 per year of a LCF) for all three production cases.

Table 5.6.10.2–4. Annual Cancer Risks Due to MPF Accidents at the Carlsbad Site for 125 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	5.0×10^{-7}	1.5×10^{-5}	2.7×10^{-5}
Fire in a Single Building	2.7×10^{-6}	6.9×10^{-5}	1.7×10^{-5}
Explosion in a Feed Casting Furnace	0.00031	0.0081	0.0019
Nuclear Criticality	5.0×10^{-10}	2.3×10^{-8}	3.0×10^{-9}
Fire-induced Release in the CRT Storage Room	1.0×10^{-5}	0.00054	6.4×10^{-5}
Radioactive Spill Material	3.1×10^{-6}	0.00016	1.9×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of the Carlsbad Site.

Table 5.6.10.2–5. Annual Cancer Risks Due to MPF Accidents at the Carlsbad Site for 250 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	5.2×10^{-7}	1.6×10^{-5}	2.7×10^{-6}
Fire in a Single Building	2.8×10^{-6}	7.2×10^{-5}	1.7×10^{-5}
Explosion in a Feed Casting Furnace	0.00031	0.0081	0.0019
Nuclear Criticality	5.0×10^{-10}	2.3×10^{-8}	3.0×10^{-8}
Fire-induced Release in the CRT Storage Room	1.0×10^{-5}	0.00054	6.4×10^{-5}
Radioactive Spill Material	3.1×10^{-6}	0.00016	1.9×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of the Carlsbad Site.

Table 5.6.10.2–6. Annual Cancer Risks Due to MPF Accidents at the Carlsbad Site for 450 ppy

Accident	Offsite MEI[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.0×10^{-6}	3.0×10^{-5}	5.3×10^{-6}
Fire in a Single Building	5.3×10^{-6}	0.00014	3.3×10^{-5}
Explosion in a Feed Casting Furnace	0.00031	0.0081	0.0019
Nuclear Criticality	5.0×10^{-10}	2.3×10^{-8}	3.0×10^{-9}
Fire-induced Release in the CRT Storage Room	2.1×10^{-5}	0.0011	0.00026
Radioactive Spill Material	3.1×10^{-6}	0.00016	1.9×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased number of LCFs.
[c] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of the Carlsbad Site.

Hazardous Chemicals Impacts

DOE estimated the impacts of the potential release of the most hazardous chemicals used at the MPF. A chemical's vapor pressure, acceptable concentration (ERPG-2), and quantity available for release are factors used to rank a chemical's hazard. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Additional information on the evaporation and dispersion of each chemical is provided in Appendix C. Tables 5.6.10.2–7 through 5.6.10.2–9 provide information on each chemical and the frequency and consequences of an accidental release. The source term shown represents the amount of the chemical that is accidentally released. The American Industrial Hygiene Association defines the ERPG-2 as the maximum airborne concentration below which 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. The distance from the release point to the point where the ERPG-2 concentration is reached in relation to the site boundary reflects the consequence of the chemical's release. As the distance to the ERPG-2 point increases, the potential number of persons onsite and offsite that may be exposed to concentrations in excess of ERPG-2 would be expected to increase. The distance to the nearest site boundary is 2.3 km (1.4 mi). None of the chemicals released in an accident would exceed ERPG-2 limits offsite.

Table 5.6.10.2–7. MPF Alternative Chemical Accident Frequency and Consequences at the Carlsbad Site for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.3 km (ppm)	
Nitric acid	10,500	6	1.0	6.18	1.57	10^{-4}
Hydrofluoric acid	550	20	0.81	12.7	2.49	10^{-4}
Formic acid	1,500	10	0.28	0.97	0.24	10^{-4}

[a] Site boundary is at a distance of 2.3 km (1.4 mi) east.

Table 5.6.10.2–8. MPF Alternative Chemical Accident Frequency and Consequences at the Carlsbad Site for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.3 km (ppm)	
Nitric acid	21,000	6	1.5	11.9	3.04	10^{-4}
Hydrofluoric acid	1,100	20	1.1	24.9	4.86	10^{-4}
Formic acid	3,000	10	0.39	1.88	0.47	10^{-4}

[a] Site boundary is at a distance of 2.3 km (1.4 mi) east.

Table 5.6.10.2–9. MPF Alternative Chemical Accident Frequency and Consequences at the Carlsbad Site for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.3 km (ppm)	
Nitric acid	40,000	6	2.3	21.9	5.64	10^{-4}
Hydrofluoric acid	2,000	20	1.5	43.7	8.71	10^{-4}
Formic acid	5,500	10	0.54	3.36	0.85	10^{-4}

[a] Site boundary is at a distance of 2.3 km (1.4 mi) east.

Involved Worker Impacts

For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Prediction of potential health effects becomes increasingly difficult to quantify as the distance between the accident location and the receptor decreases. This is because the individual worker exposure cannot be adequately defined with respect to the presence of shielding and other protective features. The worker also may be acutely injured or killed by physical effects of the accident.

The number of workers that would be at the MPF during operations would range from 988-1,797 (including security guards). Each process facility within the MPF would have attached safe haven structures designed in accordance with a number of life safety, fire protection, and safeguards and security requirements. These structures are required for personnel protection during various accident scenarios and are made of reinforced concrete similar in design to the process building wall construction. They would be designed to accommodate 120 percent of the building occupancy for a number of hours and would require their own independent ventilation systems (WSRC 2002b).

The facility ventilation system would control dispersal of any airborne radiological debris from the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk of injury.

5.6.11 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as being Black or African American; American Indian or Alaska Native; Asian; Native Hawaiian and other Pacific Islander; or another non-White race; or persons of Hispanic or Latino ethnicity. Persons whose incomes are below the Federal poverty threshold are designated low-income.

For the Carlsbad Site, this 80-km (50-mi) area includes portions of Chaves, Eddy, and Lea Counties in New Mexico, and Loving, Culberson, and Winkler Counties in Texas. Table 5.6.11–1 provides the racial and ethnic composition of these counties based on the 2000 Census, as well as the number of people below the poverty level. Figure 5.6.11–1 shows the minority populations located with an 80-km (50-mi) radius of the site. Figure 5.6.11–2 shows the low-income populations located within the same 80-km (50-mi) radius. This study area corresponds to the region of potential radiological impacts. Figures 5.6.11–1 and 5.6.11–2 show the distribution of these populations throughout the area around the site.

Table 5.6.11–1. Racial, Ethnic, and Socioeconomic Composition Surrounding the Carlsbad Site

Population Group	Population	Percent of Total
Hispanic or Latino	83,889	43.7
Black or African American	4,481	2.3
American Indian and Alaska Native	1,214	0.6
Asian	765	0.4
Native Hawaiian and Other Pacific Islander	44	0.0
Other Race	128	0.1
Two or More Races	1,889	1.0
White	99,493	51.8
Total	**191,903**	**100**

In 2002, minority populations comprised 30.9 percent of the U.S. population, and 50.5 percent of the New Mexico population. The percentage of minority populations in the area surrounding WIPP is 48.1 percent, more than that in the United States but less than the entire State of New Mexico.

Low-income populations comprised 12.4 percent of the U.S. population, based on 1999 income, and 18.4 percent of the New Mexico population. Within the counties surrounding WIPP, 20.6 percent of the population lives below the poverty level.

As shown in Section 5.6.9, Human Health and Safety, there are no large adverse impacts to any populations. Therefore, there would be no disproportionately high and adverse impacts to minority or low-income populations.

5.6.12 Transportation

Impacts to the human environment from transportation can result from two sources: operation of the vehicle and the presence of the cargo. Vehicle-related impacts could include increased emissions, traffic congestion, noise, and traffic accidents. Cargo-related impacts could include incident-free radiation dose to those on and near the highway and radiation dose or chemical exposure from the cargo when the containers are breached following an accident.

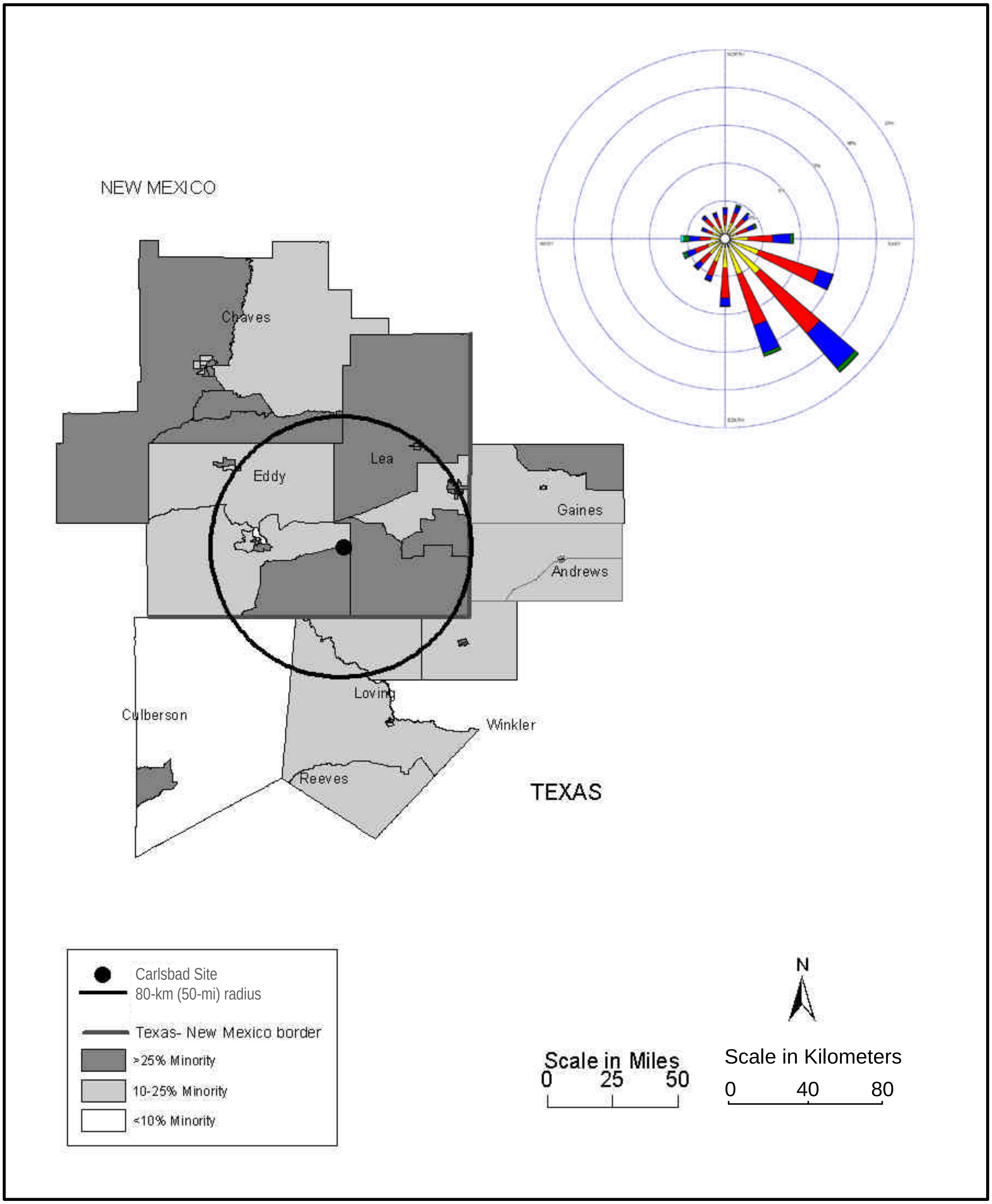

Figure 5.6.11–1. Distribution of the Minority Population Surrounding the Carlsbad Site

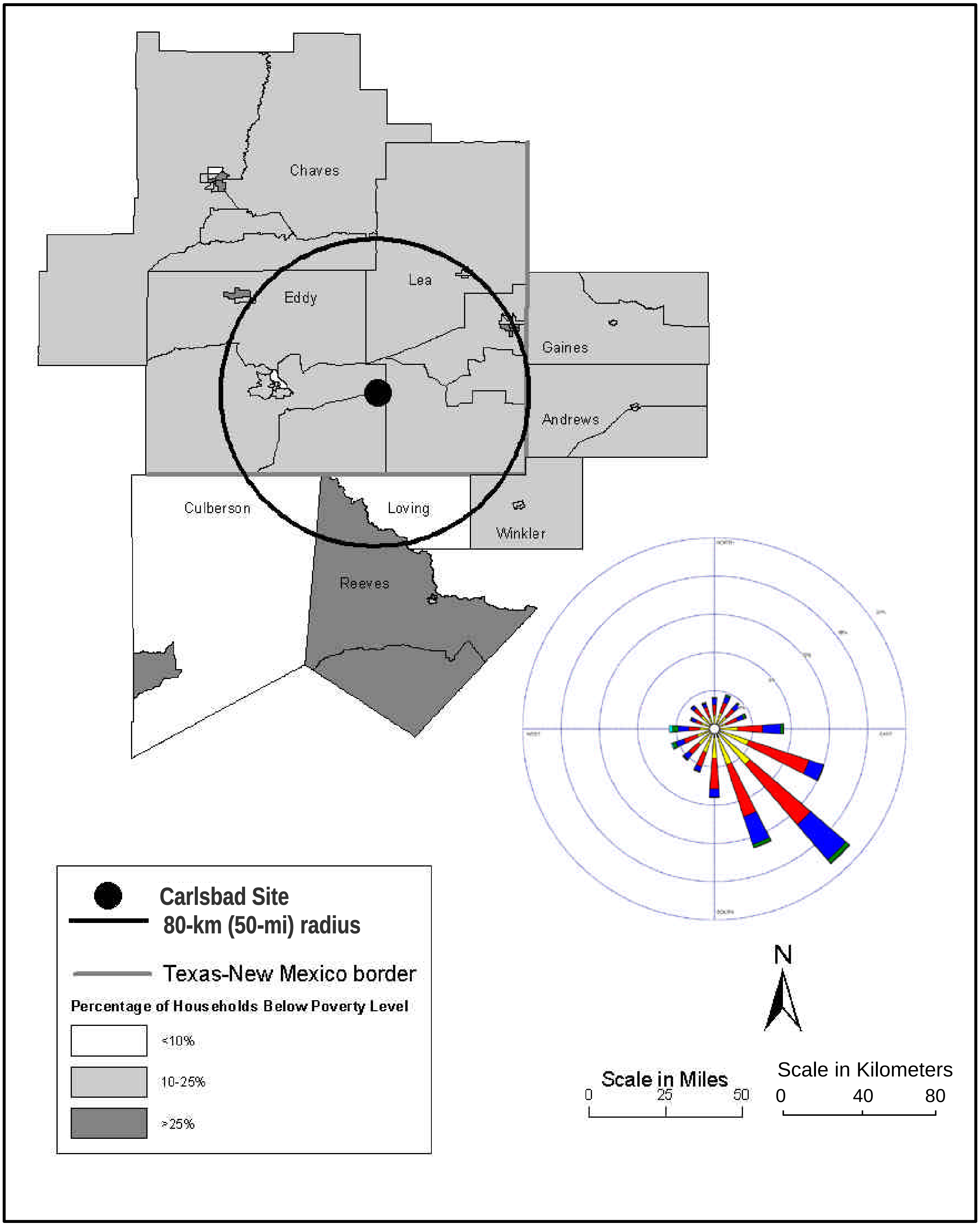

Figure 5.6.11–2. Distribution of the Low-Income Population Surrounding the Carlsbad Site

This EIS is primarily concerned with determining a candidate DOE site for MPF. A second EIS would be prepared once a DOE site is identified for more detailed analysis. Accordingly, this EIS focuses on a limited suite of analyses that will most specifically aid decisionmakers in distinguishing transportation impacts among the five DOE sites under consideration. NNSA has selected for quantitative analysis incident-free radiation dose to workers and the public, accident radiation dose-risk (which includes the probability of the accident occurring) to all individuals affected by the accident, and traffic accident fatalities. In addition, the analysis presents a qualitative discussion on traffic impacts near the DOE facility under both construction and operations. Traffic impacts would result from commuting workers and construction deliveries. Other potential analytical endpoints are roughly proportional to the analyzed endpoints and would yield similar relative distinction among the five DOE sites.

Appendix D presents DOE's methodology in analyzing the selected analytical endpoints and provides some detail on the calculations, including the more important analytical parameters.

5.6.12.1 No Action Alternative

Under the No Action Alternative, transportation of TRU waste between LANL and the Carlsbad Site would have impacts that are assigned to LANL. See Section 5.2.12.1.

5.6.12.2 Modern Pit Facility Alternative

Construction Impacts

Construction of a new facility at the Carlsbad Site would result in increased traffic due to commuting construction workers and deliveries of construction materials and equipment. Although this traffic increase would tend to increase congestion on local roads, the increase would be small compared to the average daily traffic levels reported in Section 4.6.10 and would be temporary.

Operations Impacts

Radiological transportation under the MPF Alternative for the Carlsbad Site would include transport of pits from Pantex (near Amarillo, Texas) to the Carlsbad Site, recycle of enriched uranium parts to and from Y-12 (Oak Ridge, Tennessee), return of pits, and enriched uranium parts to Pantex, and shipment of LLW to NTS (Nye County, Nevada). TRU waste would be disposed of at WIPP. DOE's analysis includes options for processing 125, 250, and 450 ppy. Table 5.6.12.2–1 presents the number of shipments for the MPF Alternative. Tables 5.6.12.2–2 and 5.6.12.2–3 present incident-free impacts from this transportation. Tables 5.6.12.2–4 and 5.6.12.2–5 present the accident impacts.

Table 5.6.12.2–1. Numbers of Shipments per Year at the Carlsbad Site for the MPF

Transported Materials	125 ppy	250 ppy	450 ppy
Pits	14	28	50
EU Parts	10	20	36
LLW	136	217	331
Total	**160**	**265**	**417**

Table 5.6.12.2–2. Annual Incident-Free Transportation Impacts to Workers at the Carlsbad Site for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.057	2.3×10^{-5}	0.11	4.6×10^{-5}	0.20	8.2×10^{-5}
EU parts	0.16	6.2×10^{-5}	0.31	1.2×10^{-4}	0.56	2.2×10^{-4}
LLW	3.5	1.4×10^{-3}	5.5	2.2×10^{-3}	8.4	3.4×10^{-3}
Total	**3.7**	**1.5 ´ 10^{-3}**	**6.0**	**2.4 ´ 10^{-3}**	**9.2**	**3.7 ´ 10^{-3}**

Table 5.6.12.2–3. Annual Incident-Free Transportation Impacts to the General Public at the Carlsbad Site for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs	Collective Dose (person-rem)	LCFs
Pits	0.072	3.6×10^{-5}	0.14	7.2×10^{-5}	0.26	1.3×10^{-4}
EU parts	0.24	1.2×10^{-4}	0.47	2.4×10^{-4}	0.85	4.3×10^{-4}
LLW	2.3	1.2×10^{-3}	3.7	1.9×10^{-3}	5.7	2.8×10^{-3}
Total	**2.6**	**1.3 ´ 10^{-3}**	**4.3**	**2.2 ´ 10^{-3}**	**6.8**	**3.4 ´ 10^{-3}**

Table 5.6.12.2–4. Annual Transportation Accident Radiological Impacts at the Carlsbad Site for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs	Dose Risk (person-rem)	LCFs
Pits	6.1×10^{-8}	3.1×10^{-11}	1.2×10^{-11}	6.1×10^{-11}	2.2×10^{-7}	1.1×10^{-10}
EU parts	2.3×10^{-10}	1.2×10^{-13}	4.7×10^{-10}	2.3×10^{-13}	8.4×10^{-10}	4.2×10^{-13}
LLW	4.3×10^{-4}	2.2×10^{-7}	6.9×10^{-4}	3.5×10^{-7}	1.1×10^{-3}	5.3×10^{-7}
Total	**4.3 ´ 10^{-4}**	**2.2 ´ 10^{-7}**	**6.9 ´ 10^{-4}**	**3.5 ´ 10^{-7}**	**1.1 ´ 10^{-3}**	**5.3 ´ 10^{-7}**

The addition of 988-1,797 new employees under the three capacity options would represent an increase in the Carlsbad Site employment ranging from 95-170 percent, with a corresponding increase in commuting traffic. Although this employment increase is large, the increase in congestion on local roads would be small compared to the average daily traffic levels reported in Section 4.6.10, and the highway capacities are sufficient to absorb the increase.

Table 5.6.12.2–5. Annual NonRadiological Fatalities from Transportation Accidents at the Carlsbad Site for the MPF

Transported Materials	125 ppy		250 ppy		450 ppy	
	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities	Number of Accidents	Number of Fatalities
Pits	2.3×10^{-3}	1.5×10^{-4}	4.5×10^{-3}	2.9×10^{-4}	8.1×10^{-3}	5.2×10^{-4}
EU parts	8.8×10^{-3}	4.8×10^{-4}	0.018	9.5×10^{-4}	0.032	1.7×10^{-3}
TRU waste	0.030	2.3×10^{-3}	0.05	3.7×10^{-3}	0.073	5.6×10^{-3}
Total	**0.041**	**2.9 ´ 10^{-3}**	**0.070**	**4.9 ´ 10^{-3}**	**0.11**	**7.8 ´ 10^{-3}**

Sensitivity Analysis

Should DOE elect to operate a new 450 ppy facility at the Carlsbad Site in two shifts, the impacts would increase. The incident-free doses for the 450 ppy facility reported in Tables 5.6.12.2–2 and 5.6.12.2–3 would increase by approximately the factor 1.8 because the number of shipments would increase. The accident values in Table 5.6.12.3–4 would also increase by a factor of 1.8 because of increased probability of the accident; however, the consequences of an accident, should one occur, would not change. The duration of traffic congestion during shift change would increase.

5.6.13 Waste Management

This section considers the burden that waste generation associated with construction and operation of the MPF places on the WIPP waste treatment, storage, and disposal infrastructure. Impacts are evaluated based on routine waste generation, excluding wastes generated from environmental restoration or D&D activities. Impacts associated with transportation of radioactive waste from the Carlsbad Site to offsite disposal facilities are provided in Section 5.6.12.

5.6.13.1 No Action Alternative

Under the No Action Alternative, DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. There would be no change to the current and planned Carlsbad Site waste management activities described in Section 4.6.11.

5.6.13.2 Modern Pit Facility Alternative

Construction Impacts

Construction of the MPF would generate solid and liquid sanitary waste and liquid hazardous waste. Table 5.6.13.2–1 summarizes the total volume of waste generated over the 6 years of construction activity for the three proposed MPF operating capacities.

Table 5.6.13.2–1. Total Waste Generation from Construction of the MPF (m^3)

Waste type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
Hazardous waste	4.9	5.1	5.9
Sanitary waste	7,110	7,870	11,200
Sanitary wastewater	37,500	41,300	54,100

Source: MPF Data 2003.

The Carlsbad Site currently manages small quantities of site-generated waste. It has limited waste management infrastructure other than TRU waste management capabilities associated with repository operations.

Nonhazardous wastes may be disposed of in the onsite construction debris landfill in Section 6 or at an offsite landfill. Although construction of the MPF would result in a two- to three-fold increase in the annual routine sanitary waste generation relative to current the Carlsbad Site operations, the disposal facilities are expected to have adequate capacity to handle the projected amount of waste during MPF construction.

MPF construction activities would increase the annual routine hazardous waste generation by less than 3 percent over current WIPP operations. Hazardous wastes would be managed in satellite accumulation areas or the less-than-90-day storage area (Section 474) pending shipment offsite for treatment and disposal at a commercial facility. Commercial treatment is readily available and currently used to treat WIPP hazardous wastes.

The projected sanitary wastewater volumes for the three proposed MPF operating capacities are 17,100, 18,800, and 24,700 L/day (4,500, 5,000, and 6,500 gal/day). The daily discharge limit for the WIPP sewage treatment facility includes 87,064 L (23,000 gal) of domestic wastewater. Even at the lowest proposed pit manufacturing capacity, the combination of MPF operations and repository operations could exceed the capacity of the existing sewage treatment facility. Treatment of the MPF wastewater would require an expansion of the existing sewage treatment facility or construction of a new facility to service the MPF workforce.

A detention pond would be constructed to manage stormwater runoff from the entire MPF site including the Construction Laydown Area and Concrete Batch Plant. The basin would be sized to limit stormwater discharge from the developed site to no greater than the pre-existing conditions, with a basin area of approximately 0.4 ha (1 ac) per 16 ha (40 ac) of developed land.

A Concrete Batch Plant would operate at the MPF site during the construction phase. The Concrete Batch Plant would include a basin to manage wastewater from equipment wash out activities. The facility would be located on approximately 4 ha (10 ac) adjacent to the PIDAS area. The Concrete Batch Plant would be disassembled and the area would be restored once MPF construction is completed.

Operations Impacts

Normal operation of the MPF would generate TRU waste, LLW, mixed LLW, hazardous waste, and sanitary waste. Table 5.6.13.2–2 summarizes the estimated waste generation rates for the three proposed MPF operating capacities.

Table 5.6.13.2–2. MPF Operations Annual Waste Generation (m^3)

Waste type	MPF Operating Capacity		
	125 ppy	250 ppy	450 ppy
TRU waste	590	740	1,130
LLW	2,070	3,300	5,030
Mixed LLW—solid	1.5	2.0	3.5
Mixed LLW—liquid	0.2	0.4	0.7
Hazardous waste—solid	2.5	3.0	5.0
Hazardous waste—liquid	0.3	0.4	0.6
Sanitary waste	5,500	5,800	6,900
Sanitary wastewater	45,000	61,900	81,800

Source: MPF Data 2003.

Because the Carlsbad Site currently manages only small quantities of site-generated waste, MPF operations would require a substantial increase in the waste management infrastructure at the Carlsbad Site.

Except for site-derived waste, Carlsbad Site operations do not generate TRU waste. Although there is considerable knowledge of TRU waste management requirements, there are no provisions for managing newly-generated (i.e., non-site-derived waste) at this time. TRU waste generated from plutonium pit manufacturing includes gloves, filters, and other operations/maintenance waste from the MPF gloveboxes. Americium process waste would be solidified and packaged as TRU waste. About 36 percent of the TRU waste would be mixed waste. The TRU waste would be transferred from the MPF process buildings to the Waste Staging/TRU Packaging Building, which would be located outside of the PIDAS. The Waste Staging/TRU Packaging Building would include a staging area with capacity for approximately 1,200 TRU waste drums (about 250 m^3 [8,829 ft^3] of TRU waste). The capability to load waste drums into TRUPACT-II shipping containers and load the TRUPACT-II containers onto trucks would not be required under this alternative. Waste drums could be transferred directly to the WIPP Waste Handling Building at the Carlsbad Site.

The size of the Waste Staging/TRU Packaging Building (approximately 1,950 m^2 [20,990 ft^2]) is not expected to vary with the MPF operating capacity but may be reduced somewhat by eliminating the TRUPACT-II loading requirements. Section 6.5 discusses the availability of the WIPP or another facility for disposal of TRU waste resulting from MPF operations.

LLW from MPF operations would include job control waste, failed equipment, and other general operations/maintenance waste. Any liquid LLW resulting from MPF operations would be solidified prior to leaving the facility. Site-derived LLW is packaged and disposed in the underground Hazardous Waste Disposal Units (HWDUs) comprising the repository. Under current regulatory constraints, it is unlikely that LLW not associated with repository operations would be accepted in the HWDUs. For purposes of analysis, DOE assumed the LLW from MPF operations would be shipped offsite for disposal. If the Carlsbad Site were selected as the host site for the MPF, the tiered site-specific EIS would evaluate the reasonableness of establishing an on-site LLW disposal facility.

Section 5.6.12 describes the impacts for LLW transportation from the Carlsbad Site to NTS. At this time, there is no infrastructure at the Carlsbad Site to support storage of LLW until it can be shipped offsite for disposal.

MPF operations would generate small amounts of hazardous waste and mixed LLW. These wastes include lead acid batteries, lubricating oils/fluids, rags, and sorbents. The projected hazardous waste volumes from MPF operations represent about 7.4-15 percent of the annual routine waste volumes currently managed at WIPP. Commercial treatment is readily available and currently used to treat Carlsbad Site hazardous wastes.

The Carlsbad Site does not routinely generate mixed LLW. Any site-derived mixed LLW is packaged for disposal in the HWDUs. Under current regulatory constraints, it is unlikely that mixed LLW not associated with repository operations would be accepted in the HWDUs. The mixed LLW from MPF operations would be transferred to an offsite DOE or commercial treatment or disposal facility. At this time, there is no infrastructure at the WIPP site to support storage of mixed LLW until it can be shipped offsite for disposal.

Nonhazardous waste from MPF operations includes sanitary solid waste and wastewater. Solid wastes may be disposed in the onsite construction debris landfill in Section 6. The remainder would be transferred to an offsite landfill. MPF operations would increase the annual routine waste generation by a factor of 9.5-12 relative to current Carlsbad Site operations. This increase would accelerate DOE’s consumption of the available capacity of these disposal facilities.

The projected sanitary wastewater volumes for the three proposed MPF operating capacities are 123,000, 170,000 and 224,000 L/day (32,600, 44,800, and 59,200 gal/day). The daily discharge limit for the WIPP sewage treatment facility includes 87,064 L (23,000 gal) of domestic wastewater. Even at the lowest proposed pit manufacturing capacity, MPF operations would exceed the capacity of the existing sewage treatment facility. Treatment of the MPF wastewater would require an expansion of the existing sewage treatment facility or construction of a new facility to service the MPF workforce.

MPF operations are not expected to generate radioactive wastewater. However, the potential does exist for generating radioactively contaminated water from the operation and maintenance of safety showers in contamination areas, the operation of decontamination stations, the mopping of floors in contamination areas, and the testing of fire sprinkler systems located in contamination areas. Wastewaters that could potentially be contaminated would be collected, sampled, and analyzed prior to discharge. Any contaminated wastewater would be solidified by processing through the liquid process waste facilities for the plutonium purification process (MPF Data 2003).

Sensitivity Analysis

DOE could elect to operate the MPF using a double shift to increase the plutonium pit manufacturing capability. Double-shift operation of the 450 ppy facility would approximately double the impacts to the waste management infrastructure from those described above for the single-shift operation. The Carlsbad Site currently manages only small quantities of site-generated waste. Even at the lowest proposed pit manufacturing capacity, the combination of MPF operations and repository operations would require a substantial increase in waste management infrastructure at the Carlsbad Site. The waste volumes resulting from double-shift operation would require additional expansion of the Carlsbad Site's waste management infrastructure. See Section 6.5 for a discussion of the availability of WIPP for disposal of TRU waste resulting from MPF operations.

5.7 IMPACTS COMMON TO ALL ALTERNATIVES

There are three impacts which are common to all of the action alternatives, regardless of which site is chosen. These are the operation of a new Beryllium Facility to supply required beryllium parts for the increased levels of pit production, decommissioning the MPF Alternative or the TA-55 Upgrade Alternative at the end of their useful lives, and the phase out of the No Action Alternative Pit Production Activity at LANL. These impacts are discussed below.

5.7.1 New Beryllium Facility

A beryllium fabrication capability is necessary to produce the required supporting component parts for the MPF. Currently, NNSA does not have an existing capability to produce the beryllium components that would be required for the MPF. Although it is unclear where beryllium components would be produced, there is no requirement to collocate such a capability at the MPF site. Additionally, there is no need to propose alternatives for a Beryllium Facility at this time, because the planning requirements for such a facility are much shorter than for the MPF. Nonetheless, because it is reasonably foreseeable that beryllium components would be produced to support MPF operations, this EIS assesses the environmental impacts of such beryllium production for completeness. DOE will explore all reasonable options for providing beryllium components to the MPF and will prepare any appropriate NEPA documentation when this issue is ripe for review and decisionmaking.

Although transportation of properly packaged beryllium material to the Beryllium Facility and transport of the finished components to the MPF is not hazardous, breathing fine particulate beryllium is a health hazard. Inhaled beryllium triggers an auto-immune response in an estimated 1-6 percent of exposed individuals that can result in Chronic Beryllium Disease, a debilitating and sometimes fatal disease. Consequently, individuals working with beryllium must minimize exposure and establish rigorous housekeeping practices and emissions to the environment must be severely limited.

Supply of beryllium feed stock is also in question. The former plant at Rocky Flats received metal blanks of the material from commercial suppliers, but there are now problems with this supply, so the plant may have to process its own blanks from beryllium powder. This option is included in the following plant description. If a commercial supplier of beryllium blanks can be developed, then that part of the facility may not be necessary.

Since only one Beryllium Facility will be required to support the MPF, no matter where it is located, the environmental impacts of its operation would have equal impact on all alternatives. Included is a brief description of the proposed facility and its operation.

5.7.1.1 Beryllium Operations

The Beryllium Facility would have two main production areas: the blank forming operations and machining 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 specialty 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.

5.7.1.2 Beryllium Impacts

The Beryllium Facility would house all production operations that must be performed in a beryllium control area. 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).

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.

Beryllium and beryllium compounds enter the environment as a result of the release and/or disposal of beryllium-contaminated wastewater, dust, or as a component of solid wastes. Once beryllium has been released to the environment, exposure to beryllium can occur by breathing air, eating food, or drinking water that contains beryllium. Dermal contact with metal containing beryllium or water containing dissolved beryllium salts will result in only a small fraction of the beryllium actually entering the body. A portion of beryllium dust breathed into the lungs will dissolve and eventually result in the transfer of the beryllium into the bloodstream; some may be transferred to the mouth then swallowed, and the rest will remain in the lungs for a long time. Of the beryllium ingested via contaminated foodstuffs or water, or swallowed subsequent to inhalation, about 1 percent will pass from the stomach and intestines into the bloodstream. Therefore, most of the beryllium that is swallowed leaves the body through the feces without entering the bloodstream. Of the beryllium that enters the bloodstream, some is routed to the kidneys and is eliminated from the body in urine. Some beryllium can also be carried by the blood to the liver and bones where it may remain for a long period of time. If beryllium is swallowed, it leaves the body in a few days. However, if beryllium is inhaled, it may take months to years before the body rids itself of beryllium.

As with any contaminant, the health effects resulting from exposure to beryllium are dependent on the exposure concentration, frequency, and duration. Inhalation of large amounts of soluble beryllium compounds can result in Acute Beryllium Disease. Acute Beryllium Disease results in lung damage that resembles pneumonia with reddening and swelling of the lungs. Lung damage may heal provided exposure does not continue or the exposed individual may become sensitive to beryllium. The increased sensitivity of some individuals to beryllium results in an immune or inflammatory reaction when subsequent low-level exposures occur. This condition is called Chronic Beryllium Disease. This disease can occur long after exposure to either the soluble or the insoluble forms of beryllium. Studies linking exposure to beryllium or beryllium compounds with an increased incidence of cancer (in particular, lung cancer) have been performed on laboratory animals. However, these studies are not considered reliable predictors of human health effects and ongoing efforts are currently underway to evaluate workers who have been known to be exposed.

In 1997, DOE initiated an Interim Chronic Beryllium Disease Prevention Program. The purpose of the program was to enhance, supplement, and integrate a worker protection program to reduce the number of current workers exposed, minimize the levels of beryllium exposure and the potential for exposure to beryllium, and to establish medical surveillance protocols to ensure early detection of disease. In December of 1999, DOE published a final rule to establish the Chronic Beryllium Disease Prevention Program that became effective on January 7, 2000 (10 CFR 850). The final rule establishes:

- An airborne beryllium concentration action level as 0.2 $\mu g/m^3$
- A requirement for employers to ensure that workers use respirators in areas where the concentration of beryllium is at or above the action level and to provide a respirator to any employee who requests one regardless of the concentration of airborne beryllium
- Criteria and requirements governing the release of beryllium-contaminated equipment and other items at DOE sites for use by other DOE facilities or the public
- Requirements for offering medical surveillance to any “beryllium-associated worker”
- Medical removal protection and multiple physician review provisions

Any beryllium production would be accomplished using layered engineering and administrative controls to protect workers by providing primary, secondary, and tertiary confinement to protect workers and the environment. Process improvements, engineered confinement controls, and the use of gloveboxes would be expected to reduce worker exposures to beryllium to as low as reasonably achievable. Based upon previous analyses for beryllium production at the Y-12, it is expected that the public Hazard Quotient from beryllium exposure would be much less than 1.0, and the excess cancer risk for exposure of the public would be less than the EPA range of concern (1.0×10^{-4} to 1.0×10^{-6}). For workers, it is expected that the Hazard Quotient from beryllium exposure would be much less than 1.0, and the excess cancer risk for exposure would be within the EPA range of concern.

5.7.2 Decommissioning the Modern Pit Facility or the TA-55 Upgrade Facility

At the end of their use for producing new and replacement pits for the Nuclear Weapons Stockpile, the MPF facilities or the TA-55 Upgrade Facilities would be subject to the process of decommissioning. The primary decommissioning goal would be for the facility to be decontaminated to the extent that its residual radioactivity is at an acceptable level. The facility decontamination would be conducted in a manner to minimize potential impact on health and safety to workers, the general public, and the environment. The facility decontamination would be executed in accordance with the decommissioning plan prepared by the facility operator (a DOE contractor) and approved by DOE.

Prior to the initiation of decommissioning activities, the facility operator would have to prepare a detailed decommissioning plan. The decommissioning plan would contain a detailed description of the site-specific decommissioning activities to be performed and would be sufficient to allow an independent reviewer to assess the appropriateness of the decommissioning activities; the potential impacts on the health and safety of workers, the public, and the environment; and the adequacy of the actions to protect health and safety and the environment. The decommissioning plan would also contain a credible site-specific cost estimate for these actions to allow DOE to allocate adequate funding such that decommissioning activities could be conducted in a timely manner. It is expected that both LLW and TRU waste would result from decommissioning activities.

5.7.3 Impacts Associated With Phasing Out Pit Production at Los Alamos National Laboratory

If the decision is made to proceed with the MPF, then interim pit production involving the manufacture of war reserve pits for the stockpile at LANL would be phased out once the MPF becomes operational. The environmental impacts of phasing out pit production at LANL are addressed in this section. In general, these environmental impacts, which are tantamount to the impacts associated with the No Action Alternative at LANL, would have a slightly positive impact on the LANL environment. Phasing out pit production would have no noticeable effect on the following resources: Land Use, Visual Resources, Noise, Nonradiological Air Emissions, Geology and Soils, Ecological, and Cultural and Historic. This is due to the fact that the PF-4 and other support facilities at TA-55 would continue to operate and perform other missions for the foreseeable future. As such, these resources are not discussed further in this section. Socioeconomics would also not be affected, as it is expected that any workers associated with pit production would perform other missions at LANL. Resources that might be affected include: infrastructure (energy use), water use, radiological air emissions, human health, waste generation, transportation, and accidents. These resources are discussed below.

Infrastructure

Electricity demands associated with No Action Alternative pit production are small (less than approximately 5,000 MWh/yr). This quantity is less than 1 percent of the total electrical energy consumption at LANL. Consequently, the positive impact of reducing electricity demands by less than 1 percent are insignificant. Natural gas use would also decrease by less than 1 percent.

Water Use

Groundwater use associated with No Action Alternative pit production is small, less than approximately 30 million L/yr (7.9 million gal/yr). This quantity is less than 1 percent of the total groundwater use at LANL. Consequently, the positive impact of reducing groundwater use by less than 1 percent is insignificant.

Radiological Air Emissions

Radiological air emissions associated with No Action Alternative pit production are small, approximately 10 microcuries per year. This accounts for less than 2 percent of the total radiological air emissions from LANL. The positive impacts to human health from a less than 2 percent reduction in radiological air emissions are insignificant.

Human Health

The average dose to workers associated with No Action Alternative pit production is approximately 380 mrem/yr. For approximately 230 workers, this translates into a total worker dose of approximately 90 person-rem/yr. Statistically, this translates into a LCF risk of 0.045, which means approximately one LCF would be expected approximately every 22 years of operation. Phasing out pit production at LANL would eliminate this source of exposure to workers and reduce the risk of LCFs by 0.045. For the 80-km (50-mi) population, reducing radiological air emissions by less than 2 percent would have an insignificant impact on human health, which is already projected to be small (less than 0.017 LCFs per year of LANL operations). Consequently, no changes to environmental justice are expected.

Waste Generation

Waste generation would be reduced if pit production were phased out at LANL. TRU waste would be reduced by approximately 15 m^3 (530 ft^3) and LLW would be reduced by approximately 200 m^3 (7,063 ft^3). These reductions amount to less than 1 percent of the total TRU waste and LLW quantities generated by other LANL activities and are not considered significant.

Transportation

If pit production were phased-out at LANL, there would be no need to transport pits from LANL to Pantex for weapons assembly. This would eliminate 28 shipments per year. As described in Section 5.2.12, the impact associated with transportation to and from LANL is approximately 1.9×10^{-3} LCFs per year for incident-free transport. Eliminating this impact is not considered significant.

Accidents

If pit production were phased out at LANL, there would be no potential impacts from accidents associated with pit production. The potential impacts associated with pit production at LANL are described in Appendix C and Section 5.2.10. These impacts, while small, would be eliminated.

5.8 CUMULATIVE IMPACTS

5.8.1 Introduction

The CEQ regulations implementing the NEPA define cumulative effects as "the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). The regulations further explain "cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." Other DOE programs and other Federal, state, and local development programs all have the potential to contribute to cumulative effects on DOE sites.

The methodology for the analysis of cumulative effects is presented in Appendix F and was developed from the guidelines and methodology in the CEQ's *Considering Cumulative Effects Under the National Environmental Policy Act*. Cumulative impacts are presented for those resource areas having the potential to present a significant impact. Each potential site is examined separately for cumulative impacts, and generally the alternative with the maximum impact (MPF with 450 ppy) is presented as the bounding impact to cumulative effects. For some resource areas, such as waste management, the cumulative effect may only be the impact from the MPF project combined with the impact (if any) from existing operations.

5.8.2 Los Alamos Site

The No Action Alternative provides the baseline for the cumulative effects of the Proposed Action at LANL. The projected incremental environmental impacts of implementing the Proposed Action at LANL were added to the impacts of other present, past, and reasonably foreseeable future actions at or near LANL to obtain the cumulative impacts.

Primary sources of information for cumulative impacts at LANL, include the following DOE documents:

Transportation

If pit production were phased-out at LANL, there would be no need to transport pits from LANL to Pantex for weapons assembly. This would eliminate 28 shipments per year. As described in Section 5.2.12, the impact associated with transportation to and from LANL is approximately 1.9×10^{-3} LCFs per year for incident-free transport. Eliminating this impact is not considered significant.

Accidents

If pit production were phased out at LANL, there would be no potential impacts from accidents associated with pit production. The potential impacts associated with pit production at LANL are described in Appendix C and Section 5.2.10. These impacts, while small, would be eliminated.

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5.8.2 Los Alamos Site

The No Action Alternative provides the baseline for the cumulative effects of the Proposed Action at LANL. The projected incremental environmental impacts of implementing the Proposed Action at LANL were added to the impacts of other present, past, and reasonably foreseeable future actions at or near LANL to obtain the cumulative impacts.

Primary sources of information for cumulative impacts at LANL, include the following DOE documents:

- *Draft Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory* (draft EIS currently in production) (DOE 2003)
- *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-0319, August 2002 (DOE 2002k)
- *Site-wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238, January 1999 (DOE 1999a)
- *Final Supplement Analysis for Pit Manufacturing Facilities at Los Alamos National Laboratory, Stockpile Stewardship and Management Programatic Environmental Impact Statement*, DOE/EIS-0236/SA-6, September 1999 (DOE 1999f)
- *Environmental Surveillance at Los Alamos during 2001*, LA-13979-ENV, September 2002 (LANL 2002b)

The Los Alamos Laboratory's original mission in 1943 was to build the world's first nuclear weapon. In 1981, the laboratory was designated as a national laboratory and became LANL. Following World War II, activities focused on nuclear defense and development, but expanded to include nuclear energy and other high-technology civilian research and development.

At LANL, resources that may reasonably be expected to be affected by the Proposed Action include electrical consumption, water use, air quality, human health and safety, transportation, and waste management.

Resource Requirements Impacts

At LANL, both peak-load electrical capacity and available water capacity would be exceeded in the future regardless of the addition of the MPF Alternative. For all projected uses of electrical power and water supply (including non-LANL users) over the next 50 years, LANL would require approximately 120 percent of the current peak load capacity, 95 percent of its total available capacity (DOE 2003), and 142 percent of the available water capacity (DOE 2003). Compared to the No Action Alternative, operation of the MPF Alternative (producing 450 ppy) would result in a 36 percent increase in total electrical energy consumption, 44 percent in peak load electrical energy consumption, and a 29.5 percent increase in water consumption. For the near term, no electrical or water resource capacity constraints are expected, because LANL operational demands have been well below projected levels and within site capacities (DOE 2003).

DOE is currently pursuing a project to increase the availability and reliability of LANL's electrical power supply by the addition of new gas-fired combustion turbine generators at the TA-3 Co-generation Complex. This project will increase LANL's onsite electric generation by 40 MW after FY2007 (DOE 2003).

For water supply, Los Alamos County is the primary water supplier serving LANL. DOE transferred ownership of 70 percent of its water rights to the county and leases the remaining 30 percent. Los Alamos County is currently pursuing the use of San Juan-Chama Transmountain

Diversion Project water to secure additional water rights and supply for its remaining water customers. Any potential shortfalls in available water capacity would be addressed as demand increases (DOE 2003).

Air Quality Impacts

Cumulative impacts on air quality at LANL would be the same as discussed in the LANL SWEIS. LANL would continue to be in compliance with all Federal and state ambient air quality standards. The effects of air quality from other proposed actions at LANL would not result in cumulatively significant impacts. Effects on air quality from associated construction and excavation activities would be temporary and localized.

Human Health and Safety

For the LANL SWEIS (DOE 1999a) Expanded Operations Alternative, the MEI was conservatively located within the LANL reservation and would receive a dose of 5.44 mrem/yr, corresponding to a lifetime dose over 72 years of 390 mrem. Radiological impacts from the proposed relocation of TA-18 and the CMRR project are within the bounds of those estimated for the LANL SWEIS Expanded Operations Alternative. The dose to the MEI calculated as a result of airborne releases from the MPF is 1.2×10^{-7} mrem representing 2.2×10^{-8} percent of the LANL SWEIS Expanded Operations Alternative. The limit set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) is 10 mrem/yr for airborne releases of radioactivity. The background total effective dose equivalent in the Los Alamos area is estimated to be 360 mrem/yr; thus the cumulative dose to the MEI is 3.3×10^{-8} percent of the background dose.

For the population surrounding the LANL within a 80-km (50-mi) radius, the LANL SWEIS estimated a population dose of 33.1 person-rem per year for the Expanded Operations Alternative and an annual operations excess LCF risk of 0.017 (DOE 1999a). The incremental population dose and increased annual LCF risk associated with the MPF Alternative (450 ppy) is 1.0×10^{-6} and 5.0×10^{-10}, or 3.0×10^{-6} percent of the SWEIS Expanded Operations Alternative population dose and annual operation excess LCF risk.

Transportation

The incremental impacts from transportation associated with the operation of the MPF Alternative (450 ppy) would result in a total collective dose to workers of 1.8 person-rem and 0.00073 LCFs. For the general population, the collective dose was estimated at 2.9 person-rem and 0.0014 LCFs. For all radioactive shipments throughout the United States over approximately a 100-year timeframe (historical and projected through 2047) the potential worker dose has been estimated at 410,000 person-rem (approximately 160 LCFs) (DOE 2002p). For the general population the dose was estimated at 350,000 person-rem (approximately 180 LCFs) (DOE 2002p).

Waste Management Impacts

Waste generation would increase significantly if a MPF (450 ppy) were built at LANL. TRU waste volumes (1,130 m^3 [45,909 ft^3]) would increase 1,200 percent. Additionally, DOE expects to generate approximately 5,292 m^3 (186,885 ft^3) of TRU waste at LANL. An additional 42 m^3

(1,483 ft^3) of TRU waste from offsite generators would be brought to LANL. This waste would be transferred to WIPP or a new TRU waste repository similar to WIPP.

LLW from MPF operations (450 ppy) would increase at LANL by 900 percent. DOE has decided to expand LLW disposal at LANL and the new capacity could readily accommodate the projected LANL LLW volumes for 50-100 years.

There is sufficient disposal capacity for all other waste types forecast for operations at LANL. However, the contribution to cumulative waste management from decontamination and demolition of buildings, and environmental restoration programs could be large (DOE 2003). Construction and demolition wastes would be recycled and reused to the extent practicable. Solid wastes would be disposed of at the Los Alamos County Landfill or other appropriate permitted solid waste landfills.

5.8.3 Nevada Test Site

The No Action Alternative provides the baseline for the cumulative effects of the Proposed Action at NTS. The projected incremental environmental impacts of implementing the Proposed Action at NTS were added to the impacts of other present, past, and reasonably foreseeable future actions at or near NTS to obtain the cumulative impacts.

Primary sources of information for cumulative impacts at NTS, include the following DOE documents:

- *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS 0243, August 1996 (DOE 1996b)
- *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243-SA-01, July 2002 (DOE 2002i)
- *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250, February 2002 (DOE 2002p)
- *Nevada Test Site Annual Site Environmental Report for Calendar Year–2001*, DOE/NV11718-747, October 2002 (NTS 2002)

Historically, the primary mission of the NTS, established in 1951, was to conduct nuclear weapons tests. In 1992, a moratorium on testing began, and the mission changed to maintain a readiness to conduct tests in the future if needed. Additionally, NTS missions now include national security, environmental management, stewardship of the NTS, and technology and economic diversification. Cumulative impacts at the NTS include historical impacts associated with weapons testing.

At NTS, resources that may reasonably be expected to be affected by the Proposed Action include electrical consumption, water use, air quality, human health and safety, transportation, and waste management.

Resource Requirements Impacts

For all capacities of the proposed MPF at NTS, both peak-load electrical capacity and available site electrical energy capacity would be exceeded. Compared to the No Action Alternative, operation of the MPF Alternative (producing 450 ppy) would result in a 133 percent increase in total electrical energy consumption, and 103 percent in peak load electrical energy consumption. Improvements to the electrical power capacity would be required if the MPF were sited at NTS. Additionally, NTS does not use natural gas or coal which are necessary for the production of steam for heating. Coal would have to be transported to the site, or a natural gas pipeline installed.

For water supply, the maximum increase over existing water use at NTS would be 6.3 percent of NTS's maximum production capacity (8 billion L/yr [2.1 billion gal/yr]) and 9.8 percent of the sustainable site capacity (5.15 billion L/yr [1.36 billion gal/yr]). If the proposed Advanced Accelerator were built at NTS, water use during construction and system initialization (4.9 billion L/yr [1.3 billion gal/yr]) would be on the order of the peak historic withdrawal rate (DOE 2002e). Annual operational consumption for the Advanced Accelerator could be up to 980 million L/yr (258.9 million gal/yr) (DOE 2002i).

Air Quality Impacts

Cumulative impacts on air quality at NTS were examined including all anticipated foreseeable actions at the NTS (DOE 2002i) and the Yucca Mountain Repository (DOE 2002p). Nonradiological pollutants would be generally less than 10 percent of applicable regulatory limits for all reasonably foreseeable actions (DOE 2002p, DOE 2002i), and less than 1 percent for MPF alternatives. Radiological releases would result in an annual dose to the MEI of 2.5 mrem (or 16.7 percent of the 40 CFR 63.204 limit of 15 mrem from radioactive releases from the repository and the NTS). Effects on air quality from associated construction and excavation activities would be temporary and localized.

Human Health and Safety

For the NTS, the *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002i) examined existing and proposed new projects since the original EIS was issued in 1996. The radiological impacts from the combination of existing and proposed new projects at NTS are within the bounds of the 1996 EIS. The great distances from the areas in which operations are conducted to the nearest members of the public ensures that routine operations have negligible offsite health impacts. The dose to the MEI calculated as a result of airborne releases from the MPF is 4.5×10^{-9} mrem representing 2.0×10^{-7} percent of the combined NTS and Yucca Mountain repository dose from all current and proposed activities. The limit set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) is 10 mrem/yr for airborne releases of radioactivity. In the Yucca Mountain Repository EIS (DOE 2002p) the combined total doses from repository activities and NTS activities was estimated to be 2.3 mrem to the MEI (1.2×10^{-6} LCF risk) and 42 person-rem to the population (0.021 LCF risk). The total dose from natural background radiation in the NTS area is estimated to be 314 mrem/yr (see Section 4.3.9); thus the cumulative dose to the MEI is 1.4×10^{-9} percent of the background dose. Emissions from past nuclear weapons testing could have resulted in a dose of 150 mrem over the lifetime of those individuals exposed during atmospheric weapons testing. The incremental population dose and increased annual LCF risk associated with the MPF Alternative (450 ppy) is 7.7×10^{-8} and 3.8×10^{-11} LCF, or 1.8×10^{-7} percent of the population dose and annual operation excess LCF risk from NTS and Yucca Mountain combined.

Transportation

Incremental impacts from transportation associated with the MPF Alternative would be added to the impacts of the radioactive waste shipments to both NTS and the Yucca Mountain Repository. This increment can be compared to both all shipments to NTS and Yucca Mountain Repository, and all shipments of radioactive materials throughout the United States. The incremental impacts from transportation associated with the operation of the MPF Alternative (450 ppy) would result in a total collective dose to workers of 5 person-rem and 0.002 LCFs. For the general population, the collective dose was estimated at 7.7 person-rem and 0.0039 LCFs. The general population dose from transportation of radioactive shipments to the NTS projected in the NTS EIS (DOE 1996b) is 150 person-rem (this number includes the worker dose). For maximum shipments to the Yucca Mountain Repository (Module 2 with mostly truck shipments) the worker dose was estimated at 60,000 person-rem (24 LCFs) and the general population dose 9,700 person-rem (5 LCFs). For all radioactive shipments throughout the United States over approximately a 100-year timeframe (historical and projected through 2047) the potential worker dose has been estimated at 410,000 person-rem (approximately 160 LCFs) (DOE 2002p). For the general population the dose was estimated at 350,000 person-rem (approximately 180 LCFs) (DOE 2002p).

Waste Management Impacts

Waste generation would increase significantly if a MPF (450 ppy) were built at NTS. NTS does not generate TRU waste, but does manage about 600 m^3 (21,189 ft^3) of legacy waste transferred to NTS from offsite generators pending disposal at WIPP. The MPF project would generate an additional 1,300 m^3 (45,909 ft^3) of waste at 450 ppy. This waste would be transferred to WIPP or a new TRU waste repository similar to the WIPP.

NTS generates very little LLW although it manages large volumes of LLW as a national disposal site for LLW. LLW from MPF (450 ppy) could amount to 5,030 m^3/yr (177,633 ft^3/yr) of operation. This quantity of LLW is well within the capacity of NTS LLW disposal. In 2000, DOE projected a need for 1.1 million m^3 (38.8 million ft^3) of the LLW disposal capacity (approximately 30 percent). Disposal of Yucca Mountain Repository LLW would require up to 9 percent of the reserve capacity of 2.6 million m^3 (91.8 million ft^3) (DOE 2002p).

While the annual sanitary waste generated by the MPF project would only represent less than 3.3 percent of the disposal capacity (210,000 m^3 [7.4 million ft^3]) of the Area 23 landfill, up to 290,000 m^3 (10.2 million ft^3) could be generated by the Yucca Mountain Repository (DOE 2002p). Thus, solid sanitary waste disposal at NTS would require expansion to accommodate Yucca Mountain Repository waste.

5.8.4 Pantex Site

The No Action Alternative provides the baseline for the cumulative effects of the Proposed Action at Pantex. The projected incremental environmental impacts of implementing the Proposed Action at Pantex were added to the impacts of other present and reasonably foreseeable future actions at or near Pantex to obtain the cumulative impacts. To obtain information for cumulative impacts at Pantex, the following DOE documents were examined:

- *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Component*, DOE/EIS-0225, November 1996 (DOE 1996d)
- *Supplement Analysis for the Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225/SA-03, April 2002 (DOE 2002e)
- *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, November 1999 (DOE 1999h)
- *2001 Site Environmental Report for Pantex Plant*, DOE/AL/66620-2002, December 2002 (BWXT 2002c)
- *Pantex Plant FY2003 10-Year Comprehensive Site Plan*, October 2002 (Pantex 2002)
- *Environmental Information Document in Support of the National Environmental Policy Act Documents for Pantex Plant* (BWXT 2002a)

Pantex was originally built for the U.S. Army during World War II to produce conventional munitions bombs and artillery projectiles. After the war, the plant was deactivated and eventually sold to Texas Technological College. In 1951, the plant was transferred back to the U.S. Government and was used to assemble nuclear weapons.

At Pantex, resources that may reasonably be expected to be affected by the Proposed Action include electrical consumption, water quality, air quality, human health and safety, transportation, and waste management.

Resource Requirements Impacts

If Pantex were selected for the MPF, site capacity for electrical power would be exceeded. Improvements in electrical capacity would be required for both the production of 250 ppy and 450 ppy. Operation of the MPF Alternative (producing 450 ppy) would result in a 147 percent increase above the available capacity of the electrical energy system.

In the Ogallala aquifer (underlying Pantex), regional groundwater withdrawals and long-term pumping exceed the natural recharge rate (DOE 2002e). The large water demands, including irrigation, in the Amarillo area are primarily responsible for the drop in the water table. Pantex withdrawals have decreased over time, with a 29 percent reduction from 1995-2000 (DOE 2002e). While there is no limit on the quantity of water Pantex can pump from the aquifer, the proposed water use of 996.3 million L/yr (263.2 million gal/yr) for the proposed MPF (450 ppy) represents a 102.5 percent increase in water use for Pantex, thereby adding to the cumulative drawdown of the aquifer.

Air Quality Impacts

Cumulative impacts on air quality at Pantex include the impacts of existing operations combined with impacts from the construction of the MPF Alternative at Pantex. For most nonradiological pollutants the maximum incremental concentration increases would be less than 1 percent. Although releases of radiological materials from the MPF would be low, most of the increased release would be from plutonium, which is not currently emitted by Pantex. However, the MEI would receive a dose of 0.00000005 mrem/yr compared to the DOE and EPA standard of 10 mrem/yr. Effects on air quality from associated construction and excavation activities would be temporary and localized.

Human Health and Safety

For the Pantex, the dose to the MEI in 2001 was estimated to be 1.31×10^{-5} mrem (BWXT 2002c). The dose to the MEI calculated as a result of airborne releases from the MPF is 5.0×10^{-8} mrem representing 0.38 percent of the current Pantex annual MEI dose. The limit set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) is 10 mrem/yr for airborne releases of radioactivity. The annual dose in the vicinity of Pantex from background of radiation was estimated at 335 mrem/yr (see Section 4.4.9). Thus the cumulative dose to the MEI is 3.9×10^{-6} percent of the background dose.

For the population surrounding Pantex within an 80-km (50-mi) radius, the 2000 estimated population dose is 0.000136 person-rem per year (BWXT 2002c), resulting in an annual operations excess LCF risk of 6.8×10^{-8}. The incremental population dose and increased annual LCF risk associated with the MPF Alternative (450 ppy) is 3.6×10^{-7} person-rem/yr and 1.8×10^{-10}, or 0.26 percent of the annual population dose and annual operation excess LCF risk.

Transportation

The incremental impacts from transportation associated with the operation of the MPF Alternative (450 ppy) would result in a total collective dose to workers of 10.2 person-rem and 3.8×10^{-3} LCFs. For the general population, the collective dose was estimated at 8.0 person-rem and 3.4×10^{-3} LCFs. For all radioactive shipments throughout the United States over approximately a 100-year timeframe (historical and projected through 2047) the potential worker dose has been estimated at 410,000 person-rem (approximately 160 LCFs). For the general population the dose was estimated at 350,000 person-rem (approximately 180 LCFs).

Waste Management Impacts

Waste generation would increase significantly if a MPF were built at Pantex. Currently, there is no TRU waste generated at Pantex, and 1,300 m^3 (45,909 ft^3) of TRU waste would be generated if Pantex (450 ppy) were selected for the MPF. This waste would be transferred to WIPP on a new TRU waste repository similar to the WIPP.

LLW from MPF operations (450 ppy) would increase at Pantex by a factor of 59. The LLW generated would need to be transported to NTS for disposal, increasing transportation risks.

Annual solid sanitary waste generated by a MPF at Pantex would increase by a factor of 11 relative to current Pantex operations. This would increase the rate at which DOE would consume the available capacity of onsite or offsite facilities.

There is sufficient disposal capacity for all other waste types forecast for operations at Pantex.

5.8.5 Savannah River Site

The No Action Alternative provides the baseline for the cumulative effects of the Proposed Action at SRS. The projected incremental environmental impacts of implementing the Proposed Action at SRS were added to the impacts of other present, past and reasonably foreseeable future actions at or near SRS to obtain the cumulative impacts.

Primary sources of information for cumulative impacts at SRS, include the following DOE documents:

- *The Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement*, DOE/EIS-0303, May 2002 (DOE 2002f)
- *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, July 1995 (DOE 1995b)
- *Final Environmental Impact Statement Construction and Operation of a Tritium Extraction Facility at the Savannah River Site*, DOE/EIS-0271 March 1999 (DOE 1999b)
- *Savannah River Site Salt Processing Final Supplemental Environmental Impact Statement*, DOE/EIS 0082-S2, June 2001 (DOE 2001d)
- *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, November 1999 (DOE 1999h)
- *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, DOE/EIS-0306, July 2000 (DOE 2000e)
- *Savannah River Site Environmental Report for 2001*, WSRC-TR-2001-00474, 2002 (WSRC 2002h)

In order to determine cumulative impacts of current and future planned activities in the region, historical environmental impacts were also examined. In 1950, the Savannah River Plant (now SRS) was created for construction and operation of facilities required to produce nuclear fuels for the nation's defense. Normal operations included emissions of both radioactive and nonradioactive pollutants to the surrounding air and onsite steams. Thermal impacts were severe in the nearby streams because of cooling water releases. Contamination of onsite groundwater occurred due to seepage from waste sites and seepage basins (DOE 2002f). In 1988, DOE placed the active site reactors on standby, and at the end of the Cold War they were permanently shutdown. Once the reactors were shutdown, environmental indicators improved rapidly. For example, by 1996 the dose to the MEI decreased to about one eighth of its 1987 value (DOE

2002f). The combination of mitigation measures and environmental restoration efforts has demonstrated a trend of improved environmental quality (DOE 2002f). Groundwater modeling indicates that most contaminants have reached their peak concentration. However, some slow-moving contaminants will peak in the coming millennium. Additional discussion of historical environmental impacts and trends in improving environmental quality is contained in the *Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement* (DOE 2002f).

Other nuclear facilities and numerous existing and planned industrial facilities have been examined for their potential cumulative impacts when combined with the effects of the proposed MPF. Previous analyses (DOE 2002f) has indicated that for the nuclear facilities in the surrounding area, only the Vogtle Electric Generating Plant has any effect on cumulative impacts in the area of the SRS, and that impact was found to be minimal. Because of the distance between SRS and other industrial facilities, comingling of effluents is unlikely to occur (DOE 2002f). Ambient levels of pollutants have remained below regulatory levels in and around the SRS region (DOE 2002f, WSRC 2002h).

Resources that may reasonably be expected to be affected by the proposed MPF at SRS include air quality, human health and safety, transportation, and waste management. These impacts were examined in the context of cumulative effects at the SRS and the surrounding area. No impacts to water quality or availability are anticipated (see Section 5.5.4) and there would be negligible impacts to site infrastructure (electrical energy demands, fuel and process gases).

Air Quality Impacts

Cumulative impacts on air quality at SRS include the impacts of reasonably foreseeable actions at SRS. Both radiological and nonradiological increases would be less than 1 percent of emissions from reasonably foreseeable action. The MEI would receive a dose of 8×10^{-9} mrem/yr compared to the DOE and EPA standard of 10 mrem/yr. Effects on air quality from associated construction and excavation activities would be temporary and localized.

Human Health and Safety

For SRS, baseline radiological doses were obtained from the *Savannah River Site Environmental Report for 2001* (WSRC 2002h). For 2001, the total dose from airborne and water releases to the MEI was estimated to be 0.18 mrem. For other foreseeable SRS activities[1] and the Vogtle Plant the MEI would receive an additional dose of 0.17 mrem/yr (DOE 2002f), corresponding to a lifetime dose over 72 years of 390 mrem. The dose to the MEI at the SRS boundary calculated as a result of airborne releases from the MPF (450 ppy) is 8.0×10^{-9}. The limit set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) is 10 mrem/yr for airborne releases of radioactivity. The average annual dose received by a typical resident in the Central Savannah River Area from background radiation is estimated to be 293 mrem/yr (see Section 4.5.9); thus the cumulative dose to the MEI is 2.7×10^{-9} percent of the background dose.

[1] Includes Spent Nuclear Fuel, Enriched Uranium, Tritium Extraction Facility, Management of Certain Plutonium Residues and Scrub Alloy Concentrations, Defense Waste Processing Facility, and Disposition of Surplus Plutonium (Pit Disassembly and Conversion Facility, Mixed Oxide Fuel Fabrication Facility, and Immobilization Facility), Sodium-Bonded Spent Nuclear Fuel, and components from throughout the DOE complex.

For the population surrounding the SRS (the Central Savannah River Area) within a 80-km (50-mi) radius, the total population dose, including baseline doses, other foreseeable SRS activities[1], and the Vogtle Plant, was estimated to be 10.8 person-rem per year (DOE 2002f). The estimated annual excess LCF risk for this dose is 0.0054. The incremental population dose and increased annual LCF risk associated with the MPF Alternative (450 ppy) is 1.3×10^{-6} person-rem and 6.5×10^{-10}, or 1.2×10^{-5} percent, of the total population dose and annual operation excess LCF risk.

Transportation

The incremental impacts from transportation associated with the operation of the MPF Alternative (450 ppy) would result in a total collective dose to workers of 6.4 person-rem and 2.5×10^{-3} LCFs. For the general population, the collective dose was estimated at 12 person-rem and 5.9×10^{-3} LCFs. For all radioactive shipments throughout the United States over approximately a 100-year timeframe (historical and projected through 2047) the potential worker dose has been estimated at 410,000 person-rem (approximately 160 LCFs) (DOE 2002p). For the general population the dose was estimated at 350,000 person-rem (approximately 180 LCFs).

Waste Management Impacts

Waste generation would increase significantly if a MPF (450 ppy) were built at SRS. TRU waste volumes (1,300 m^3 [45,909 ft^3]) would increase by a factor of 14. Additionally, DOE expects to generate approximately 720 m^3 (25,427 ft^3) of TRU waste at SRS after the scheduled closure of WIPP in 2035. This waste would be transferred to WIPP or a new TRU waste repository similar to the WIPP.

LLW from MPF operations (450 ppy) would increase at SRS by 92 percent. The estimated capacity of the onsite disposal facility is 250,000 m^3 (8.8 million ft^3) and the projected total volumes for all ongoing and anticipated projects at the SRS over the next 30 years are about 450,000 m^3 (15.8 million ft^3) (DOE 2002f). The projected volume of LLW from MPF operations (450 ppy) is 251,000 m^3 (8.8 million ft^3).

There is sufficient disposal capacity for all other waste types forecast for operations at SRS.

5.8.6 Carlsbad Site

The No Action Alternative provides the baseline for the cumulative effects of the Proposed Action at the Carlsbad Site. The projected incremental environmental impacts of implementing the Proposed Action at the Carlsbad Site were added to the impacts of other present, past and reasonably foreseeable future actions at or near WIPP to obtain the cumulative impacts.

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[2] Includes Spent Nuclear Fuel, Enriched Uranium, Tritium Extraction Facility, Management of Certain Plutonium Residues and Scrub Alloy Concentrations, Defense Waste Processing Facility, and Disposition of Surplus Plutonium (Pit Disassembly and Conversion Facility, Mixed Oxide Fuel Fabrication Facility, and Immobilization Facility), Sodium-Bonded Spent Nuclear Fuel, and components from throughout the DOE complex.

Primary sources of information for cumulative impacts at the Carlsbad Site, include the following DOE documents:

- *Waste Isolation Pilot Plant Disposal Phase Supplemental Environmental Impact Statement*, DOE/EIS-0026-S2, September 1997 (DOE 1997b)
- *Waste Isolation Pilot Plant 2001 Site Environmental Report*, DOE/WIPP 02-2225, 2002 (WTRU 2002)

WIPP began operations in 1999 as the first underground repository to permanently dispose of TRU and mixed waste generated through the research and production of nuclear weapons and other national defense-related activities. In the latest annual site environmental report (WTRU 2002), no evidence of any adverse environmental effects on the surrounding environment was identified. At the Carlsbad Site, resources that may reasonably be expected to be affected by the proposed action include site infrastructure, water use, air quality, human health and safety, transportation, and waste management.

Resource Requirements Impacts

The existing power grid is capable of supplying sufficient electrical power to operate the MPF. Two new transformers also would be needed to upgrade the existing system to provide redundant electrical power to the MPF.

Currently, WIPP does not use natural gas, which is necessary for the production of steam for heating. A natural gas pipeline would need to be installed for the generation of steam (see Section 5.6.2).

For water supply, the percent change in water consumption from the No Action Alternative was an increase of 1,940 percent for MPF at 450 ppy. The annual water demand at 450 ppy would be 530.3 million L (140.1 million gal). However, WIPP has the capacity of 2.5 billion L (0.65 billion gal), and the increased water demand represents only 15 percent of the available capacity. Water is contracted from the Carlsbad municipal water system. No measurable impact on regional groundwater levels or availability would be expected.

Air Quality Impacts

Cumulative impacts on air quality at the Carlsbad Site include the impacts of existing operations combined with impacts from the construction of the MPF Alternative at the Carlsbad Site. For most nonradiological pollutants the maximum incremental concentration increases would be less than 1 percent. Although releases of radiological materials would be low, most of the increase is due to a potential release of plutonium, which is not currently emitted by WIPP. The MEI would receive a dose of 6.5×10^{-8} mrem/yr from MPF operations, compared to the MEI dose of 0.0000899 mrem (WTRU 2002) for current WIPP operations. The DOE and EPA standard is 10 mrem/yr. Effects on air quality from associated construction and excavation activities would be temporary and localized.

Human Health and Safety

For WIPP, the dose to the MEI in 2001 was estimated to be 8.99×10^{-5} mrem (WTRU 2002). The dose to the MEI calculated as a result of airborne releases from the MPF is 6.5×10^{-8} mrem representing 0.072 percent of the current WIPP annual MEI dose. The limit set by both EPA (40 CFR 61) and DOE (DOE Order 5400.5) is 10 mrem/yr for airborne releases of radioactivity. The annual dose in the vicinity of WIPP from natural sources of radiation was estimated at 295 mrem/yr (see Section 4.6.9). Thus the dose to the MEI is 2.2×10^{-8} percent of the background dose.

For the population surrounding WIPP within an 80-kilometer radius, the estimated LCF risk is 3×10^{-4} (DOE 1997b), which translates to a population dose of 0.6 person-rem. The incremental population dose and increased annual LCF risk associated with the MPF Alternative (450 ppy) are 1.2×10^{-7} person-rem and 6.2×10^{-11}, which would represent 0.00002 percent of dose and LCF risk from DOE operations at WIPP.

Transportation

Incremental impacts from transportation associated with the MPF alternative would be added to the impacts of the TRU waste and mixed waste shipments to WIPP for disposal. This increment can be compared to both all shipments to WIPP, and all shipments of radioactive materials throughout the United States. The incremental impacts from transportation associated with the operation of the MPF Alternative (450 ppy) would result in a total collective dose to workers of 9.4 person-rem and 0.0037 LCFs. For the general population, the collective dose was estimated at 7.0 person-rem and 0.0035 LCFs. For transportation of all TRU and mixed waste to WIPP from throughout the United States, a total of 3 LCFs was estimated (DOE 1997b) for the general population, which translates to a population dose of 6,000 person-rem. The occupational LCF risk for all shipments to WIPP has been estimated to be 0.3 (DOE 1997b). For all radioactive shipments throughout the United States over approximately a 100-year timeframe (historical and projected through 2047) the potential worker dose has been estimated at 410,000 person-rem (approximately 160 LCFs). For the general population the dose was estimated at 350,000 person-rem (approximately 180 LCFs).

Waste Management Impacts

WIPP currently manages only small quantities of site-generated waste, therefore MPF operations would require a substantial increase in the waste management infrastructure at WIPP. TRU waste generated from MPF operations would be transferred to the WIPP Waste Handling Building or a new TRU waste repository similar to the WIPP.

LLW and mixed LLW from MPF operations (450 ppy) would be shipped offsite for disposal. The analysis assumes LLW would be transported to NTS for disposal (see Section 5.6.13). There is currently no infrastructure at the Carlsbad Site to support storage of LLW or mixed LLW until it can be shipped offsite for disposal.

For MPF operating at 450 ppy, the projected sanitary wastewater volume would be 224,000 L/day (59,000 gal/day). The discharge limit for the current WIPP sewage treatment

facility is 87,065 L/day (23,000 gal/day). Even at the lowest operating capacity of MPF, the capacity of the sewage treatment plant would be exceeded and would require expansion.

Solid sanitary wastes generated by MPF (450 ppy) would be expected to increase the total from WIPP by a factor of 12. This would accelerate DOE's consumption of available capacity in both onsite and offsite facilities.

5.9 UNAVOIDABLE ADVERSE IMPACTS

Implementing any of the MPF alternatives analyzed in this EIS would result in unavoidable adverse impacts on the environment. Generally, the impacts are small and would be from the construction and operation of new facilities at any one of the five locations analyzed.

Operations at Los Alamos Site, NTS, SRS, Pantex Site, or Carlsbad Site would all result in unavoidable radiation exposure to workers and the general public. Workers would be exposed to direct radiation and other chemicals associated with operating MPF and handling and transporting radioactive waste. The public would be exposed to radioactive contaminants released to the air and through exposure to radioactive materials, including waste, that would be transported both to the proposed MPF and to ultimate disposition sites for radioactive wastes. Discussion of the health effects to workers and the public is included in Sections 5.2.9, 5.3.9, 5.4.9, 5.5.9, and 5.6.9. Potential transportation impacts are described in Sections 5.2.12, 5.3.12, 5.4.12, 5.5.12, and 5.6.12.

Unavoidable quantities of radioactive and nonradioactive wastes would be generated by implementing any of the MPF alternatives. This waste would need to be segregated, stored, managed, and transported to final disposal locations.

Discussion of Air Impacts

For all alternatives, various chemical and radiological constituents would be released to the air. Generally, nonradiological releases would result in incremental increases of less than 1 percent. For radiological releases, while the incremental increases compared to the baseline and all reasonably foreseeable actions is large for most alternatives, the actual releases for all alternatives would result in a dose significantly less than the DOE and EPA standard of 10 mrem/yr. Additionally, there would be temporary and localized effects on air quality from associated construction and excavation activities.

There would also be temporary impacts from the construction of new facilities associated with the MPF project. These impacts would consist of increased fugitive dust, increased potential for erosion and stormwater pollution, and increased construction vehicle traffic and emissions.

5.10 RELATIONSHIP BETWEEN SHORT-TERM AND LONG-TERM USES

Implementation of any of the alternatives would require short-term commitments of resources such as land use and permanent commitment of resources such as energy.

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There would also be temporary impacts from the construction of new facilities associated with the MPF project. These impacts would consist of increased fugitive dust, increased potential for erosion and stormwater pollution, and increased construction vehicle traffic and emissions.

5.10 RELATIONSHIP BETWEEN SHORT-TERM AND LONG-TERM USES

Implementation of any of the alternatives would require short-term commitments of resources such as land use and permanent commitment of resources such as energy.

Under the No Action Alternative, environmental resources have already been committed. DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. The current rate of resource use would continue.

For all other alternatives, short-term use of resources would increase, generally proportional to the number of plutonium pits manufactured each year. Short-term commitments of resources include the land and materials needed to construct the facilities, the labor commitment, transportation and associated impacts. Workers, the public, and the environment would be exposed to small amounts of radioactive and hazardous materials over the short-term from operations, waste handling, and transportation. The long-term benefit is the remedy of the U.S. security concern that the lack of long-term pit production capability is a national security issue requiring timely resolution. Since 1989, DOE has been without the capability to produce plutonium pits, which results in a decrease in the safety and reliability of the U.S. nuclear weapons stockpile.

Regardless of which alternative and location is selected, air emissions associated with the proposed MPF would introduce small quantities of radiological and nonradiological pollutants to the air around Los Alamos Site, NTS, SRS, Pantex Site, or Carlsbad Site. Over the operating period, these emissions would result in cumulative exposures to the workers, the public, and the environment. However, emissions would be within air quality and radiation exposure standards at any of the proposed sites, at all proposed levels of production. There would be no significant residual environmental effects on long-term environmental viability.

The management and disposal of radioactive wastes, sanitary solid and liquid wastes, and small amounts of hazardous waste would require temporary commitment of resources for treatment and storage, and long-term commitment of land for the disposal of radioactive wastes.

Continued and increased employment, expenditures, and generated tax revenues would occur during the short-term benefiting local, regional, and state economies. These benefits would occur at any location selected for the MPF project. Long-term economic gain could result from local governments investing project-generated tax revenues into infrastructure and other services.

Upon the closure of the MPF facilities, and eventual return of DOE land to public use in the future, DOE could decontaminate and decommission the facilities and equipment, allowing for potential future reuse. All five proposed locations for the MPF are on currently dedicated DOE facilities handling nuclear materials and wastes. Therefore, no change in long-term land use is anticipated. The short-term resources to operate the MPF at any of the proposed sites would not affect the long-term productivity of the sites.

5.11 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable commitment of resources for each alternative involving the new proposed MPF would include the commitment of mineral, water and energy resources for construction. For all alternatives, including the No Action Alternative, mineral, chemical, energy resources, process gases, and water would all be irretrievably committed.

Under the No Action Alternative, environmental resources have already been committed. DOE would continue to use the plutonium pit manufacturing capability of PF-4 located in TA-55 at LANL. The current rate of resource use would continue.

For all other alternatives, short-term use of resources would increase, generally proportional to the number of plutonium pits manufactured each year. Short-term commitments of resources include the land and materials needed to construct the facilities, the labor commitment, transportation and associated impacts. Workers, the public, and the environment would be exposed to small amounts of radioactive and hazardous materials over the short-term from operations, waste handling, and transportation. The long-term benefit is the remedy of the U.S. security concern that the lack of long-term pit production capability is a national security issue requiring timely resolution. Since 1989, DOE has been without the capability to produce plutonium pits, which results in a decrease in the safety and reliability of the U.S. nuclear weapons stockpile.

Regardless of which alternative and location is selected, air emissions associated with the proposed MPF would introduce small quantities of radiological and nonradiological pollutants to the air around Los Alamos Site, NTS, SRS, Pantex Site, or Carlsbad Site. Over the operating period, these emissions would result in cumulative exposures to the workers, the public, and the environment. However, emissions would be within air quality and radiation exposure standards at any of the proposed sites, at all proposed levels of production. There would be no significant residual environmental effects on long-term environmental viability.

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Upon the closure of the MPF facilities, and eventual return of DOE land to public use in the future, DOE could decontaminate and decommission the facilities and equipment, allowing for potential future reuse. All five proposed locations for the MPF are on currently dedicated DOE facilities handling nuclear materials and wastes. Therefore, no change in long-term land use is anticipated. The short-term resources to operate the MPF at any of the proposed sites would not affect the long-term productivity of the sites.

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Irreversible and irretrievable commitment of resources for each alternative involving the new proposed MPF would include the commitment of mineral, water and energy resources for construction. For all alternatives, including the No Action Alternative, mineral, chemical, energy resources, process gases, and water would all be irretrievably committed.

Energy expended would be in the form of fuel for equipment and vehicles, electricity for facility operations, and either coal or natural gas for steam generation used for heating. The electrical energy requirement represents a large increase in electrical energy demand at most of the proposed sites. Los Alamos Site, NTS, Pantex Site, and Carlsbad Site would require improvements in the electrical power capacity, thereby increasing the irreversible and irretrievable commitment of resources for electrical power system improvements and expansion. Only SRS would not require expansion of the electrical power system for the proposed MPF.

MPF operations would generate nonrecyclable waste streams, such as radiological and hazardous waste. Disposal of these waste streams would require irreversible and irretrievable commitment of land resources. However, certain materials and equipment used during operations of the proposed facilities could be recycled when the facilities are decontaminated and decommissioned.

Water at all sites would be obtained from onsite sources or local government suppliers. Water would be used for domestic uses and cooling towers. Approximately 12 percent of the annual water consumption would be returned to the local environment as wastewater. The remaining 88 percent would be released to the atmosphere through evaporation, which would eventually return to the ground, although not necessarily locally, in the form of precipitation.

Process gases and chemicals irreversibly and irretrievably committed are listed in Table 5.11–1. Process gases are provided for glovebox inert atmosphere (nitrogen and argon), component cleaning (carbon dioxide), leak testing (helium), process chemistry (hydrogen and oxygen) and analytical laboratory analyses (nitrogen, argon, carbon dioxide, helium, hydrogen, oxygen and propane). Process chemical consumption is based on using an aqueous process as the baseline to produce pure metal for foundry operations. (Use of a pyrochemical purification process would require less nitric acid, and use hydrochloric acid rather than hydrofluoric acid).

Chemical additives are also used for domestic water (bacteria and pH control) and cooling tower water makeup (bacteria and corrosion control). Additional chemicals used in operations include those consumed in nondestructive examination (radiography and dye-penetrant testing) and analytical support operations.

For the alternatives analyzed in this EIS, the No Action Alternative would have the least commitment of irretrievable and irreversible resources, and the permanent commitment of resources would increase with the increased production of plutonium pits regardless of location.

Table 5.11–1. Chemical Requirements for MPF Alternatives

Chemical	Production Rate		
	125 ppy	250 ppy	450 ppy
Gases			
Helium, ft^3	130	250	450
Hydrogen, ft^3	2.7	5.4	9.8
Oxygen, ft^3	265	530	960
Argon, 10^3 ft^3	290	540	920
Carbon Dioxide, 10^3 ft^3	440	890	1,600
Nitrogen, 10^6 ft^3	8	9	11
Propane, ft^3	450	890	1,600
Process Chemicals			
Sulfamic acid, kg	1,200	2,400	4,400
Aluminum Nitrate Nonohydrate, kg	43,000	86,000	155,000
Nitric acid[a], kg	42,000	84,000	150,000
Sodium nitrite, kg	150	300	520
Tributyl Phosphate, kg	20	45	80
N-paraffin, kg	40	80	150
Ascorbic acid, kg	700	1,400	2,500
Hydrofluoric acid, kg	2,200	4,500	8,000
Calcium metal, kg	750	1,500	2,750
Formic acid, kg	6,000	12,000	22,000
Potassium fluoride, kg	70	130	240
Sodium carbonate, kg	70	70	70
Hydroxylamine nitrate, kg	490	970	1,800
Hydrazine, kg	150	300	560
Sodium hydroxide, kg	11,500	23,000	41,400
Erbium oxide, kg	4.5	9.1	18.0
Trichloroethane, liters	190	280	380
Machine oil, liters	20	40	80
Bromobenzene, liters	110	190	280
Hydraulic fluid, liters	470	950	1,700

[a] Assumes no nitric acid recycle – preliminary material balance estimates indicate that as much of 50 percent of this total may be recovered for reuse in process operations.

6.0 ENVIRONMENTAL OCCUPATIONAL SAFETY AND HEALTH PERMIT, COMPLIANCE, AND OTHER REGULATORY REQUIREMENTS

6.1 INTRODUCTION AND PURPOSE

As part of the *National Environmental Policy Act* (NEPA) process, the environmental impact statement (EIS) must consider whether actions described under its alternatives would result in a violation of any Federal, state, or local laws or requirements (40 *Code of Federal Regulations* [CFR] 1508.27) or require a permit, license, or other entitlement (40 CFR 1502.25). This chapter provides a summary of the major existing environmental requirements, agreements, and permits that relate to the U.S. Department of Energy's (DOE's) programmatic decision regarding construction and operations of a Modern Pit Facility (MPF).

There are a number of Federal environmental laws that affect environmental protection, health, safety, compliance, and/or consultation at every DOE location under consideration for siting of a MPF. In addition, certain environmental requirements have been delegated to state authorities for enforcement and implementation. Furthermore, state legislatures have adopted laws to protect health and safety and the environment. It is DOE policy to conduct its operations in a manner that ensures the protection of public health, safety, and the environment through compliance with all applicable Federal and state laws, regulations, orders, and other requirements.

The various action alternatives analyzed in this MPF EIS involve either the upgrading of existing DOE facilities or the construction and operations of new DOE facilities and the transportation of materials. Actions required to comply with statutes, regulations, and other Federal and state requirements may depend on whether a MPF is newly built or is incorporated as upgrades to an existing facility. Requirements vary among alternatives located in different states. In this EIS, alternatives are considered in the states of Nevada, New Mexico, South Carolina, and Texas. Chapter 3 provides a detailed discussion of these alternatives.

6.2 BACKGROUND

Requirements governing construction and operations of a MPF arise primarily from six sources: Congress, Federal agencies, Executive Orders, legislatures of the affected states, state agencies, and local governments. In general, Federal statutes establish national policies, create broad legal requirements, and authorize Federal agencies to create regulations that conform to the statute. Detailed implementation of these statutes is delegated to various Federal agencies such as DOE, the U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA). For many environmental laws under EPA jurisdiction, state agencies may be delegated responsibility for the majority of program implementation activities, such as permitting and enforcement, but EPA usually retains oversight of the delegated program.

Some applicable laws such as NEPA, the *Endangered Species Act*, and the *Emergency Planning and Community Right-To-Know Act* require specific reports and/or consultations rather than ongoing permits or activities. These would be satisfied through the legal/regulatory process, including the preparation of this EIS, leading to the siting of a MPF.

Other applicable laws establish general requirements that must be satisfied, but do not include processes (such as the issuance of permits or licenses) to consider compliance prior to specific instances of violations or other events that trigger their provisions. These include the *Toxic Substances Control Act* (affecting polychlorinated biphenyl [PCB] transformers and other designated substances); the *Federal Insecticide, Fungicide, and Rodenticide Act* (affecting pesticide/herbicide applications); the *Hazardous Materials Transportation Act*; and (if there were to be a spill of a hazardous substance) the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA, also known as Superfund).

Executive Orders establish policies and requirements for Federal agencies. Executive Orders are applicable to executive branch agencies, but do not have the force of law or regulation.

In addition to implementing some Federal programs, state legislatures develop their own laws. State statutes supplement as well as implement Federal laws for protection of air and water quality and for groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and local resource, historic, and cultural values. The laws of local governments add a level of protection to the public, often focusing on zoning, utilities, and public health and safety concerns.

Regulatory agreements and compliance orders may also be initiated to establish responsibilities and timeframes for Federal facilities to come into compliance with provisions of applicable Federal and state laws. There are also other agreements, memorandums of understanding, or formalized arrangements that establish cooperative relationships and requirements.

Each of the alternative sites being considered for a MPF is located on property controlled by DOE. DOE has the authority to regulate some environmental activities, as well as the health and safety aspects of nuclear facilities operations. The *Atomic Energy Act* of 1954, as amended, is the principal authority for DOE regulatory activities not externally regulated by other Federal or state agencies. Regulation of DOE activities is primarily established through the use of DOE orders and regulations.

External environmental laws, regulations, and Executive Orders can be categorized as applicable to either broad environmental planning and consultation requirements or regulatory environmental protection and compliance activities, although some requirements are applicable to both planning and operations compliance.

Section 6.3.1 discusses the major Federal statutes and regulations that impose nuclear safety and environmental protection requirements on DOE facilities and might require DOE to obtain a permit or license (or amendment thereof), prior to construction or operations of a MPF. Each of the applicable regulations and statutes establishes how activities are to be conducted or how potential releases of pollutants are to be controlled or monitored. These applicable regulations and statutes include requirements for the issuance of permits or licenses for new operations or new emission sources and for amendments to existing permits or licenses to allow new types of operations at existing sources.

Section 6.3.2 discusses Executive Orders. Section 6.3.3 identifies DOE regulations, orders, and procedures for compliance with the *Atomic Energy Act*, the *Occupational Safety and Health Act*, and other environmental, safety, and health matters. Section 6.3.4 identifies state and local laws, regulations, and ordinances, as well as local agreements potentially affecting the construction and operations of a MPF. Other regulatory requirements are discussed in Section 6.4. Section 6.4.1 identifies radioactive material packaging and transportation laws and regulations. Section 6.4.2 discusses emergency management and response laws, regulations, and Executive Orders.

Consultations with Federal, state, and local agencies and Federally-recognized Native American groups are discussed in Section 6.4.3. Section 6.5 provides alternative-specific information.

6.3 ENVIRONMENTAL STATUTES, ORDERS, AND AGREEMENTS

6.3.1 Federal Environmental, Safety, and Health Statutes and Regulations

This section describes the Federal environmental, safety, and health laws and regulations that may apply to the proposed action and alternatives.

***National Environmental Policy Act* of 1969, as amended (42 U.S.C. 4321 *et seq*.)**

NEPA establishes a national policy promoting awareness of the environmental consequences of human activity on the environment and consideration of environmental impacts during the planning and decision-making stages of a project. It requires Federal agencies to prepare a detailed EIS for any major Federal Action with potentially significant environmental impact.

This EIS has been prepared in accordance with NEPA requirements, Council on Environmental Quality regulations (40 CFR 1500 et seq.), and DOE provisions (10 CFR Part 1021, DOE Order 451.1B) for implementing the procedural requirements of NEPA. It discusses reasonable alternatives and their potential environmental consequences.

***Atomic Energy Act* of 1954 (42 U.S.C. 2011 *et seq*.)**

The *Atomic Energy Act* authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction. Through a series of DOE orders, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities. The DOE regulations are found in 10 CFR Parts 200-1099.

The *Atomic Energy Act* establishes regulatory control of the disposal of radioactive waste as well as production, possession, and use of three types of radioactive material: source, special nuclear, and byproduct materials. This Act authorizes DOE to set radiation protection standards for itself and its contractors at DOE nuclear facilities and provides exclusions from U.S. Nuclear Regulatory Commission (NRC) licensing for defense production facilities.

The *Atomic Energy Act* authorizes DOE to establish standards that protect health and minimize danger to life or property from activities under DOE's jurisdiction. The mechanisms through which DOE manages its facilities are the promulgation of regulations (set forth in 10 CFR 830) and issuance of DOE orders and associated standards and guidance. Requirements for environmental protection, safety, and health are implemented at DOE sites primarily through contractual mechanisms that establish the applicable DOE requirements for management and operating contractors.

Several DOE nuclear safety rules and environmental procedural rules are in effect (for example, 10 CFR 835, "Occupational Radiation Protection"), and more are in final stages of promulgation. Nuclear safety regulations are effective under the schedule and implementing requirements of each rule, regardless of whether they are included in the contract. DOE contractors are also required to comply with all applicable external laws and regulations, regardless of contract language.

Chapter 5 discusses the application of DOE procedures to the management and control of radioactive waste and material for each alternative. Potential occupational radiation doses and doses to the general public resulting from construction and operations of a MPF would be well within DOE limits.

***Clean Air Act* of 1970, as amended (42 U.S.C. 7401 *et seq.*)**

The *Clean Air Act* is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Section 118 of the *Clean Air Act* (42 U.S.C. 7418) requires that each Federal agency with jurisdiction over any property or facility engaged in any activity that might result in the discharge of air pollutants comply with "all Federal, state, interstate, and local requirements" with regard to the control and abatement of air pollution.

The *Clean Air Act*: (1) requires EPA to establish National Ambient Air Quality Standards (NAAQS) as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 U.S.C. 7409 et seq.); (2) requires establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 U.S.C. 7411); (3) requires specific emission increases to be evaluated so as to prevent a significant deterioration in air quality (42 U.S.C. 7470 et seq.); and (4) requires specific standards for releases of hazardous air pollutants (including radionuclides) (42 U.S.C. 7412). These standards are implemented through state implementation plans developed by each state with EPA approval. The *Clean Air Act* requires sources to meet standards and obtain permits to satisfy these standards.

Emissions of air pollutants are regulated by EPA under 40 CFR Parts 50-99. Radionuclide emissions from DOE facilities are subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations in 40 CFR Part 61. Approval to construct a new facility or to modify an existing one may be required by these regulations under 40 CFR 61.07

Chapter 5 compares expected releases from MPF construction and operations at each site with applicable standards. Some releases will result from construction activities, such as heavy equipment operation. During operation, small releases will result during testing of emergency diesel generators and from other sources.

This EIS is primarily concerned with determining a candidate DOE site for a MPF. NNSA has selected for analysis a reference location at each of the alternative sites. A second tiered EIS would be prepared once a DOE site is identified for more detailed analysis, including consideration of alternative locations for a MPF within that site. A Prevention of Significant Deterioration analysis would be performed as part of that site-specific EIS.

In compliance with state and Federal programs, detailed analyses were conducted that demonstrate construction and operations of a MPF would not result in violations of ambient air quality standards, or contribute to unacceptable increases in pollutant levels. If a MPF were located in an area in which the attainment or maintenance of ambient air quality standards is not well established, the proposed alternatives would also be subject to *Clean Air Act* conformity reviews. A conformity review serves as a means to assure that a Federal action does not hinder or interfere with programs developed by state and Federal agencies to bring the area into compliance with ambient air standards. As described in the air quality sections of Chapter 5, each of the alternative sites is located in an attainment area for all criteria pollutants. Although construction and operations of a MPF would result in criteria pollutant emissions, a conformity review is not necessary.

***Clean Water Act* of 1972, as amended (33 U.S.C. 1251 *et seq*.)**

The *Clean Water Act* (CWA), which amended the *Federal Water Pollution Control Act*, was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The CWA prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the CWA requires all branches of the Federal Government engaged in any activity that might result in a discharge or runoff of pollutants to surface waters to comply with Federal, state, interstate, and local requirements.

The CWA provides water quality standards for the Nation's waterways, guidelines and limitations for effluent discharges from point-source discharges, and the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES Program is administered by EPA, pursuant to regulations in 40 CFR 122 *et seq*. Sections 401-405 of the *Water Quality Act* of 1987 added Section 402(p) to the CWA requiring that EPA establish regulations for permits for stormwater discharges associated with industrial activities. The stormwater provisions of the NPDES program are set forth at 40 CFR 122.26. Permit modifications are required if discharge effluent is altered. Section 404 of the CWA requires permits for the discharge of dredge or fill materials into navigable waters.

Chapter 4 discusses existing wastewater treatment facilities and discharges at each site. Chapter 5 discusses management of wastewater at each site during construction and operation of a MPF. Sanitary waste may be managed by use of portable toilet facilities during construction. During operations, sanitary wastes would generally be processed through existing facilities. Under the Nevada Test Site (NTS) Alternative, a septic system may be constructed to accept sanitary wastewater from MPF operations. Under the Carlsbad Site Alternative, construction of a new wastewater treatment facility or an expansion of the existing sewage treatment facility would be required to accommodate the projected sanitary wastewater volume from MPF operations. With the exception of the NTS and Carlsbad Site Alternatives, DOE would need to modify the existing NPDES permit at any of the sites to address the increase in wastewater volume. With the exception of the Carlsbad Site Alternative, DOE does not expect construction or operation of a MPF to result in discharges requiring a new NPDES permit.

***Safe Drinking Water Act* of 1974, as amended (42 U.S.C. 300[f] *et seq*.)**

The primary objective of the *Safe Drinking Water Act* is to protect the quality of public drinking water supplies and sources of drinking water. The implementing regulations, administered by EPA unless delegated to states, establish standards applicable to public water systems. These regulations include maximum contaminant levels (including those for radioactivity) in public water systems, which are defined as water systems that have at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. EPA regulations implementing the *Safe Drinking Water Act* are found in 40 CFR Parts 141-149. For radioactive material, the regulations specify that the average annual concentration of man-made radionuclides in drinking water, as delivered to the user by such a system, shall not produce a dose equivalent to the total body or an internal organ greater than 4 millirem per year (mrem/yr) beta and photon activity (40 CFR 141.16 [a]). Other programs established by the *Safe Drinking Water Act* include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program.

Chapter 4 discusses groundwater resources and current groundwater protection programs at each site. Chapter 5 explains that there would be no direct discharge to the surface or subsurface of sanitary or industrial effluent associated with MPF construction or operations under any alternative.

***Low-Level Radioactive Waste Policy Act* of 1980, as amended (42 U.S.C. 2021 *et seq*.)**

This legislation amended the *Atomic Energy Act* to specify that the Federal Government is responsible for disposal of low-level waste (LLW) generated by its activities, and that states are responsible for disposal of other LLW. The Act provides for and encourages interstate compacts to carry out the state responsibilities.

LLW would be generated as a result of MPF operations. Chapter 4 discusses existing LLW management programs at each site. Section 4.2.11.8 discusses DOE's LLW management decisions based on the *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (*Waste Management PEIS*,* DOE 1997a). Chapter 5 discusses the projected volume of LLW from MPF operations and the management of that waste under each of the alternatives. Consistent with the LLW and mixed LLW Record of Decision (ROD) (65 FR 10061, February 25, 2000) for the Waste Management PEIS, this EIS assumes that LLW resulting from MPF operations would be shipped to NTS for disposal if the alternative site (i.e., Pantex Site, Carlsbad Site) lacks an onsite LLW disposal capability.

***Solid Waste Disposal Act* of 1965, as amended by the *Resource Conservation and Recovery Act* of 1976 and the Hazardous and Solid Waste Amendments of 1984 (42 U.S.C. 6901 *et seq*.)**

The *Solid Waste Disposal Act* of 1965, as amended, governs the transportation, treatment, storage, and disposal of hazardous and nonhazardous waste. Under the *Resource Conservation and Recovery Act* of 1976 (RCRA), which amended the *Solid Waste Disposal Act* of 1965, EPA defines and identifies hazardous waste; establishes standards for its transportation, treatment, storage, and disposal; and requires permits for persons engaged in hazardous waste activities. Section 3006 of RCRA (42 U.S.C. 6926) allows states to establish and administer these permit programs with EPA approval. The EPA regulations implementing RCRA are found in 40 CFR Parts 260-282.

Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also impacts the extent and complexity of the requirements.

MPF construction and operations activities would be conducted in compliance with this Act. Chapter 4 provides information on the management of hazardous waste, mixed LLW, and mixed transuranic (TRU) waste for each of the alternative sites. Chapter 5 discusses the management of waste resulting from MPF construction and operations.

***Federal Facility Compliance Act* of 1992 (42 U.S.C. 6961 *et seq*.)**

The *Federal Facility Compliance Act*, enacted on October 6, 1992, amended RCRA. Section 102(a)(3) of the *Federal Facility Compliance Act* waives sovereign immunity for Federal facilities from fines and penalties for violations of RCRA, state, interstate, and local hazardous and solid waste management requirements. This waiver was delayed for three years following enactment for violations of the land disposal restrictions (LDR) storage prohibition (RCRA Section 3004[j]) involving mixed waste at DOE facilities. This legislation further delays the waiver of sovereign immunity beyond the 3-year period at a facility if DOE is in compliance with an approved plan for developing treatment capacity and technologies for mixed waste generated or stored at the facility, as well as an order requiring compliance with the plan.

Mixed LLW and mixed TRU waste would be generated from MPF operations at each of the sites. The Waste Management sections of Chapter 4 and 5 provide information on the generation and management of mixed waste for each of the alternatives. Section 6.3.4 discusses the site treatment plans and orders at each of the alternative sites.

***Pollution Prevention Act* of 1990 (42 U.S.C. 13101 *et seq*.)**

The *Pollution Prevention Act* establishes a national policy for waste management and pollution control. Source reduction is given first preference, followed by environmentally safe recycling, with disposal or releases to the environment as a last resort. In response to the policies established by the *Pollution Prevention Act*, DOE committed to participation in the *Superfund Amendments and Reauthorization Act*, Section 313, EPA 33/50 Pollution Prevention Program. The goal for facilities involved in compliance with Section 313 is to achieve a 33 percent reduction (from a 1993 baseline) in the release of 17 priority chemicals by 1997. On November 12, 1999, the Secretary of Energy issued 14 pollution prevention and energy efficiency goals for DOE. These goals were designed to build environmental accountability and stewardship into DOE's decision-making process. Under these goals, DOE will strive to minimize waste and maximize energy efficiency as measured by continuous cost-effective improvements in the use of materials and energy, using the years 2005 and 2010 as interim measurement points.

Efforts would be made to minimize the generation of waste from MPF construction and operations. As discussed in the Waste Management sections of Chapter 4, waste minimization programs are in place at each of the sites to reduce waste generation and to recycle where possible.

***Toxic Substances Control Act* of 1976 (15 U.S.C. 2601 *et seq*.)**

The *Toxic Substances Control Act* of 1976 (TSCA) provides EPA with the authority to require testing of chemical substances entering the environment and to regulate them as necessary. The law complements and expands existing toxic substance laws such as Section 112 of the *Clean Air Act* and Section 307 of the CWA. TSCA requires compliance with inventory reporting and chemical control provisions of the legislation to protect the public from the risks of exposure to chemicals. TSCA also imposes strict limitations on the use and disposal of PCBs, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium.

MPF construction and operations are not expected to involve materials regulated under TSCA. DOE would comply with any TSCA requirements applicable to MPF activities under all alternatives.

***Federal Insecticide, Fungicide, and Rodenticide Act* (7 U.S.C. 136 *et seq*.)**

This Act regulates the use, registration, and disposal of several classes of pesticides to ensure that pesticides are applied in a manner that protects the applicators, workers, and the environment. Implementing regulations include recommended procedures for the disposal and storage of pesticides (40 CFR 165 [proposed regulation]) and worker protection standards (40 CFR 170).

MPF activities at all sites would need to be conducted in compliance with this Act.

***National Historic Preservation Act* of 1966, as amended (16 U.S.C. 470 *et seq*.)**

The *National Historic Preservation Act* of 1966 (NHPA) provides that sites with significant national historic value be placed on the National Register of Historic Places (NRHP), which is maintained by the Secretary of the Interior. The major provisions of the Act for DOE are Sections 106 and 110. Both sections aim to ensure that historic properties are appropriately considered in planning Federal initiatives and actions. Section 106 is a specific, issue-related mandate to which Federal agencies must adhere. It is a reactive mechanism that is driven by a Federal action. Section 110, in contrast, sets out broad Federal agency responsibilities with respect to historic properties. It is a proactive mechanism with emphasis on ongoing management of historic preservation sites and activities at Federal facilities. No permits or certifications are required under the Act.

Section 106 requires the head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking to ensure compliance with the provisions of the Act. It compels Federal agencies to "take into account" the effect of their projects on historical and archaeological resources and to give the Advisory Council on Historic Preservation (ACHP) the opportunity to comment on such effects. Section 106 mandates consultation during Federal actions if the undertaking has the potential to affect a historic property. This consultation normally involves the State and/or Tribal Historic Preservation Officers (SHPO) and may include other organizations and individuals such as local governments, Native American tribes, and Native Hawaiian organizations. If an adverse effect is found, the consultation often ends with the execution of a memorandum of agreement that states how the adverse effects will be resolved.

The regulations implementing Section 106, found in 30 CFR 800, were revised on December 12, 2000 (65 FR 77698), and were effective January 11, 2001. This revision modified the process by which Federal agencies consider the effects of their undertakings on historic properties and provides the ACHP with a reasonable opportunity to comment with regard to such undertakings, as required by Section 106 of the NHPA. In promulgating the new regulations, the ACHP has sought to better balance the interests and concerns of various users of the Section 106 process, including Federal agencies, SHPOs, Tribal Historic Preservation Officers, Native Americans and Native Hawaiians, industry, and the public.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts of MPF construction and operations to those resources.

***American Antiquities Act* of 1906, as amended (16 U.S.C. 431 to 433)**

This Act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally controlled lands from appropriation, excavation, injury, and destruction without permission.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts of MPF construction and operations to those resources.

***Archaeological and Historic Preservation Act* of 1974, as amended (16 U.S.C. 469 to 469c)**

This Act protects sites that have historic and prehistoric importance.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts of MPF construction and operations to those resources.

***Archaeological and Resources Protection Act* of 1979, as amended (16 U.S.C. 470 *et seq*.)**

This Act requires a permit for any excavation or removal of archaeological resources from Federal or Native American lands. Excavations must be undertaken for the purpose of furthering archaeological knowledge in the public interest, and resources removed remain the property of the United States. The law requires that whenever any Federal agency finds that its activities may cause irreparable loss or destruction of significant scientific, prehistoric, or archaeological data, the agency must notify the U.S. Department of the Interior (DOI) and may request that the DOI undertake the recovery, protection, and preservation of such data. Consent must be obtained from the Native American tribe or the Federal agency having authority over the land on which a resource is located before issuance of a permit; the permit must contain the terms and conditions requested by the tribe or Federal agency.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts of MPF construction and operations to those resources.

***Endangered Species Act* of 1973, as amended (16 U.S.C. 1531 *et seq*.)**

The *Endangered Species Act* is intended to prevent the further decline of endangered and threatened species and to restore these species and their critical habitats. Section 7 of the Act requires Federal agencies having reason to believe that a prospective action may affect an endangered or threatened species or its critical habitat to consult with the U.S. Fish and Wildlife Service (USFWS) of the DOI or the National Marine Fisheries Service of the U.S. Department of Commerce to ensure that the action does not jeopardize the species or destroy its habitat (50 CFR 17). Despite reasonable and prudent measures to avoid or minimize such impacts, if the species or its habitat would be jeopardized by the action, a formal review process is specified.

Threatened or endangered species in the regions of the five sites have been identified and listed in Chapter 4. The Biological Resources section of Chapter 5 discusses the potential impact to these species.

Under the Los Alamos Site, SRS, and Carlsbad Site Alternatives, no listed species are currently known to be present within the representative locations evaluated for MPF. Preconstruction surveys would be performed to verify site conditions immediately prior to construction.

At NTS, there is a potential impact to the desert tortoise. Although desert tortoises are found throughout the southern half of the site, the abundance of tortoises at NTS is low to very low compared to other areas within the range of this species. Area 6, which is the reference location for a MPF, is located within that part of the Mojave Desert that makes up the northernmost territory for the desert tortoise. A preconstruction survey immediately prior to construction would be necessary if NTS were selected for a MPF.

At Pantex, there is a potential impact to the bald eagle, interior lesser tern, and whooping crane, which are seasonal residents or migrants on the Pantex site. In addition, the black-tailed prairie dog, which is a candidate for listing as threatened or endangered species, is a Pantex resident. A preconstruction survey immediately prior to construction would be necessary if Pantex were selected for a MPF.

***Migratory Bird Treaty Act* of 1918, as amended (16 U.S.C. 703 *et seq*.)**

The *Migratory Bird Treaty Act*, as amended, is intended to protect birds that have common migratory patterns within the United States, Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying conditions such as the mode of harvest, hunting seasons, and bag limits. The Act stipulates that it is unlawful at any time, by any means, or in any manner, to "kill ... any migratory bird." Implementing regulations are found in *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants* (50 CFR Part 10) and *Migratory Bird Hunting* (50 CFR Part 20). Although no permit for a MPF would be required under the Act, DOE is required to consult with the USFWS regarding impacts to migratory birds, and to avoid or minimize these effects in accordance with the USFWS Mitigation Policy.

Chapter 4 identifies species known at each alternative site. Chapter 5 discusses impacts to biological resources for the reference locations under each alternative.

***Bald and Golden Eagle Protection Act* of 1973, as amended (16 U.S.C. 668-668d)**

The *Bald and Golden Eagle Protection Act*, as amended, makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States (Section 668, 668c). A permit must be obtained from the DOI to relocate a nest that interferes with resource development or recovery operations. Implementing regulations are delineated in *Eagle Permits* (50 CFR Part 22).

As described in Chapter 4, with the exception of NTS and the Carlsbad Site, the bald eagle is known to occur at each of the alternative sites. The bald eagle occupies or uses portions of LANL. The bald eagle is sighted yearly at Pantex and is considered a winter resident and a spring and fall migrant. Bald eagles are found on SRS in all months of the year, with most sightings in the winter and spring months. There are three bald eagle nesting territories on SRS. Although the bald eagle is known to occur in Eddy County, there is no record of occurrence at the Carlsbad Site. Chapter 5 discusses impacts to biological resources for the reference locations under each alternative. The potential for MPF activities to disturb eagles would be evaluated as part of a biological assessment that would be prepared prior to construction.

***Fish and Wildlife Coordination Act* (16 U.S.C. 661 *et seq*.)**

The *Fish and Wildlife Coordination Act* promotes more effectual planning and cooperation between Federal, state, public, and private agencies for the conservation and rehabilitation of the Nation's fish and wildlife and authorizes the DOI to provide assistance. This Act requires consultation with the USFWS on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 4 hectares (ha) (10 acres [ac]) in surface area.

Chapter 4 describes the water resources at each of the alternative sites. MPF construction and operations would not result in any direct discharges to surface water bodies.

Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 *et seq.*)

The *Farmland Protection Policy Act* requires Federal agencies to consider prime or unique farmlands when planning major projects and programs on Federal lands. Federal agencies are required to use prime and unique farmland criteria developed by the U.S. Department of Agriculture's Soil Conservation Service. Under the *Farmland Protection Policy Act*, the Soil Conservation Service is authorized to maintain an inventory of prime and unique farmlands in the United States to identify the location and extent of rural lands important in the production of food, fiber, forage, and oilseed crops (7 CFR 657).

As described in Chapter 4, there are no agricultural activities at the reference location at any of the alternative sites.

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)

This Act reaffirms Native American religious freedom under the First Amendment and sets U.S. policy to protect and preserve the inherent and constitutional right of Native Americans to believe, express, and exercise their traditional religions. The Act requires that Federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religions.

Chapter 4 describes Native American resources known to exist at each site. Chapter 5 discusses the potential impacts to Native American resources for each alternative.

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001)

This Act establishes a means for Native Americans to request the return or repatriation of human remains and other cultural items presently held by Federal agencies or federally assisted museums or institutions. The Act also contains provisions regarding the intentional excavation and removal of, inadvertent discovery of, and illegal trafficking in Native American human remains and cultural items. Major actions under this law include (1) establishing a review committee with monitoring and policymaking responsibilities; (2) developing regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (3) providing oversight of museum programs designed to meet the inventory requirements and deadlines of this law; and (4) developing procedures to handle unexpected discoveries of graves or grave goods during activities on Federal or tribal lands. All Federal agencies that manage land and/or are responsible for archaeological collections obtained from their lands or generated by their activities must comply with the Act. DOE managers of ground-disturbing activities on Federal and tribal lands should make themselves aware of the statutory provisions treating inadvertent discoveries of Native American remains and cultural objects. Regulations implementing the Act are found at 43 CFR Part 10.

Chapter 4 describes Native American resources known to exist at each site. Chapter 5 discusses the potential impacts to Native American resources for each alternative.

Occupational Safety and Health Act of 1970 (29 U.S.C. 651 *et seq.*)

The *Occupational Safety and Health Act* establishes standards for safe and healthful working conditions in places of employment throughout the United States. The Act is administered and enforced by the Occupational Safety and Health Administration (OSHA), a U.S. Department of

Labor agency. Although OSHA and EPA both have a mandate to reduce exposures to toxic substances, OSHA's jurisdiction is limited to safety and health conditions that exist in the workplace environment.

Under the Act, it is the duty of each employer to provide a workplace that is free of recognized hazards that are likely to cause death or serious physical harm. Employees have a duty to comply with the occupational safety and health standards and rules, regulations, and orders issued under the Act. OSHA regulations (29 CFR Part 1910) establish specific standards telling employers what must be done to achieve a safe and healthful working environment. Government agencies, including DOE, are not technically subject to OSHA regulations, but are required under 29 U.S.C. 668 to establish their own occupational safety and health programs for their places of employment consistent with OSHA standards. DOE emphasizes compliance with these regulations at its facilities and prescribes, through DOE orders, the OSHA standards that contractors shall meet, as applicable to their work at government-owned, contractor-operated facilities (DOE Order 440.1A). DOE keeps and makes available the various records of minor illnesses, injuries, and work-related deaths as required by OSHA regulations.

MPF construction and operations activities would be conducted in compliance with this Act.

***Noise Control Act* of 1972, as amended (42 U.S.C. 4901 *et seq*.)**

Section 4 of the *Noise Control Act* of 1972*,* as amended, directs all Federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise jeopardizing health and welfare.

DOE programs to promote control of noise at each of the sites are discussed in Chapter 4. Chapter 5 discusses the potential noise impact of MPF construction and operations for each alternative.

6.3.2 Executive Orders

Executive Order 11514 (Protection and Enhancement of Environmental Quality, March 5, 1970)

This order (regulated by 40 CFR 1500-1508) requires Federal agencies to continually monitor and control their activities to: (1) protect and enhance the quality of the environment, and (2) develop procedures to ensure the fullest practicable provision of timely public information and understanding of the Federal plans and programs that may have potential environmental impacts so that the views of interested parties can be obtained. DOE has issued regulations (10 CFR 1021) and DOE Order 451.1B for compliance with this Executive Order.

This EIS has been prepared in accordance with NEPA requirements (i.e., 40 CFR 1500-1508, 10 CFR 1021, and DOE Order 451.1B).

Executive Order 11593 (National Historic Preservation, May 13, 1971)

This order directs Federal agencies to locate, inventory, and nominate qualified properties under their jurisdiction or control to the NRHP. This process requires DOE to provide the ACHP the opportunity to comment on the possible impacts of the proposed activity on any potential eligible or listed resources.

Chapter 4 identifies historic resources at each of the alternative sites. Chapter 5 discusses potential impacts to historic resources at each site.

Executive Order 11988 (Floodplain Management, May 24, 1977)

This order requires Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain, and that floodplain impacts be avoided to the extent practicable. DOE regulations in 10 CFR Part 1022 establish policy and procedures for discharging the DOE's responsibilities with respect to compliance with this order.

Chapter 4 identifies the delineated floodplains at each alternative site. MPF construction and operations are not expected to impact floodplains at any of the sites. With exception of NTS, and SRS and Carlsbad Site, the reference locations analyzed for a MPF are not located within the 100-year or 500-year floodplains.

Because of the size of NTS, no comprehensive floodplain analysis has been conducted to delineate the 100-year and 500-year floodplains. If NTS were selected, the proposed MPF would be sited in accordance with applicable regulatory requirements and DOE Orders, including this Executive Order.

The reference location at SRS is outside the 100-year floodplain, but information regarding the 500-year floodplain is not available. If SRS were selected, the proposed MPF would be sited in accordance with applicable regulatory requirements and DOE Orders, including this Executive Order.

The reference location at the Carlsbad Site is outside the 100-year floodplain, but information regarding the 500-year floodplain is not available. If the Carlsbad Site were selected, the proposed MPF facilities would be sited in accordance with applicable regulatory requirements and DOE Orders including this Executive Order.

Executive Order 11990 (Protection of Wetlands, May 24, 1977)

This order requires Federal agencies to avoid any short- or long-term adverse impacts on wetlands wherever there is a practicable alternative. DOE regulations at 10 CFR Part 1022 establish policy and procedures for discharging DOE's responsibilities with respect to compliance with this order.

Chapter 4 identifies the wetlands at each alternative site. MPF construction and operations are not expected to impact wetlands at any of the sites. There are no wetlands within the reference locations analyzed for construction of a MPF and the associated construction staging and laydown areas.

Executive Order 12088 (Federal Compliance with Pollution Control Standards, October 13, 1978, as amended by Executive Order 12580, Federal Compliance with Pollution Control Standards, January 23, 1987)

This order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the *Clean Air Act*, *Noise Control Act*, CWA, *Safe Drinking Water Act*, TSCA, and RCRA.

MPF construction and operations activities at each of the alternative sites would be conducted in compliance with this order.

Executive Order 12580 (Superfund Implementation, August 28, 1996)

This order delegates to the heads of Executive departments and agencies the responsibility of undertaking remedial actions for releases or threatened releases that are not on the National Priorities List and for removal actions, other than emergencies, where the release is from any facility under the jurisdiction or control of executive departments and agencies.

MPF construction and operations activities at each of the alternative sites would be conducted in compliance with this order.

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994)

This order requires each Federal agency to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

The Environmental Justice section of Chapter 5 provides information that demonstrates compliance with this order.

Executive Order 13007 (Indian Sacred Sites, May 24, 1996)

This order requires: "In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sites."

Chapter 4 identifies Native American resources at each alternative site. Chapter 5 discusses the potential impacts to Native American resources. A cultural resource survey will be done at the selected site prior to any construction activity.

Executive Order 13101 (Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition, September 14, 1998)

This order requires each Federal agency to incorporate waste prevention and recycling in its daily operations and to work to increase and expand markets for recovered materials. This order states that it is national policy to prefer pollution prevention, whenever feasible. Pollution that cannot be prevented should be recycled; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner. Disposal should be employed only as a last resort.

MPF construction and operations activities at each of the alternative sites would be conducted in compliance with this order.

Executive Order 13112 (Invasive Species, February 3, 1999)

This order requires Federal agencies to prevent the introduction of invasive species to provide for their control, and to minimize their economic, ecological, and human health impacts.

MPF construction and operations activities at each of the alternative sites would be conducted in compliance with this order.

Executive Order 13123 (Greening the Government Through Efficient Energy Management, June 3, 1999)

This order directs Federal agencies to improve energy management in order to save taxpayer dollars and reduce emissions that contribute to air pollution and global climate change.

MPF construction and operations activities at each of the alternative sites would be conducted in compliance with this order.

Executive Order 13148 (Greening the Government Through Leadership in Environmental Management, April 21, 2000)

This order sets new goals for pollution prevention, requires all Federal facilities to have an environmental management system, and requires compliance or environmental management system audits.

MPF construction and operations activities at each of the alternative sites would be conducted in compliance with this order.

Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments, November 6, 2000)

This order requires agencies to establish regular and meaningful consultation with tribal officials in the development of policies that have tribal implications.

MPF construction and operations activities at each of the alternative sites would be conducted in compliance with this order.

6.3.3 DOE Environmental, Safety, and Health Regulations and Orders

The *Atomic Energy Act* authorizes DOE to establish standards to protect health and/or minimize the dangers to life or property from activities under DOE's jurisdiction. Through a series of DOE orders and regulations, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities.

DOE regulations are found in Title 10 of the CFR. These regulations address such areas as energy conservation, administrative requirements and procedures, nuclear safety, and classified information. For the purpose of this EIS, relevant regulations include: "Procedural Rules for DOE Nuclear Activities" (10 CFR 820), "Nuclear Safety Management" (10 CFR 830), "Occupational Radiation Protection" (10 CFR 835), "National Environmental Policy Act Implementing Procedures" (10 CFR 1021), and "Compliance with Floodplains/Wetlands Environmental Review Requirements" (10 CFR 1022).

DOE orders are issued in support of environmental, safety, and health programs. Many DOE orders have been revised and reorganized to reduce duplication and eliminate obsolete provisions. New DOE orders are organized by series, with each number identified by three digits, and include all DOE orders, policies, manuals, and requirement documents, notices, and guides. The remaining DOE orders, which are identified by four digits, are expected to be revised, and converted to the new DOE numbering system. The major DOE orders pertaining to construction and operation of a MPF are listed in Table 6.3.3–1.

Table 6.3.3–1. DOE Orders and Directives Relevant to MPF

DOE Order	Subject
Leadership/Management/Planning	
151.1A	Comprehensive Emergency Management System (11/01/00)
Information and Analysis	
225.1A	Accident Investigations (11/26/97)
231.1	Environment, Safety, and Health Reporting (09/30/95; Change 2, 11/07/96)
232.1A	Occurrence Reporting and Processing of Operations Information (07/21/97)
252.1	Technical Standards Program (11/19/99)
Work Process	
411.1-1B	Safety Management Functions, Responsibilities, and Authorities Manual (5/22/01)
414.1A	Quality Assurance (09/29/99; Change 1, 07/12/01)
420.1A	Facility Safety (05/20/02)
425.1C	Startup and Restart of Nuclear Facilities (03/13/03)
430.1A	Life Cycle Asset Management (10/14/98)
433.1	Maintenance Management Program for DOE Nuclear Facilities (06/01/01)
435.1	Radioactive Waste Management (07/09/99; Change 1, 08/28/01)
440.1A	Worker Protection Management for DOE Federal and Contractor Employees (03/27/98)
450.1	Environmental Protection Program (01/15/03)
451.1B	National Environmental Policy Act Compliance Program (10/26/00; Change 1, 09/28/01)
460.1A	Packaging and Transportation Safety (10/02/96)
460.2	Departmental Materials Transportation and Packaging Management (09/27/95; Change 1, 10/26/95)
461.1	Packaging and Transfer or Transportation of Materials of National Security Interest (09/29/00)
470.1	Safeguards and Security Program (09/28/95; Change 1, 06/21/96)
470.2B	Independent Oversight and Performance Assurance Program (10/31/02)
471.1A	Identification and Protection of Unclassified Controlled Nuclear Information (06/30/00)
471.2A	Information Security Program (03/27/97)
472.1C	Personnel Security Activities (03/25/03)
473.1	Physical Protection Program (12/23/02)
473.2	Protective Force Program (06/30/00)
474.1A	Control and Accountability of Nuclear Materials (11/22/00)
External Relationships	
1230.2	American Indian Tribal Government Policy (04/08/92)
Personnel Relations and Services	
3790.1B	Federal Employee Occupational Safety and Health Program (01/07/93)
Environmental Quality and Impact	
5400.5	Radiation Protection of the Public and the Environment (02/08/90; Change 2, 01/07/93)
5480.4	Environmental Protection, Safety, and Health Protection Standards (05/15/84; Change 4, 01/07/93)
5480.19	Conduct of Operations Requirements for DOE Facilities (07/09/90; Change 2, 10/23/01)
5480.20A	Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities (11/15/94; Change 1, 07/12/01)
Emergency Preparedness	
5530.3	Radiological Assistance Program (01/14/92; Change 1, 04/10/92)
5530.5	Federal Radiological Monitoring and Assessment Center (07/10/92; Change 1, 12/02/92)
Office of National Nuclear Security Administration	
5660.1B	Management of Nuclear Materials (05/26/94)

6.3.4 State Environmental Laws, Regulations, and Agreements

Certain environmental requirements, including some discussed in Section 6.3.1, have been delegated to state authorities for implementation and enforcement. It is DOE policy to conduct its operations in an environmentally safe manner that complies with all applicable laws, regulations, and standards, including state laws and regulations. A list of applicable state laws, regulations, and agreements is provided in Table 6.3.4–1. This list is not exhaustive and other state laws and regulations may be applicable.

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF

Law/Regulation/Agreement	Citation/Date	Requirements
Los Alamos Site and Carlsbad Site, New Mexico		
New Mexico Air Quality Control Act	New Mexico Statutes Annotated (NMSA), Chapter 74, Environmental Improvement, Article 2, Air Pollution, and Implementing Regulations at New Mexico Administrative Code (NMAC) Title 20, Environmental Protection, Chapter 2, Air Quality	Establishes air quality standards and requires a permit prior to construction or modification of an air contaminant source. Also requires an operating permit for major producers of air pollutants and imposes emission standards for hazardous air pollutants.
New Mexico Radiation Protection Act	NMSA, Chapter 74, Article 3, Radiation Control	Establishes state requirements for worker protection.
New Mexico Water Quality Act	NMSA, Chapter 74, Article 6, Water Quality; Implementing Regulations found in NMAC, Title 20, Chapter 6, Water Quality	Establishes water quality standards and requires a permit prior to the construction or modification of a water discharge source.
New Mexico Groundwater Protection Act	NMSA, Chapter 74, Article 6B, Groundwater Protection	Establishes state standards for protection of groundwater from leaking underground storage tanks.
New Mexico Solid Waste Act	NMSA, Chapter 74, Article 9, *Solid Waste Act*; Implementing Regulations found in NMAC Title 20, Environmental Protection, Chapter 9, Solid Waste	Requires permit prior to construction or modification of a solid waste disposal facility.
New Mexico Hazardous Waste Act	NMSA, Chapter 74, Article 4, Hazardous Waste, and Implementing Regulations at NMAC Title 20, Environmental Protection, Chapter 4, Hazardous Waste	Requires a permit prior to construction or modification of a hazardous waste disposal facility.
New Mexico Hazardous Chemicals Information Act	NMSA, Chapter 74, Article 4E-1, Hazardous Chemicals Information	Implements the hazardous chemical information and toxic release reporting requirements of the EPCRA of 1986 (SARA Title III) for covered facilities.
New Mexico Wildlife Conservation Act	NMSA, Chapter 17, Game and Fish, Article 2, Hunting and Fishing Regulations, Part 3, Wildlife Conservation Act	Requires permit and coordination if a project may disturb habitat or otherwise affect threatened or endangered species.
New Mexico Raptor Protection Act	NMSA, Chapter 17, Article 2-14	Makes it unlawful to take, attempt to take, possess, trap, ensnare, injure, maim, or destroy any of the species of hawks, owls, and vultures.

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF (*continued*)

Law/Regulation/Agreement	Citation/Date	Requirements
New Mexico Endangered Plant Species Act	NMSA, Chapter 75, Miscellaneous Natural Resource Matters, Article 6, Endangered Plants	Requires coordination with the state.
Threatened and Endangered Species of New Mexico	NMAC, Title 19, Natural Resources and Wildlife, Chapter 33, Endangered and Threatened Species, Section 19.33.6.8	Establishes the list of threatened and endangered species.
Endangered Plant Species	NMAC, Title 19, Chapter 21, Endangered Plants	Establishes plant species list and rules for collection.
New Mexico Cultural Properties Act	NMSA, Chapter 18, Libraries and Museums, Article 6, Cultural Properties	Establishes SHPO and requirements to prepare an archaeological and historic survey and consult with the SHPO.
Environmental Oversight and Monitoring Agreement	Agreement in Principle Between DOE and the State of New Mexico, October 1, 1995	Provides DOE support for state activities in environmental oversight, monitoring, access, and emergency response.
Pueblo Accords	DOE 1992 Cooperative Agreements with each of four Pueblos	Sets forth the relationship between DOE and the Pueblos.
Los Alamos County Noise Restrictions	Los Alamos County Code, Chapter 8.28	Imposes noise restrictions and makes provisions for exceedances.
City of Albuquerque Noise Control Ordinance	Ordinance 21-1975	Establishes acceptable noise levels for various activities within the City of Albuquerque.
LANL Federal Facility Compliance Order	October 1995 (Issued to both DOE and LANL)	Requires compliance with the site treatment plan, which documents the development of treatment capacities and technologies or use of offsite facilities for treating mixed radioactive waste.
Consultation and Cooperation Agreement between DOE and the State of New Mexico	July 1, 1981, Agreement for Consultation and Cooperation, as amended by the November 30, 1984, "First Modification," the August 4, 1987, "Second Modification," and the March 22, 1988, modification to the Working Agreement	Affirms the intent of the Secretary of Energy to consult and cooperate with the State of New Mexico with respect to state public health and safety concerns at WIPP. Limits the volume of remote handled TRU waste that may be disposed of at WIPP to 7,080 m^3 (250,000 ft^3).

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF (*continued*)

Law/Regulation/Agreement	Citation/Date	Requirements
Joint Powers Agreement on Management of the WIPP Withdrawal Area	June 26,1997	Establishes formal relationships and specifies responsibilities and protocols between DOE and New Mexico state government (New Mexico Department of Game and Fish, New Mexico Energy, Minerals and Natural Resources Department, New Mexico Office of Cultural Affairs, New Mexico State Land Office) with respect to WIPP land management.
Nevada Test Site, Nevada		
Nevada Air Pollution Control Law	Nevada Revised Statutes (NRS), Title 40, Public Health and Safety, Chapter 445B, Air Pollution	Requires permit prior to construction or modification of an air contaminant source.
Nevada Air Quality Regulations	Nevada Administrative Code (NAC), Chapter 445B, Air Controls, Air Pollution	Implements both state and Federal (EPA) clean air statutes. Identifies permit and monitoring requirements.
Nevada Water Pollution Control Law	NRS Title 40, Chapter 445A, Water Controls	Requires permit prior to construction or modification of a water discharge source.
Nevada Water Pollution Control Regulations	NAC, Chapter 445A, Sections 070-348, Water Pollution Control	Classifies waters of the state, establishes standards for water quality, and specifies discharge permit requirements and notification requirements.
Nevada Water Quality Standards	NAC, Chapter 445A, Water Controls	Establishes water quality standards. Requires permit prior to discharge to surface waters or groundwaters of the state.
Nevada Drinking Water Regulations	NAC, Chapter 445A, Water Controls	Sets standards for drinking water specifications for certification and control of variances and exemptions. Sets standards for wells and other water supply systems. Establishes regulation of wells, aquifer exemptions, prohibited wells, operation, monitoring, etc., as well as plugging and abandonment activities.
Nevada Solid Waste Disposal Law	NRS, Title 40, Chapter 444, Sanitation	Requires permit prior to construction or modification of a solid waste disposal facility.

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF (*continued*)

Law/Regulation/Agreement	Citation/Date	Requirements
Nevada Solid Waste Regulations	NAC, Chapter 444, Sanitation, Sections 570-749, Solid Waste Disposal	Sets forth definitions, methods of disposal, and special requirements for hazardous waste collection and transportation standards and classification of landfills.
Nevada Hazardous Waste Regulations	NAC, Chapter 444, Sanitation, Sections 842-874, Facilities for Management of Hazardous Waste	Establishes fees, variances, restrictions, and permits. Adopts 40 CFR 2, 124, and 260 to 270, inclusive as a part of the Nevada Administrative Code.
Nevada Regulation of Highly Hazardous Substances	NAC, Chapter 459, Hazardous Materials, Sections 952-95528	Requires facilities having listed highly hazardous substances in threshold quantities to conduct a hazardous assessment, implement prevention and emergency response programs, and submit assessment and annual compliance reports.
Nevada Storage Tank Regulations	NAC, Chapter 590, Cleanup of Discharged Petroleum, Sections 700-790	Adopts Federal regulations at 40 CFR Part 280. Establishes requirements for cleanup of petroleum discharges.
Nevada Sewage Disposal Regulations	NAC, Chapter 444, Sanitation, Sections 750-840, Sewage Disposal	Establishes standards, regulations, permits, and requirements for septic tanks and other sewage disposal systems for dwellings, communities, and commercial buildings.
Nevada Public Waters Law	NRS, Title 48, Water Chapter 533, Adjudication of Vested Water Rights; Appropriation of Public Waters	Sets forth requirements, procedures, and a process for acquiring a permit for appropriation of public waters. Establishes permit fees and sets forth environmental requirements. Note that the Legislative Counsel Bureau, Carson City, has not published a corresponding chapter in the Nevada Administrative Code covering the implementation of Nevada Revised Statutes, Chapter 533.
Nevada Underground Water, Wells, and Related Drilling Requirements	NAC, Chapter 534, Underground Water and Wells, Sections 280-298, License to Drill Well and Sections 300-450, Drilling, Construction, and Plugging of Wells	Establishes ownership of underground waters and their appropriation for beneficial use. Specifies the conditions, requirements, and rules for acquiring such water. Sets forth license requirements for well drillers; requirements of drilling, construction, and plugging of wells; and protection of aquifers from pollution and waste.

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF (*continued*)

Law/Regulation/Agreement	Citation/Date	Requirements
Protection of Indigenous Flora	NRS Title 47, Forestry; Forestry Products and Flora, Chapter 527, Protection and Preservation of Timbered Lands, Trees, and Flora	Provides protection of indigenous flora. Plants declared to be threatened with extinction are placed on the state list of fully protected species.
Nevada Wildlife Regulations	NAC, Chapter 503, Hunting, Fishing, and Trapping; Miscellaneous Protective Measures, Sections 010-104, General Provisions	Specifies classification of wildlife as protected and unprotected.
Nevada Historic Preservation and Archaeology Law	NRS, Title 33, Libraries, Museums; Historic Preservation, Chapter 383, Historic Preservation and Archaeology	Requires permit prior to the investigation, exploration, or excavation of a historic or prehistoric site.
Mutual Consent Agreement between State of Nevada and DOE for the Storage of the Low-Level Land Disposal Restricted Mixed Radioactive Waste	Signed in January 1994, modified in June 1995 and 1998	Provides a 9-month period to prepare and submit a plan for the treatment and disposal of newly generated mixed LLW not covered under the Site Treatment Plan. Allows available storage capacity of the TRU waste pad to be used for storage of onsite-generated mixed LLW that does not meet RCRA land disposal restriction provisions.
Agreement in Principle between DOE and the State of Nevada	June 1999	Provides funding to Nevada for oversight of DOE's environmental, safety, and health activities.
Settlement Agreement between DOE and the State of Nevada	June 1992	Authorizes storage of only the current inventory of mixed TRU waste. Storage of additional TRU waste at NTS would require a permit.
Site Treatment Plan and Consent Order	March 1996	Address treatment of legacy mixed waste streams on the NTS. Under a June 1998 revision to the Order, new milestones and deadlines for mixed waste treatment must be proposed through annual updates to the Site Treatment Plan.
Federal Facility Agreement and Consent Order with DOE, the State of Nevada, and Department of Defense (DOD)	May 1996	Address environmental restoration of inactive contaminated sites at NTS and other sites in Nevada. The Agreement outlines a process for identifying, prioritizing, investigating, and remediating contaminated sites.
U.S. District Court of Nevada jurisdiction for the Death Valley Groundwater Flow System	U.S. v. Cappaert *et al.*, 375 F. Supp. 456 (D. Nevada 1974)	Maintains an adequate water supply while ensuring protection of the surrounding ecosystem.

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF (*continued*)

Law/Regulation/Agreement	Citation/Date	Requirements
Pantex Site, Texas		
Texas Air Pollution Control Regulations	TX Admin. Code, Title 30, Chapter 101-122, 305	Requires permit prior to construction or modification of an air contaminant source.
Texas Water Quality Standards	TX Admin. Code, Title 30, Chapter 305, 308-325	Requires permit prior to construction or modification of a water discharge source.
Texas Consolidated Permit Rules	TX Admin. Code, Title 30, Chapter 305	Requires permit prior to construction or modification of a water discharge source.
Texas Risk Reduction Standards	TX Admin. Code, Title 30, Chapter 335, Industrial Solid Waste and Municipal Hazardous Waste, Subchapter S: Risk Reduction Standards §§335.551 - 335.569	Regulates closure or remediation of facilities or areas containing industrial solid waste or municipal hazardous waste in accordance with §335.8.
Texas Public Drinking Water Regulations	TX Admin. Code, Title 30, Chapter 290	Requires permit prior to construction or modification of a water discharge source affecting a public water supply.
Texas Underground and Aboveground Storage Tanks Rules	TX Admin. Code, Title 30, Chapter 334	Requires permit prior to construction or modification of an underground storage tank.
Texas Spill Prevention and Control Regulations	TX Admin. Code, Title 30, Chapter 327	Requires certain spills to be reported and outlines response actions to be taken.
Texas General Permit Regulations	TX Admin. Code, Title 30, Chapter 205	Requires permit prior to discharge of stormwater or other groupings of waste discharges. Establishes conditions for general permits for wastewater discharges.
Texas Solid Waste Disposal Act	TX Statutes, Article 4477-7, and Implementing Regulations at TX Admin. Code, Title 30, Chapter 305, 335, Industrial Solid Waste and Municipal Hazardous Waste Regulations	Requires permit prior to construction or modification of a solid waste disposal facility.
Texas Endangered, Threatened, and Protected Native Plants Regulations	TX Admin. Code, Title 31, Natural Resources and Conservation, Part 2, TX Parks and Wildlife Department, Chapter 69, Resource Protection, Subchapter A, Endangered, Threatened, and Protected Native Plants	Requires permit for anyone who possesses, takes, or transports endangered, threatened, or protected plants or animals.

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF (*continued*)

Law/Regulation/Agreement	Citation/Date	Requirements
Antiquities Code of Texas	TX Statutes, Chapter 9, Natural Resources, Title 9, Heritage, Chapter 191	Requires permit for the examination or excavation of sites and the collection or removal of objects of antiquity.
EPA Administrative Order Docket No. VI-98-0012 and Docket No. VI-98-0401; Federal Facility Compliance Agreement, Docket No. VI-98-1210	Federal Facility Compliance Agreement signed November 28, 1998	This Order lists wastewater discharge permit violations and a schedule of corrective actions to achieve permit compliance. Federal Facility Compliance Agreement No. VI-98-1210 includes a compliance schedule. As of the end of 2000, all corrective actions were on or ahead of schedule.
Pantex Plant Site Treatment Plan/Compliance Plan and Agreed Order	October 3, 1995	Establishes schedules for development of treatment technologies for mixed LLW subject to the RCRA Land Disposal Restrictions. All milestones in the original plan were completed in 2000. The plan was updated in 2001 to address newly identified wastes and waste that required development of new disposition paths.
Savannah River Site, South Carolina		
South Carolina Pollution Control Act	SC Code of Laws, Title 48, Environmental Protection and Conservation, Chapter 1 and implementing regulations at SC Code of Regulations, R.61-62, Air Pollution Control Regulations and Standards	Requires permit prior to construction or modification of an air contaminant source.
South Carolina Water Classifications and Standards	SC Code of Regulations, Chapter 61, R.61-68	Classifies waters of the state and establishes standards for water quality.
South Carolina Water Pollution Control Permits	SC Code of Regulations, Chapter 61, R.61-9	Requires permit prior to construction or modification of a water discharge source.
South Carolina Standards for Wastewater Facility Construction	SC Code of Regulations, Chapter 61, R.61-67	Sets standards for permitting of wastewater treatment systems.
South Carolina Safe Drinking Water Act	SC Code, Title 44, Health, Chapter 55 and Implementing Regulations at SC Code of Regulations, Chapter 61, R.61-58, South Carolina State Primary Drinking Water Regulations	Establishes drinking water standards.
Stormwater Management and Sediment Reduction Act	SC Code of Laws, Title 48, Chapter 14	Requires submission of a stormwater management and sediment control plan and obtaining a permit to proceed prior to engaging in a land disturbing activity.

Table 6.3.4–1. State Environmental Laws, Regulations, and Agreements Relevant to MPF (*continued*)

Law/Regulation/Agreement	Citation/Date	Requirements
South Carolina Underground Storage Tank Control Regulations	SC Code of Regulations, Chapter 61, R.61-92	Requires permit prior to construction or modification of an underground storage tank. Establishes design and operating standards for underground storage tanks.
South Carolina Hazardous Waste Management Act	SC Code of Laws, Title 44, Health, Chapter 56 and Implementing Regulations at SC Code of Regulations, Chapter 61, R.61-79, South Carolina Hazardous Waste Management Regulations	Requires permit to operate, construct, or modify a hazardous waste treatment, storage or disposal facility.
South Carolina Hazardous Waste Management Location Standards	SC Code of Regulations, Chapter 61, R.61-104	Establishes requirements for the siting of hazardous waste treatment, storage, and disposal facilities.
South Carolina Solid Waste Policy and Management Act	SC Code, Title 44, Health Chapter 96 and Implementing Regulations at SC Code or Regulations, Chapter 61, R.61-107, Solid Waste Management	Establishes standards to treat, store or dispose of solid waste.
South Carolina Nongame and Endangered Species Conservation Act	SC Code, Title 50, Fish, Game, and Watercraft, Chapter 15	Requires consultation with SC Wildlife and Marine Resources Department and efforts to minimize impact.
South Carolina Museum Commission and Institute of Archaeology and Anthropology	SC Code of Laws, Title 60, Libraries, Archives, Museums and Arts, Section 60-13-210	Requires consultation with SC Historic Preservation Office and efforts to minimize impact.
Federal Facility Agreement with EPA Region IV and South Carolina Department of Health and Environmental Control (SCDHEC)	August 1993	Governs the corrective/remedial action process at SRS from site investigation through site remediation. Describes the process for setting annual work priorities. Stipulates design and operating standards for the SRS high-level waste tank systems.
SRS Site Treatment Plan and Consent Order	September 29, 1995	Addresses the development of capacities and technologies for treating SRS mixed wastes in accordance with the RCRA land disposal restrictions. Annual plan updates identify changes in mixed waste treatment status, including the addition of new mixed waste streams.

6.4 OTHER REGULATORY REQUIREMENTS

6.4.1 Radioactive Material Packaging and Transportation Regulations

DOT and NRC regulations govern the transportation of hazardous and radioactive materials and substances. The *Hazardous Material Transportation Act* of 1975 (49 U.S.C. 5105 *et seq*.) requires DOT to prescribe uniform national regulations for transportation of hazardous materials (including radioactive materials). Most state and local regulations regarding such transportation that are not substantively the same as DOT regulations are preempted (i.e., rendered void) (49 U.S.C. 5125). This allows state and local governments only to enforce the Federal regulations, not to change or expand upon them.

This program is administered by the DOT Research and Special Programs Administration, which coordinates its regulations with those of NRC (under the *Atomic Energy Act*) and EPA (under RCRA) when covering the same activities.

DOT regulations (49 CFR Parts 171-178, and 49 CFR Parts 383-397) contain requirements for identifying a material as hazardous or radioactive. These regulations interface with the NRC regulations for identifying material, but DOT hazardous material regulations govern the hazard communication (e.g., marking, hazard labeling, vehicle placarding, emergency response telephone number) and shipping requirements.

NRC regulations applicable to radioactive materials transportation are found in 10 CFR Part 71. These regulations include detailed packaging design and package certification testing requirements. Complete documentation of design and safety analysis and the results of the required testing are submitted to NRC to certify the package for use.

The transportation casks used to transport radioactive material are subject to numerous inspections and tests. These tests are designed to ensure that cask components are properly assembled and meet applicable safety requirements. Tests and inspections are clearly identified in the Safety Analysis Report for Packaging and/or the Certificate of Compliance for each cask. Casks are loaded and inspected by registered users in compliance with approved quality assurance programs. Reports of defects or accidental mishandling are submitted to NRC.

Chapter 5 discusses the potential impacts associated with transportation of radioactive material (plutonium pits, recyclable enriched uranium parts, TRU waste, LLW) for each alternative.

6.4.2 Emergency Management and Response Laws, Regulations, and Executive Orders

This section discusses the laws, regulations, and Executive Orders that address the protection of public health and worker safety and require the establishment of emergency plans. These laws, regulations, and Executive Orders relate to the operation of facilities, including DOE facilities that engage directly or indirectly in the production of special nuclear material.

6.4.2.1 Emergency Management and Response Laws

***Emergency Planning and Community Right-to-Know Act* of 1986 (U.S.C. 11001 *et seq.*) (also known as "SARA Title III")**

This Act requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. EPA implements this Act under regulations found in 40 CFR Parts 355, 370, and 372. Under Subtitle A of this Act, Federal facilities are required to provide information (such as inventories of specific chemicals used or stored and releases that occur from these sites) to the state emergency response commission and to the local emergency planning committee to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. Implementation of the provisions of this Act began voluntarily in 1987, and inventory and annual emissions reporting began in 1988. DOE requires compliance with Title III as a matter of DOE policy at its contractor-operated facilities.

Chapter 4 describes emergency planning for each alternative site. Each alternative site is at an existing, operating DOE facility with an established emergency management program that would be activated in the event of an accident. These programs have been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management plan for each site includes emergency planning, training, preparedness, and response.

Chapter 5 and Appendix C discuss the impacts of potential accidents for each alternative.

***Comprehensive Environmental Response, Compensation, and Liability Act* of 1980 (42 U.S.C. 9604[I] also know as "Superfund")**

This Act provides authority for Federal and state governments to respond directly to hazardous substance incidents. The Act requires reporting of spills, including radioactive spills, to the National Response Center.

DOE would comply with this requirement for any alternative.

***Robert T. Stafford Disaster Relief and Emergency Assistance Act* of 1988 (42 U.S.C. 5121)**

This Act, as amended, provides an orderly, continuing means of providing Federal government assistance to state and local governments in managing their responsibilities to alleviate suffering and damage resulting from disasters. The President, in response to a state governor's request, may declare an "emergency" or "major disaster" to provide Federal assistance under this Act. The President, in Executive Order 12148, delegated all functions except those in Sections 301, 401, and 409 to the Director of the Federal Emergency Management Agency (FEMA). The Act provides for the appointment of a Federal coordinating officer who will operate in the designated area with a state coordinating officer for the purpose of coordinating state and local disaster assistance efforts with those of the Federal Government.

***Justice Assistance Act* of 1984 (42 U.S.C. 3701-3799)**

This Act establishes Emergency Federal Law Enforcement Assistance, which provides assistance to state and local governments in responding to a law enforcement emergency. The Act defines the term "law enforcement emergency" as an uncommon situation which requires law enforcement, which is or threatens to become of serious or epidemic proportions, and with respect to which state and local resources are inadequate to protect the lives and property of citizens or to enforce the criminal law. Emergencies that are not of an ongoing or chronic nature (for example, the Mount Saint Helens volcanic eruption) are eligible for Federal law enforcement assistance including funds, equipment, training, intelligence information, and personnel.

***Price-Anderson Act* (42 U.S.C. 2210)**

Enacted in 1957, this Act allows DOE to indemnify its contractors if the contract involves the risk of public liability from a nuclear incident. The 1988 *Price-Anderson Amendments Act* continued the indemnification of DOE operating contractors, but required the DOE to begin undertaking enforcement actions against those contractors who violate nuclear safety rules. The 1988 amendments allow DOE to assess civil fines against its contractors for safety violations, although the amended Act also exempts seven nonprofit institutions (including the University of California for activities at LANL) from civil penalties.

6.4.2.2 Emergency Management and Response Regulations

Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release (10 CFR §30.72, Schedule C)

This section of the NRC regulations provides a list that is the basis for both the public and private sector to determine whether the radiological materials they handle must have an emergency response plan for unscheduled releases, and is one of the threshold criteria documents for identifying hazards as required by DOE Order 151.1A, "Comprehensive Emergency Management System." The "Federal Radiological Emergency Response Plan," dated November 1995, primarily discusses offsite Federal response in support of state and local governments with jurisdiction during a peacetime radiological emergency.

Chapter 4 describes emergency preparedness for each alternative.

Occupational Safety and Health Administration Emergency Response, Hazardous Waste Operations, and Worker Right to Know (29 CFR 1910)

This regulation establishes OSHA requirements for employee safety in a variety of working environments. It addresses employee emergency and fire prevention plans (Section 1910.38), hazardous waste operations and emergency response (Section 1920.120), and hazards communication (Section 1910.1200) to make employees aware of the dangers they face from hazardous materials at their workplace. These regulations do not directly apply to Federal agencies. However, Section 19 of the *Occupational Safety and Health Act* (29 U.S.C. 668) requires all Federal agencies to have occupational safety programs "consistent" with *Occupational Safety and Health Act* standards.

Chapter 4 describes DOE emergency programs.

Hazardous Materials Tables and Communications, Emergency Response Information Requirements (49 CFR 172)

This regulation defines the requirements for marking, labeling, placarding, and documenting hazardous material shipments. The regulation also specifies the requirements for providing hazardous material information and training.

DOE would comply with this requirement for any alternative.

6.4.2.3 Emergency Response and Management Executive Orders

Executive Order 12148 (Federal Emergency Management, July 20, 1979)

This order transfers functions and responsibilities associated with Federal emergency management to the Director of FEMA. The order assigns the director the responsibility to establish Federal policies for, and to coordinate all civil defense and civil emergency planning, management, mitigation, and assistance functions of, executive agencies.

Executive Order 12656 (Assignment of Emergency Preparedness Responsibilities, November 18, 1988)

This order assigns emergency preparedness responsibilities to Federal departments and agencies.

Executive Order 12938 (Proliferation of Weapons of Mass Destruction, November 14, 1994)

This order states that the proliferation of nuclear, biological, and chemical weapons ("weapons of mass destruction") and the means of delivering such weapons constitutes an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States, and that a national emergency would be declared to deal with that threat.

6.4.3 Consultations with Federal, State, and Local Agencies and Federally-Recognized Native American Groups

Certain laws, such as the *Endangered Species Act*, *Fish and Wildlife Coordination Act*, and NHPA, require consultation and coordination by DOE with other governmental entities including other Federal agencies, state and local agencies, and Federally-recognized Native American groups. These consultations must occur on a timely basis and are generally required before any land disturbance can begin. Most of these consultations are related to biotic resources, cultural resources, and Native American rights. The biotic resource consultations generally pertain to the potential for activities to disturb sensitive species or habitats. Cultural resource consultations relate to the potential for disruption of important cultural resources and archaeological sites. Native American consultations are concerned with the potential for disturbance of ancestral Native American sites and the traditional practices of Native Americans.

This EIS is primarily concerned with determining a candidate DOE site for a MPF. NNSA has selected for analysis a reference location at each of the alternative sites. A second EIS would be prepared once a DOE site is identified for more detailed analysis, including consideration of alternative locations for a MPF in the vicinity of that site. Surveys would be conducted at the proposed location for a MPF prior to any construction. At that time, DOE would consult with Federal, state, and local agencies and Federally recognized Native American groups regarding the potential impacts to biotic resources, cultural resources, and Native American rights.

6.5 ALTERNATIVE-SPECIFIC INFORMATION

6.5.1 Additional Requirements

Under any alternative, new or modified permits would be needed prior to construction or operation of a MPF. These permits regulate many aspects of facility construction and operations, such as treatment and storage of hazardous waste and discharges of airborne or liquid effluents to the environment. Permits would be obtained through the appropriate Federal, state, or local agencies. As with consultations, a more detailed analysis of the required permits and/or approvals would occur as part of the second tiered EIS that DOE will prepare after a decision is made based on the siting alternatives evaluated in this EIS. In addition to permitting, the following sections discuss site-specific requirements that would apply to construction and operation of a MPF.

6.5.1.1 Los Alamos Site Alternative

Hazardous Waste Facility Permit

The New Mexico Environment Department (NMED) issued the original RCRA permit for LANL's waste management operations at Technical Areas (TA)-50, -54, and -16 on November 8, 1989, for a term of 10 years. On January 15, 1999, LANL submitted an application for a permit renewal for TA-54. That application also covered the hazardous waste container storage areas at TA-3 and TA-16, and at TA-54's Area G, Area L, and TA-54 west; hazardous waste treatment by solidification, cementation, and vitrification at TA-55; and hazardous waste treatment by burning and detonation at TA-14 and burning at TA-16. It includes general statements that corrective action will be conducted for releases of hazardous wastes and hazardous constituents at these areas. The original permit expired after 10 years, but was administratively continued pending the NMED review of LANL's permit renewal application. LANL continues to work on the application process to renew its Hazardous Waste Facility Permit and to respond to information requests from NMED about the history of hazardous waste generation and management at LANL.

LANL is not listed on EPA's National Priorities List but it follows some CERCLA guidelines for remediating sites that contain hazardous substances not covered by RCRA and/or that may not be included in Module VIII of the Hazardous Waste Facility Permit.

***Resource Conservation and Recovery Act* Corrective Action**

On November 26, 2002, NMED issued a final order to DOE and the University of California pursuant to New Mexico Statutes Annotated 1978 Sections 74-4-10.1 and 74-4-13 of the *New Mexico Hazardous Waste Act* and the New Mexico Hazardous Waste Management Regulations 20.4 New Mexico Administrative Code. The order contains investigation and cleanup requirements and a schedule for implementation of cleanup measures at LANL. In the draft order issued on May 2, 2002, NMED made a determination that the past or present handling, storage, treatment, and/or disposal of solid or hazardous wastes at the LANL may present an imminent and substantial endangerment to health and the environment. LANL challenged that determination. LANL also commented that the Endangerment Determination and order seek to regulate source, special nuclear, and byproduct material, as defined in the *Atomic Energy Act* of 1954*,* which are exempt from regulation under RCRA and the *New Mexico Hazardous Waste Act*. DOE is pursuing legal challenges to the endangerment finding and regulatory authority issue.

A MPF would not be expected to impact ongoing LANL remediation activities.

Site Treatment Plan

In October 1995, the State of New Mexico issued a Federal Facility Compliance Order to LANL requiring compliance with a Site Treatment Plan. The LANL Site Treatment Plan, which is updated annually, provides overall schedules for achieving compliance with RCRA LDR storage and treatment requirements for mixed waste at LANL.

If LANL were selected as the site for a MPF, DOE would include mixed TRU waste and mixed LLW associated with MPF operations in a future update to the LANL Site Treatment Plan.

6.5.1.2 Nevada Test Site Alternative

NTS is subject to several formal compliance agreements with various regulatory agencies. Agreements with the State of Nevada include a Memorandum of Understanding covering releases of radioactivity; a Federal Facility Agreement and Consent Order, an Agreement in Principle covering environment, safety, and health activities; a Settlement Agreement to manage mixed TRU waste; and a Mutual Consent Agreement on management of mixed LDR wastes, among others. A brief description of these agreements and their relationship to a MPF follows.

Settlement Agreement

The Settlement Agreement, which was signed by DOE and the Nevada Department of Environmental Protection in June 1992, authorizes the temporary storage of only NTS's current inventory of mixed TRU waste. The storage of additional mixed TRU waste would require a permit. Mixed TRU waste is not normally generated at NTS; the majority of mixed TRU waste stored at NTS was generated offsite.

DOE would be required to seek a permit for storage of TRU waste associated with MPF operations.

Federal Facility Agreement and Consent Order

The agreement is a tri-party agreement with DOE, the State of Nevada, and the Department of Defense. The agreement, effective in May 1996, addresses environmental restoration of inactive contaminated sites at NTS and other sites in Nevada. The Parties agreed to negotiate to address needed environmental restoration. The Order outlines a process for identifying, prioritizing, investigating, and remediating contaminated sites. It also establishes a technical strategy for cleanup activities, maximizes the opportunity to complete multiple corrective actions, and provides a mechanism for public involvement.

A MPF would not be expected to impact NTS remediation activities under the Federal Facility Agreement and Consent Order.

Federal Facility Compliance Act-Consent Order

The State of Nevada and DOE approved the Order and its associated NTS Site Treatment Plan in March 1996. The Order and Plan address treatment of legacy mixed waste streams at NTS. Under a June 1998 revision to the Order, new milestones and deadlines for mixed waste treatment must be proposed through annual updates to the Site Treatment Plan.

If NTS were selected as the site for a MPF, DOE would include mixed TRU waste and mixed LLW associated with MPF operations in a future update to the NTS Site Treatment Plan.

Mutual Consent Agreement

The Mutual Consent Agreement was signed by Nevada Operations Office and the State of Nevada in January 1994 and modified in June 1995 and 1998. The Mutual Consent Agreement authorizes the storage of newly identified mixed waste at the NTS Area 5. State of Nevada approval of a Treatment and Disposal Plan is required for mixed waste stored for greater than 9 months.

DOE would manage mixed LLW generated from MPF operations in accordance with the Mutual Consent Agreement. A Treatment and Disposal Plan would be prepared if storage of this waste for greater than 9 months were required.

Agreement in Principle

This agreement includes commitments with regard to DOE technical and financial support to the State of Nevada for environmental, safety, and health oversight and associated monitoring activities. The DOE Nevada Operations Office/State of Nevada Joint Low-Level Waste Oversight Agreement was incorporated as an appendix to the Agreement in Principle. This appendix is a cooperative oversight arrangement between DOE and the State of Nevada and grants the state an increased role in monitoring the management of LLW generated at the NTS, as well as LLW generated elsewhere and disposed at NTS. By entering into the agreement, DOE and the State of Nevada agree to share information concerning waste types and quantities, in addition to general information that allows the state to conduct detailed oversight of NTS waste disposal operations.

Under this Agreement, the State of Nevada would oversee the disposal of LLW associated with MPF operations. This would occur under the NTS alternative, where LLW is generated and disposed of at NTS, as well as alternatives where LLW resulting from MPF operations is shipped to NTS for disposal (e.g., Pantex, WIPP).

6.5.1.3 Pantex Site Alternative

Site Treatment Plan

DOE has prepared a Site Treatment Plan (known as the Compliance Plan) for mixed waste at Pantex, which identifies how DOE proposes to obtain commercial treatment or develop technologies for the site's mixed LLW. The Compliance Plan provides overall schedules for achieving compliance with LDR requirements for mixed wastes at Pantex and is enforceable under an Agreed Order issued by the Texas Natural Resource Conservation Commission (TNRCC, now called the Texas Commission on Environmental Quality [TCEQ]). DOE provides annual updates to the Compliance Plan to the state for review and comment.

If Pantex were selected as the site for a MPF, DOE would include mixed TRU waste and mixed LLW associated with MPF operations in a future update to the Pantex Site Treatment Plan.

Hazardous Waste Permit

Pantex was included on the National Priorities List in 1994. Corrective action requirements for environmental restoration at Pantex are included in the RCRA Hazardous Waste Operating Permit (HW-50284) administered jointly by EPA and the TCEQ. Pantex has identified 249 release sites within 144 Solid Waste Management Units (SWMUs) for investigation and remediation activities. RCRA Facility Investigations have been completed for all SWMU groupings. Remediation activities are performed to reduce contamination of soils and groundwater sufficiently to achieve a No Further Action designation under the Texas Risk Reduction Standards Guidance. The state has approved 93 release sites as requiring no further action.

Under the current baseline, DOE would complete environmental restoration and decontamination activities and turn over the Pantex facilities for long-term stewardship by FY2014. DOE recently proposed to accelerate these activities to completion by the end of FY2008 (DOE 2002j). Under this accelerated schedule, these activities would be completed prior to the start of the construction of MPF. Under either schedule, a MPF would not be expected to impact ongoing Pantex remediation activities.

6.5.1.4 Savannah River Site Alternative

Federal Facility Agreement

SRS was placed on the National Priorities List in 1989. In August 1993, SRS entered into the Federal Facility Agreement with EPA Region IV and the South Carolina Department of Health and Environmental Control (SCDHEC). The Federal Facility Agreement addresses RCRA corrective action and CERCLA requirements applicable to cleanup at SRS. The Agreement governs the corrective/remedial action process from site investigation through site remediation. It also describes procedures for setting annual work priorities, including schedules and deadlines, for that process.

A MPF would not be expected to impact SRS remediation activities under the Federal Facility Agreement.

Site Treatment Plan

On September 20, 1995, SCDHEC approved the Site Treatment Plan for SRS. SCDHEC issued a consent order, signed by DOE, requiring compliance with the plan on September 29, 1995. The Site Treatment Plan provides overall schedules for achieving compliance with RCRA LDR storage and treatment requirements for mixed waste at SRS. DOE provides SCDHEC with annual updates to the information in the SRS Site Treatment Plan.

If SRS were selected as the site for a MPF, DOE would include mixed TRU waste and mixed LLW associated with MPF operations in a future update to the SRS Site Treatment Plan.

6.5.1.5 Carlsbad Site Alternative

The following discusses limitations on the use of the WIPP land withdrawal area as they relate to the alternative to construct and operate a MPF at the Carlsbad Site.

WIPP Land Withdrawal Act **(Public Law 102-579)**

The Act limits the use of the land withdrawal area to the purposes of WIPP. Section 3(a)(3) of the Act states the following:

> "RESERVATION: Such lands are reserved for the use of the Secretary for the construction, experimentation, operation, repair and maintenance, disposal, shutdown, monitoring, decommissioning, and other authorized activities associated with the purposes of WIPP as set forth in Section 213 of the *Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act* of 1980 (Pub. L. 96-164; 93 Stat. 1259, 1265), and this Act."

The purposes of WIPP as stated in Section 213 of the *Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act* of 1980 (Pub. L. 96-164; 93 Stat. 1259, 1265) are as follows:

> "…the Secretary of Energy shall proceed …Waste Isolation Pilot Plant is authorized as a defense activity for the Department of Energy, … for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs …"

In addition to the reservation in Section 3(a)(3), Section 4(a) of the *WIPP Land Withdrawal Act* gives general management authority of the land withdrawal area to the Secretary of Energy. Part of that authority allows "such non-WIPP related uses as the Secretary determines to be appropriate" (Section 4[b][3]). Although the examples in Section 4(b)(3) include grazing, hunting and trapping, the Act does not limit the acceptable non-WIPP related uses to those examples. Non-WIPP uses are "subject to such conditions and restrictions as may be necessary to permit the conduct of WIPP-related activities" (Section 4[b][2]).

The *WIPP Land Withdrawal Act* also requires the preparation of a land management plan. The *WIPP Land Management Plan* (DOE 1996a) incorporates the restrictions of the Act and the DOE Memorandum of Understanding with the DOI's Bureau of Land Management (BLM). The Plan establishes management objectives and planned actions for the use of the withdrawn land until the end of the decommissioning phase. It promotes the concept of multiple-use management for the surface area of the withdrawn land and establishes a goal of minimizing land use restrictions where possible. The plan also provides opportunity for participation in the land use planning process by the public, and local, state, and Federal agencies.

The WIPP Land Management Plan provides for multi agency involvement in the administration of DOE land management actions. The Plan envisions and encourages direct communication among stakeholders, including Federal and state agencies involved in managing the resources within, or activities impacting the areas adjacent to, the land withdrawal area. It sets forth cooperative arrangements and protocols for addressing WIPP-related land management actions.

NNSA notes that legislation may be required to proceed with the construction and operation of a MPF at the Carlsbad Site either on land at the WIPP site or in the vicinity of the WIPP site.

The EPA's current compliance certification of WIPP does not consider the potential impacts of a MPF on the long-term performance of the repository. If the Secretary were to decide to locate a MPF in the vicinity of WIPP, DOE would need to provide EPA with sufficient information for the Agency to determine whether the potential impacts of a MPF should be included in the performance assessment to ensure that they would not adversely impact the repository's long-term performance. EPA's consideration of a MPF's potential impacts could result in a modification rulemaking involving the compliance certification.

NMED Hazardous Waste Permit and EPA 40 CFR Part 191 Compliance Certification

On May 18, 1998, EPA determined that DOE had demonstrated that WIPP would comply with the TRU waste disposal regulations at Subparts B and C of 40 CFR Part 191 (63 FR 27354). EPA's certification determination allowed DOE to begin accepting TRU waste for disposal at WIPP, provided that other applicable environmental regulations were met.

Both the certification issued by the EPA and the Hazardous Waste Facility Permit issued by NMED with regard to closure and postclosure of the WIPP facility do not anticipate alternative uses of the land. Both documents require that the land be restored to as near its original condition as feasible as part of final closure. As part of the scoping process for this EIS, EPA has indicated that a decision to construct and operate a MPF at the Carlsbad Site would likely necessitate revisiting the status of WIPP's certification under 40 CFR Parts 191 and 194 (Cotsworth 2002). This would allow EPA to ensure that any potential effects of a MPF on waste emplacement and containment at the WIPP facility do not impact the basis for EPA's initial certification decision.

Consultation and Cooperation Agreement

Public Law 96-164 excluded the WIPP repository from licensing by NRC and required DOE to reach a Consultation and Cooperation Agreement with the State of New Mexico in developing the facility. The Consultation and Cooperation Agreement affirms the intent of the Secretary of Energy to consult and cooperate with the State of New Mexico with respect to public health and safety concerns and spells out terms of future studies, communications activities, and technical issues.

The Environmental Evaluation Group was established in 1978 through a contract between the State of New Mexico and DOE. The 1981 Consultation and Cooperation Agreement and the *WIPP Land Withdrawal Act* also established the Environmental Evaluation Group as an oversight organization for WIPP on behalf of the State of New Mexico. This interdisciplinary group of scientists and engineers provides independent technical evaluation of WIPP activities. If the Carlsbad Site were selected for a MPF, the Environmental Evaluation Group may provide oversight of MPF activities to ensure the protection of public health and safety, and the environment of New Mexico.

Current Capacity Limitations at WIPP

The total disposal capacity at WIPP is limited to 175,000 m^3 (6,180,000 ft^3) under the *WIPP Land Management Act*. (Of this total, DOE Consultation and Cooperation Agreement with the State of New Mexico limits the volume of remote-handled TRU waste to 7,080 m^3 [250,000 ft^3]). The Preferred Alternative in DOE's 1997 *WIPP Supplemental EIS II* (WIPP SEIS II) estimated a Basic

Inventory of 170,000 m^3 (6,004,000 ft^3) of TRU waste that would be disposed of at WIPP over a 35-year operating period. This alternative formed the basis for DOE's 1998 Record of Decision to open WIPP (63 FR 3624).

Nevertheless, the WIPP SEIS II acknowledged, and DOE continues to recognize, that the amount of TRU waste to be disposed of could exceed the volumes identified in the WIPP SEIS II preferred alternative. This could occur in the future for a number of reasons. For example, DOE sites continue to improve the accuracy of their inventories, the nature of sites' missions may change over time, waste processing decisions being made for existing waste forms can generate additional TRU waste, and several sites have missions expected to extend beyond WIPP's currently planned operating period. A MPF would fall into this latter category, in that it would be fully operational in 2020 and for a subsequent period of 50 years.

If additional disposal capacity were needed but not readily available post-treatment, storage of waste would be needed until that additional capacity became available. The WIPP SEIS II analyses under Action Alternative 1 examined the impacts of storage and disposal of 312,000 m^3 (11,018,000 ft^3) of TRU waste (WIPP SEIS section 3.2.2). This alternative included lag storage for a period of up to 160 years at all of the sites being considered as a MPF in this present EIS except WIPP. (Although the impacts at WIPP would likely be similar to those at other large sites, DOE would include analysis of lag storage there as part of the site-specific NEPA review that would be conducted prior to constructing the MPF, if WIPP were selected to host the facility.) The analyses under WIPP SEIS II Alternative 1 indicated that potential impacts to the public, involved workers, and non-involved workers from lag storage would be small. The LCFs would be one or less than one, an no cancers from potential exposure to hazardous chemicals would be expected (WIPP SEIS II section 5.2.9).

In the future, if inventory projects show a need for additional disposal capacity for TRU waste, DOE would initiate the development of strategies for expanding such capacity at an appropriate time. However, because DOE has made no plans to date regarding the location or design of a waste disposal facility for TRU waste beyond WIPP's current capacity, this MPF EIS assumed WIPP as the disposal location for TRU waste generated under each alternative, for the purposes of transportation analysis only.

6.5.2 Compliance History

The following sections describe recent compliance activities at each of the alternative sites.

6.5.2.1 Los Alamos Site Alternative

Clean Water Act* and *Safe Drinking Water Act

In 2001, LANL was in compliance with its NPDES permit liquid discharge requirements in 100 percent of the samples from its sanitary effluent outfalls and in 99.6 percent of the samples from its industrial effluent outfalls. DOE reported four exceedances of the water quality parameters for industrial outfalls. Corrective actions were taken to address each these permit noncompliances. Concentrations of chemical, microbiological, and radioactive constituents in the LANL's drinking water system remained within Federal and state drinking water standards. Also during 2001, LANL corrected deficiencies noted during a July 12, 1999, EPA Region 6 compliance inspection of LANL's Stormwater Program (LANL 2002b).

Clean Air Act

In 1994, Concerned Citizens for Nuclear Safety filed a lawsuit against DOE and the Director of LANL alleging violations of the radionuclide NESHAP (40 CFR 61, Subpart H) provisions of the *Clean Air Act*. The parties settled the lawsuit out of court on January 25, 1997. DOE and LANL entered into a Consent Decree and a Settlement Agreement to resolve the lawsuit. Under the settlement provisions of the Consent Decree, up to four comprehensive independent audits of LANL's radioactive air emissions compliance program will be performed to verify whether LANL is in full compliance with the *Clean Air Act* (40 CFR 61, Subpart H).

The first audit assessed LANL's compliance for 1996 and concluded that LANL meets the dose standard for radioactive air emissions but does not meet several technical requirements of 40 CFR 61, Subpart H. LANL implemented most of the technical recommendations contained in the assessment report. The second audit determined that LANL was in compliance with the Federal regulations governing radioactive air emissions for the year 1999. The third audit confirmed that LANL's radioactive air emissions in 2001 were less than one fifth of what is allowed by the *Clean Air Act* and that LANL's air-monitoring processes will ensure future compliance with the law. The audit team also concluded that there were no substantive deficiencies requiring corrective actions that justify having a fourth audit under the Consent Decree (LANL 2002c).

Resource Conservation and Recovery Act

LANL staff frequently interact with regulatory personnel on RCRA and *New Mexico Hazardous Waste Act* requirements and compliance activities. LANL has received a number of orders issued by NMED for noncompliance during 1997 and 1998 with hazardous waste management requirements.

More recently, NMED conducted an annual hazardous waste compliance inspection at LANL from April 23 to the end of August 2001. On October 9, 2001, NMED issued a Notice of Violation to the University of California and DOE as a result of that inspection. The Notice of Violations identified 18 categories of violations, each with one or more instances of alleged noncompliance. The types of issues described ranged from waste determinations, generator's control of waste, exceeding waste storage time, incompatible chemical storage, training, emergency response, waste manifesting, mixed waste management under the Site Treatment Plan, waste piles, and prevention of releases. The University of California and DOE responded to the Notice of Violation in February 2002.

LANL met all of its Site Treatment Plan deadlines and milestones during 2001 (LANL 2002b).

Price-Anderson Amendments Act

Since 1996, LANL has been the subject of five enforcement actions under the DOE Price-Anderson Enforcement Program. Most recently, in December 2002, NNSA issued a preliminary notice of violation asserting that LANL had violated nuclear safety rules governing waste storage. The violations involve TRU waste stored in PF-185 from March 1996 until June 2001 without required nuclear safety documentation. LANL discovered the problem in June 2001 and transferred the waste to an approved facility.

6.5.2.2 Nevada Test Site Alternative

There were no formal state inspections of NTS programs or enforcement actions during 2000 (NTS 2001). In addition, no environmental violations or enforcement actions were cited during 2001 or 2002 (EPA 2003). NTS continues to fulfill its requirements of the agreements discussed in Section 6.5.1. Compliance issues related to specific programs are noted in the following paragraphs.

Clean Water Act

There are no NPDES permits for NTS because there are no wastewater discharges directly to onsite or offsite surface waters. However, discharges to sewage lagoons and ponds are regulated by the State of Nevada under a state general permit. NTS has maintained compliance with permit requirements. However, downsizing of NTS operations has resulted in low flow conditions at several sewage lagoon systems, which has reduced the efficiency of the lagoons to properly treat effluents. DOE plans to install septic tank systems in these areas (DOE 2002d).

Safe Drinking Water Act

During 2000, the four public drinking water systems at NTS were in compliance with monitoring requirements, with one exception. Corrective action was initiated to resolve this problem. All other monitoring results were within regulatory limits. Onsite water wells and select offsite wells are monitored in accordance with Federal and state *Safe Drinking Water Act* regulations (DOE 2002d).

Resource Conservation and Recovery Act

Federal and state environmental inspections were conducted in 2001 and 2002. No violations were cited during those inspections (EPA 2003).

Clean Air Act

Criteria air pollutants emitted at NTS include particulates from construction, aggregate production, surface disturbances, and fugitive dust from vehicles traveling on unpaved roads; various pollutants from fuel-burning equipment, incineration, and open burning and volatile organics from fuel storage facilities. Emissions of hazardous air pollutants from current NTS sources are below regulatory requirements (DOE 2002d). There were no state inspections of NTS facilities possessing air quality permits during 2000.

Ambient air quality at NTS is not currently monitored for criteria pollutants or hazardous air pollutants, with the exception of radionuclides (DOE 2002d). NTS was in compliance with radionuclide emission requirements during 2000.

Comprehensive Environmental Response, Compensation, and Liability Act

Other than reporting requirements, there is no formal CERCLA program at NTS (DOE 2002d).

Price-Anderson Amendments Act

NTS has not been subject to any enforcement actions under the DOE Price-Anderson Enforcement Program.

6.5.2.3 Pantex Site Alternative

The TCEQ (formerly TNRCC) routinely conducts RCRA, *Clean Air Act*, and drinking water compliance inspections. Overall, Pantex is in compliance with the applicable environmental laws and regulations. However, since this facility existed prior to the promulgation of many current environmental laws and regulations, both EPA and the State of Texas have allowed DOE to continue operations while taking actions to achieve full compliance with all applicable environmental regulatory requirements. Pantex has reported minor noncompliances pursuant to its State of Texas and EPA permits, but no cases of noncompliance that could have impacted human health or the environment have occurred.

Compliance Agreements and Orders

In 1994, Pantex was placed on the National Priorities List based on the presence of contamination due to past practices. DOE, TNRCC, and EPA Region 6 developed a Federal Facility Compliance Agreement to address CERCLA issues at Pantex.

EPA has issued two Administrative Orders to address prior noncompliance with Pantex's NPDES permit. DOE also entered into a Federal Facility Compliance Agreement (No. VI-98-1210) with EPA Region 6 relating to the same issues. As of the end of 2000, all corrective actions contained in the Administrative Orders and the Federal Facility Compliance Agreement were on schedule.

Groundwater Protection

Pantex conducts soil and groundwater monitoring in accordance with the corrective action provisions of its Hazardous Waste Permit No. HW-50284. Nonradiological contamination was found in the perched groundwater beneath the Zone 12 operations area (metals, explosives, and organic solvents), in the soil near operations areas (traces of metals and explosives), and in the ditches and playas that form Pantex's drainage system (metals and explosives). Some contaminants were also found in the perched aquifer on properties neighboring Pantex to the south and southeast.

Trichloroethene was detected with results above the drinking water standard in an Ogallala Aquifer monitoring well sample taken in May 1999. This aquifer is the primary source of drinking water for the surrounding landowners and the cities of Amarillo and Panhandle. A study concluded that an improperly constructed monitor well was allowing trichloroethene to migrate from the upper vadose, into the well, and down into the Ogallala Aquifer. Corrective measures eliminating the contaminant pathway into the Ogallala Aquifer have been completed. A Notice of Enforcement associated with the notification and reporting requirements relating to the discovery of trichlorethene in the Ogallala Aquifer was issued to Pantex by the TNRCC during 2000.

Antimony, cadmium, chromium, manganese, and thallium were also detected in a small number of samples in a few selected Ogallala Aquifer monitoring wells at levels that exceeded drinking water standards. These exceedances may be attributed to corrosion of the stainless steel well screens, casings, and pumps. It is Pantex's intent to plug wells that have become badly corroded. Monitoring for these constituents will continue.

6.5.2.4 Savannah River Site Alternative

Notices of Violation

No Notices of Violation were issued for SRS in 2001 under RCRA or the *Safe Drinking Water Act*. One Notice of Violation was issued under the *Clean Air Act*; and another, related to an oil release, was issued under the *South Carolina Pollution Control Act*.

Under the CWA, SRS's NPDES compliance rate was 99.6 percent. DOE reported 24 exceedances of the water quality parameters. Corrective actions were taken to address each of these permit noncompliances. No Notices of Violation were received under NPDES; however, SCDHEC issued one Notice of Violation under the *South Carolina Pollution Control Act* for an oil release at an NPDES-permitted stormwater outfall.

During 2001, SCDHEC conducted compliance inspections of 102 permitted sources at SRS, reviewing 141 permitted parameters. These included biennial stack tests and annual compliance inspections. As a result of the annual compliance inspections, SRS achieved a compliance rate of 99 percent and received one Notice of Violation under the *Clean Air Act* (WSRC 2002h).

Consent Orders

In October 1999, SCDHEC issued a consent order addressing compliance with water quality parameters set forth in the site's NPDES permit at outfall A-01. During 2000, a wetland treatment system was constructed to address these problems. The wetland system was operating and had achieved compliance with permit parameters by the end of 2001.

Price-Anderson Amendments Act

Since 1996, SRS has been the subject of six enforcement actions under the DOE Price-Anderson Enforcement Program. Most recently, in March 2002, DOE issued a preliminary notice of violation asserting that SRS had failed to maintain and control the operation of safety equipment in its nuclear facilities. The notice included violation of facility safety basis requirements and ALARA deficiencies that contributed to unplanned worker uptakes and the spread of radioactive contamination.

6.5.2.5 Carlsbad Site Alternative

The *WIPP Land Withdrawal Act* authorizes EPA to oversee DOE's activities at WIPP. EPA is responsible for certifying WIPP's compliance with the Agency's radioactive waste disposal regulations (40 CFR 191). The Act also authorizes EPA to verify WIPP's compliance with all other applicable Federal environmental laws and regulations.

Section 9(a)(2) of the *WIPP Land Withdrawal Act* requires DOE biennially to submit to EPA documentation of continued compliance with the laws, regulations, and permit requirements set forth in Section 9(a)(1). This requirement is met by submission of the Biennial Environmental Compliance Report, issued in October of each even-numbered year. Section 9(a)(3) requires the Administrator of EPA to determine on a biennial basis whether WIPP is in compliance with the pertinent laws, regulations, and permit requirements. On May 9, 2003, EPA published its determination that for the period 2000 to 2002, the DOE-submitted documentation showed continued compliance with applicable Federal laws pertaining to public health and safety or the environment (68 FR 25032).

Price-Anderson Amendments Act

WIPP has not been subject to any enforcement actions under the DOE Price-Anderson Enforcement Program.

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Patrick Cochran, GA Emergency Management Agency
James Setser, Georgia Department of Natural Resources
Don Cheeks, Georgia State Senate
Glenn Carroll, Georgians Against Nuclear Energy
Sara Barczak, Georgians for Clean Energy
Alice Slater, Global Resource Action Center for the Environment
John Otter, Green Party
Wyatt Lee Johnson, Green Party National Finance Office

Tom Clements, Senior Campaigner, Greenpeace International
James Risher, Hampton County Municipal Association
Patrick McMahon, Heidel, Samberson, Newell, Cox & McMahon
Scott Wade, Honda Cars of Aiken
Carolyn Zerkle, IFC-LANL
Bernd Franke, IFEU
Emily Saliers and Amy Ray, Indigo Girls
Lois Chalmers, Institute for Energy and Environmental Research
Raymond Storey, Insulators & Asbestos Workers LU #92
Xanthe Hall, International Physicians for the Prevention of Nuclear War
Carla Sanda, IT Corp- Mgr., EM Public Affairs
Rick Jacobi, Jacobi Consulting
Joe Rivers, Jason Associates Corp.
Michael Strauss, Jesse C. Lynch Memorial Post 71
Kyle Marksteine, KATK
Moses Dunn, Labor Union 1137
Bob Drake, LANL
David Lee, LANL
Kevin McTaggart, LANL
G. R. Papazian, LANL
Ellen Taylor, LANL
David Moody, LANL/Carlsbad
Stephanie Jennings, LANL-CB
Keith Rogers, Las Vegas Review Journal
Ben Grove, Las Vegas Sun
Mary Manning, Las Vegas Sun Newspaper
R. Proko, LASG
Robert Hull, LATA Inc.
Randall Erben, Law Offices of Randall H. Erben
Dennis Holmberg, Lea County Government
Mary Kelly, League of Women Voters SC
Richard Higgs, LLNL
Roger Snodgrass, Los Alamos Monitor
Scott Traeger, Los Alamos National Laboratory
Greg Mello, Los Alamos Study Group
Eric Thompson, Lower Savannah COG
Luminous Realm
Ed Hammon, Marine Corps League, James L. Hammons Detachment #939 Inc.
Dean Campbell, Mayor of Johnston
Buddy Sandifer, Mayor Pro-Tem, City of Bamberg
Bob Young, Mayor, Augusta-Richmond County, SC
Fred Cavanaugh, Mayor, City of Aiken
Todd Etheredge, Mayor, Jackson, SC
Lark Jones, Mayor, North Augusta, SC
Frank Mizell, Mayor, Town of Windsor
Thomas Rivers, Mayor, Williston, SC

Raymond Greenberg, Medical University of South Carolina
Donna Stern-McFadden, Mescalero Apache Tribe - Tribal Historic Preservation Office
Toni Marshall, Midland Valley Chamber
Dawn Schrepel, Morgan Meguire, LLC
Valerie Peterson, Morrell Graphics
D. Edward Davis, MRD Investment, LP
R. Zerm, MTC Union
Lee Muns, Muns Welding and Mechanical, Inc.
Anne deLain Clark, NM Radioactive Waste Consultation Task Force
William Reid, National Park Service
Dr. Robert Norris, Natural Resource Defense Council
Don Elle, Nevada Division of Environmental Protection
Heather Elliot, Nevada State Clearinghouse, Department of Administration
Lindsay Lovejoy, Jr., New Mexico Attorney General's Office
Ron Curry, New Mexico Environment Dept.
John Kieling, New Mexico Environment Dept.
Tim Michael, New Mexico Environment Dept.
Steve Yanicak, New Mexico Environment Dept.
Steve Holmes, New Mexico Environment Dept., Hazardous Waste Bureau
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Joel Stone, New Mexico Office of the State Engineer
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Denise Laffan, Nipponzan MyottoJL - Atlanta Dojo
Diane D'Arrigo, NIRS
Dr. James Lewis, NM Citizens for Clean Air and Water
Roger Kennett, NMED-DOE Oversight Bureau
Ibrahim Khan, NMMD/Scheduling
Juan Griego, NNSA - OLASO
North Augusta, Chamber of Commerce
Dr. Thomas Cochran, NRDC
Edwin Lyman, Nuclear Control Institute
Rita Davis, Nuclear Fuel Services, Inc.
Mary Olson, Nuclear Information and Resource Center, Southeast Office
Colin King, Nuclear Watch of New Mexico
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Steve Frishman, NV Agency for Nuclear Projects
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Nick Jessen, P2S
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Bill Lawless, Paine College
Charles Hill, Painters LU 1756
Jerome Johnson, Panhandle 2000
Doris Berg Smith, Panhandle Area Neighbors and Landowners

Barbara Nester, Pantex
Bob Kinsey, Peace and Justice Task Force, Mt. Conf., United Church of Christ
Mavis Belisle, Peace Farm
Virginia Miller, People for Peace
Phil Carrell, Phil Carrell Chevrolet
Ed Arnold, Physicians for Social Responsibility/ Atlanta Chapter
Satomi Oba, Plutonium Action Hiroshima, Global Council of Abolition 2000
Harry Harmon, PNNL
Walter P. & Clare Baldwin, Presbyterian Church U.S.A.
Bill Lawlen, Prince College
Peter Lujan, Pro2Serve
Curtis Robbins, Pro2Serve
John Hale, Public Service Co. of NM
Charles Larke, Richmond County Board of Education
William Baker, RPP/WTP Project
Thomas Pace, RTD
David Anderson, Ruidoso Schools
James Smith, Jr., S.C. House of Representatives
Bill Pfeiffer, Sacred Earth Network (SEN)
Sara Barczak, Safe Energy Director, Georgian for Clean Energy
John DiMarzio, SAIC
John Loye, Sandia National Labs
Keith Kreager, Savannah River Regional Diversification Initative
Robert Cooper, Savannah River Site Redevelopment Authority
Frank Carl, Savannah Riverkeeper
Carlton Brown, Savannah State University
Ken Sajwan, Savannah State University
S. Hunter Howard, Jr., SC Chamber of Commerce
Arnold Karr, SC Green Party
Lonnie Hosey, SC House of Representatives
Keith Coones, SCANA
G. Kendall Taylor, SCDHEC, BLWM
W. Greg Ryberg, Senate of South Carolina
Jeff Swayze, Shaw Environmental
Kalynda Tilges, Shundahai Network
Susan Bloomfield, Sierra Club
Judith Gordon, Sierra Club
W. Quinn, Sierra Club
Jen Kato, Sierra Club GA
Penelope McMullen, Sisters of Loretto
Beatrice Brailsford, Snake River Alliance, Idaho's Nuclear Watchdog
James Morris, South Carolina Department of Commerce
Henry Porter, South Carolina Dept. of Health and Environmental Control
South Carolina Office of State Budget
Thomas Moore, South Carolina State Senator
Rich Smalley, Southeast Environmental Management Association

James Pope, Southeast Environmental Management Association
R.P. Borsody, Space - PSI
Don Hancock, SRIC
Perry Holcomb, SRS Citizens Advisory Board
Cecil Holcomb, SRS Clean up
John Cerminara, Jr., SRS Retiree Association
R.A. Stokes, SRS Retiree Association
Dr. Melvyn Galin, SRS-CAB
Pam Allison, STAND
Harry Everett, STAND
Billie Poteet, STAND
William Seewald, STAND
Butch Giusto, Stargate Productions, Inc.
Denise Brooks, State Energy Conservation Office
Joseph Strolin, State of Nevada, Agency for Nuclear Projects
David Swinford, State Representative
Carroll Leavell, State Senate - District 41
Greg Ryberg, State Senate - SC
Tony Batt, Stephens Media Group
Richard Stuhler, Stone and Webster/ DCS
William Stratton, Stratton Comp.
Kevin Brooks, Swinerton Builders
K. L. Peddicord, Texas A&M University System
Thomas Edwards, Texas Attorney General's Office
Carole Keeton Rylander, Texas Comptroller of Public Accounts
Denise Francis, Texas Governor's Office of Budget and Planning
Roger Mulder, Texas State Energy Conservation Office (Comptroller of Public Accounts)
Robert Light, The Light Company
Jack Skinner, The Mine Supply Company
The Nevada Alliance for Defense, Energy and Business
Suzyn Smith, The People-Sentinel
Teel Bivens, The Senate of the State of Texas
David Kenner, Town of Blackville
Inga Olson, Tri-Valley CAREs (Communities Against a Radioactive Environment)
Joe Martillotti, TX Dept. of Health, Bureau of Radiation Control
DeeDee Smith, TX DPS/DEM
Elizabeth Cotsworth, U.S. EPA, Office of Radiation and Indoor Air
Jon Richards, U.S. EPA Region 4
Amanda Hill, U.S. Fish and Wildlife Service
Rusty Jeffers, U.S. Fish and Wildlife Service
Joy Nicholopolus, U.S. Fish and Wildlife Service
David Brown, U.S. Nuclear Regulatory Commission
Diane Ventura, U.S. Senator Jeff Bingaman
J. Larry Read, University Health Care System
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Ruth Selimedt, Women's Action for New Direction
Elizabeth Chesnut, Women's Action for New Directions
Mary Jane Mahan, Women's Action for New Directions
John Cantwell, WSRC
Eric Frickey, WSRC
C. W. Gardner, WSRC
Frederick Grimm, WSRC
Rosa and Ben Hill, WSRC
Bob Hottel, WSRC
Mark Jackson, WSRC
John Lint, WSRC
Kevin Matthews, WSRC
J.F Ortaldo, WSRC
Dennis Thompson, WSRC
Clyde Ward, WSRC
Louisiana Wright, WSRC
James Yorio, WSRC

11.0 GLOSSARY

absorbed dose **—**For ionizing radiation, the energy imparted to matter by ionizing radiation per unit mass of the irradiated material (e.g., biological tissue). The units of absorbed dose are the rad and the gray. (See *rad* and *gray*.)

accident sequence **—**In regard to nuclear facilities, an initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

actinide **—**Any member of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium) including uranium and plutonium. All members of this group are radioactive.

activation products **—**Nuclei, usually radioactive, formed by bombardment and absorption in material with neutrons, protons, or other nuclear particles.

active fault **—**A fault that is likely to have another earthquake sometime in the future. Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years.

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 one week after the inception of a radiological accident.

administrative control level **—**A dose level that is established well below the regulatory limit to administratively control and help reduce individual and collective radiation doses. Facility management should establish an annual facility administrative control level that should, to the extent feasible, be more restrictive than the more general administrative control level.

air pollutant **—**Generally, an airborne substance that could, in high-enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated or for which maximum guideline levels have been established due to potential harmful effects on human health and welfare.

air quality control region **—**Geographic subdivisions of the United States, designed to deal with pollution on a regional or local level. Some regions span more than one state.

alluvium (alluvial) **—**Unconsolidated, poorly sorted detrital sediments ranging from clay to gravel sizes deposited by streams.

alpha activity **—**The emission of alpha particles by radioactive materials.

alpha particle **—**A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus and has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). (See *alpha radiation*.)

alpha radiation **—**A strongly ionizing, but weakly penetrating, form of radiation consisting of positively charged alpha particles emitted spontaneously from the nuclei of certain elements during radioactive decay. Alpha radiation is the least penetrating of the three common types of ionizing radiation (alpha, beta, and gamma). Even the most energetic alpha particle generally fails to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha radiation is most hazardous when an alpha-emitting source resides inside an organism. (See *alpha particle*.)

ambient **—**Surrounding.

ambient air **—**The surrounding atmosphere as it exists around people, plants, and structures.

ambient 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. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

aquatic **—**Living or growing in, on, or near water.

aquifer **—**An underground geologic formation, group of formations, or part of a formation capable of yielding a significant amount of water to wells or springs.

aquitard **—**A less-permeable geologic unit that inhibits the flow of water.

archaeological sites (resources) **—**Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

argon-41 **—**A radioactive argon isotope with a half-life of 1.83 hours that emits beta particles and gamma radiation. It is formed by the activation, by neutron absorption, of argon-40, a stable argon isotope present in small quantities in air.

artifact **—**An object produced or shaped by human workmanship of archaeological or historical interest.

as low as is reasonably achievable (ALARA) **—**An approach to radiation protection to manage and control worker and public exposures (both individual and collective) and releases of radioactive material to the environment to as far below applicable limits as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process for minimizing doses to as far below limits as is practicable.

atmospheric dispersion **—**The process of air pollutants being dispersed in the atmosphere. This occurs by wind that carries the pollutants away from their source, by turbulent air motion that results from solar heating of the Earth's surface, and by air movement over rough terrain and surfaces.

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 U.S. Nuclear Regulatory Commission and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated, and functions vested by law in the Administrator were transferred to the Secretary of Energy.

atomic number **—**The number of positively charged protons in the nucleus of an atom or the number of electrons on an electrically neutral atom.

attainment area **—**An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others. (See *National Ambient Air Quality Standards*, *non-attainment area*, and *particulate matter*.)

attractiveness level **—**A categorization of nuclear material types and compositions that reflects the relative ease of processing and handling required to convert that material to a nuclear explosive device.

background radiation **—**Radiation from (1) cosmic sources; (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material); (3) global fallout as it exists in the environment (e.g., from the testing of nuclear explosive devices); (4) air travel; (5) consumer and industrial products; and (6) diagnostic x-rays and nuclear medicine.

badged worker **—**A worker equipped with an individual dosimeter who has the potential to be exposed to radiation.

barrier **—**Any material or structure that prevents or substantially delays movement of radionuclides toward the accessible environment.

basalt **—**The most common volcanic rock, dark gray to black in color, high in iron and magnesium, and low in silica. It is typically found in lava flows.

baseline **—**The existing environmental conditions against which impacts of the proposed action and its alternatives can be compared. For this EIS, the environmental baseline is the site environmental conditions as they exist or are estimated to exist in the absence of the proposed action.

becquerel **—**A unit of radioactivity equal to one disintegration per second. Thirty-seven billion becquerels equal 1 curie.

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 element with the atomic number 4. It is metallic and is used in reactors as a neutron reflector.

best available control technology (BACT) **—**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 emitter **—**A radioactive substance that decays by releasing a beta particle.

beta particle **—**A particle emitted in the radioactive decay of many radionuclides. A beta particle is identical to an electron. It has a short range in air and a small ability to penetrate other materials.

beyond-design-basis accident **—**An accident postulated for the purpose of generating large consequences by exceeding the functional and performance requirements for safety structures, systems, and components. (See *design-basis accident*.)

beyond-design-basis events **—**Postulated disturbances in process variables due to external events or multiple component or system failures that can potentially lead to beyond-design-basis accidents. (See *design-basis events*.)

biota (biotic) **—**The plant and animal life of a region (pertaining to biota).

block **—**U.S. Bureau of the Census term describing small areas bounded on all sides by visible features or political boundaries; used in tabulation of census data.

bounded **—**Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

burial ground **—**In regard to radioactive waste, a place for burying unwanted radioactive materials in which the earth acts as a receptacle to prevent the escape of radiation and the dispersion of waste into the environment.

Cambrian **—**The earliest geologic time period of the Paleozoic era, spanning between about 570 and 505 million years ago.

cancer **—**The name given to a group of diseases characterized by uncontrolled cellular growth, with cells having invasive characteristics such that the disease can transfer from one organ to another.

canister **—**A general term for a container, usually cylindrical, used in handling, storage, transportation, or disposal of waste.

capable fault **—**A fault that has exhibited one or more of the following characteristics: (1) movement at or near the ground surface at least once within the past 35,000 years, or movement of a recurring nature within the past 500,000 years; (2) macroseismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; (3) a structural relationship to a capable fault according to characteristic (1) or (2) above, such that movement on one could reasonably be expected to be accompanied by movement on the other.

capacity factor **—**The ratio of the annual average power production of a power plant to its rated capacity.

carbon dioxide **—**A colorless, odorless gas that is a normal component of ambient air; it results from fossil fuel combustion and is an expiration product.

carbon monoxide **—**A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

carcinogen **—**An agent that may cause cancer. Ionizing radiations are physical carcinogens; there are also chemical and biological carcinogens and biological carcinogens may be external (e.g., viruses) or internal (genetic defects).

cask **—**A heavily shielded container used to store or ship radioactive materials.

categories of special nuclear material (Categories I, II, III, and IV) **—**A designation determined by the quantity and type of special nuclear material or a designation of a special nuclear material location based on the type and form of the material and the amount of nuclear material present. A designation of the significance of special nuclear material based upon the material type, the form of the material, and the amount of material present in an item, grouping of items, or in a location.

cation **—**A positively charged ion.

cell **—**See *hot cell.*

chain reaction **—**A reaction that initiates its own repetition. In nuclear fission, a chain reaction occurs when a neutron induces a nucleus to fission and the fissioning nucleus releases one or more neutrons, which induce other nuclei to fission.

cladding **—**The outer metal jacket of a nuclear fuel element or target. It prevents fuel corrosion and retains fission products during reactor operation and subsequent storage, as well as providing structural support. Zirconium alloys, stainless steel, and aluminum are common cladding materials. In general, a metal coating bonded onto another metal.

Class I areas **—**A specifically designated area where the degradation of air quality is stringently restricted (e.g., many national parks and wilderness areas). (See *Prevention of Significant Deterioratio*n.)

Class II areas **—**Most of the country not designated as Class I is designated as Class II. Class II areas are generally cleaner than air quality standards require, and moderate increases in new pollution are allowed after a regulatory-mandated impacts review.

classified information **—**Information that is classified as Restricted Data or Formerly Restricted Data under the *Atomic Energy Act* of 1954, as amended, or information determined to require protection against unauthorized disclosure under Executive Order 12958 or prior Executive Orders, which is identified as National Security Information.

clastic **—**Refers to rock or sediment made up primarily of broken fragments of pre-existing rocks or minerals.

Code of Federal Regulations **—**All Federal regulations in fore are published in codified form in the Code of Federal Regulations.

collective dose **—**The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem or person-sieverts.

colluvium (colluvial) **—**A loose deposit of rock debris accumulated at the base of a cliff or slope.

committed dose equivalent **—**The dose equivalent to organs or tissues that will be received by an individual during the 50-year period following the intake of radioactive material. It does not include contributions from external radiation sources. Committed dose equivalent is expressed in units of rem or sieverts.

committed effective dose equivalent **—**The dose value obtained by (1) multiplying the committed dose equivalents for the organs or tissues that are irradiated and the weighting factors applicable to those organs or tissues, and (2) summing all the resulting products. Committed effective dose equivalent is expressed in units of rem or sieverts. (See *committed dose equivalent* and *weighting facto*r.)

community (biotic) **—**All plants and animals occupying a specific area under relatively similar conditions.

community (environmental justice) **—**A group of people or a site within a spatial scope exposed to risks that potentially threaten health, ecology, or land values or are exposed to industry that stimulates unwanted noise, smell, industrial traffic, particulate matter, or other non-aesthetic impacts.

Comprehensive Test Ban Treaty (CTBT) **—**A proposed treaty prohibiting nuclear tests of all magnitudes.

computational modeling **—**Use of a computer to develop a mathematical model of a complex system or process and to provide conditions for testing it.

conformity **—**Conformity is defined in the *Clean Air Act* as the action's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards, expeditious attainment of such standards, and that such activities will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard, required interim emission reduction, or other milestones in any area.

contact-handled waste **—**Radioactive waste or waste packages whose external dose rate is low enough to permit contact handling by humans during normal waste management activities (e.g., waste with a surface dose rate not greater than 200 millirem per hour). (See *remote-handled wast*e.)

container —In regard to radioactive waste, the metal envelope in the waste package that provides the primary containment function of the waste package, which is designed to meet the containment requirements of 10 CFR 60.

contamination —The deposition of undesirable radioactive material on the surfaces of structures, areas, objects, or personnel.

cooperating agency —Any Federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment.

credible accident —An accident that has a probability of occurrence greater than or equal to once in a 1-million-year timeframe.

Cretaceous —The final geologic time period of the Mesozoic Era, spanning between about 144 and 66 million years ago. The end of this period also marks the end of dinosaur life on Earth.

criteria pollutants —Six air pollutants for which the National Ambient Air Quality Standards are established by the U.S. Environmental Protection Agency under Title I of the Federal *Clean Air Act*: sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than or equal to 10 micrometers (0.0004 inch) in diameter, and less than or equal to 2.5 micrometers (0.0001 inch) in diameter. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available.

critical assembly —A critical assembly is a system of fissile material (uranium-233, uranium-235, plutonium-239, or plutonium-241) with or without a moderator in a specific proportion and shape. The critical assembly can be gradually built up by adding additional fissile material and/or moderator until this system achieves the dimensions necessary for a criticality condition. A continuous neutron source is placed at the center of this assembly to measure the fission rate of the critical assembly as it approaches and reaches criticality.

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."

critical mass —The smallest mass of fissionable material that will support a self-sustaining nuclear fission chain reaction.

criticality —The condition in which a system is capable of sustaining a nuclear fission chain reaction.

cultural resources **—**Archaeological sites, historical sites, architectural features, traditional use areas, and Native American sacred sites.

cumulative impacts **—**The impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency or person who 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).

curie **—**A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

day-night average sound level **—**The 24-hour, A-weighted equivalent sound level expressed in decibels. A 10-decibel penalty is added to sound levels between 10:00 p.m. and 7:00 a.m. to account for increased annoyance due to noise during night hours.

decay (radioactive) **—**The decrease in the amount of any radioactive material with the passage of time, due to spontaneous nuclear disintegration (i.e., emission from atomic nuclei of charged particles, photons, or both).

decibel (dB) **—**A unit for expressing the relative intensity of sounds on a logarithmic scale where 0 is below human perception and 130 is above the threshold of pain to humans. For traffic and industrial noise measurements, the A-weighted decibel, a frequency-weighted noise unit, is widely used. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

decibel, A-weighted (dBA) **—**A unit of frequency-weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the American National Standards Institution (ANSI S1.4-1983 [R1594]) that accounts for the frequency response of the human ear.

decommissioning **—**Retirement of a facility, including any necessary decontamination and/or dismantlement.

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.

defense-in-depth **—**The use of multiple, independent protection elements combined in a layered manner so that the system capabilities do not depend on a single component to maintain effective protection against defined threats.

^{o}C (degrees Celsius) **—**A unit for measuring temperature using the centigrade scale in which the freezing point of water is 0 degrees and the boiling point is 100 degrees.

°F (degrees Fahrenheit) **—**A unit for measuring temperature using the Fahrenheit scale in which the freezing point of water is 32 degrees and the boiling point is 212 degrees.

delayed critical devices **—**A critical assembly designed to reach the condition of delayed supercriticality. Delayed criticality is the nuclear physics supercriticality condition, where the neutron multiplication factor of the assembly is between 1 (critical) and 1 plus the delayed neutron fraction. (See *multiplication factor* and *delayed neutrons*.)

delayed neutrons **—**Neutrons emitted from fission products by beta decay following fission by intervals of seconds to minutes. Delayed neutrons account for approximately 0.2 to 0.7 percent of all fission neutrons. For uranium-235, the delayed neutron fraction is about 0.007; for plutonium-239, it is about 0.002.

depleted uranium **—**Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium.

deposition **—**In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling out on ground and building surfaces of atmospheric aerosols and particles ("dry deposition"), or their removal from the air to the ground by precipitation ("wet deposition" or "rainout").

design basis **—**For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component, and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

design-basis accident **—**An accident postulated for the purpose of establishing functional and performance requirements for safety structures, systems, and components.

design-basis events **—**Postulated disturbances in process variables that can potentially lead to design-basis accidents.

design-basis threat **—**The elements of a threat postulated for the purpose of establishing requirements for safeguards and security programs, systems, components, equipment, information. (See *threat*.)

dewatering **—** The removal of water. Saturated soils are "dewatered" to make construction of building foundations easier.

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 jobs **—**The number of workers required at a site to implement an alternative.

diversion **—**The unauthorized removal of nuclear material from its approved use or authorized location.

dolostone **—** A carbonate rock made up predominately of the mineral dolomite, $CaMg(CO_3)_2$.

dose **—** A generic term that means absorbed dose, effective dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined elsewhere in this glossary. It is a measure of the energy imparted to matter by ionizing radiation. The unit of dose is the rem or rad.

dose equivalent **—**A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert.

dose rate **—**The radiation dose delivered per unit of time (e.g., rem per year).

dosimeter **—**A small device (instrument) carried by a radiation worker that measures cumulative radiation dose (e.g., a film badge or ionization chamber).

drinking water standards **—**The level of constituents or characteristics in a drinking water supply specified in regulations under the *Safe Drinking Water Act* as the maximum permissible.

ecology **—**A branch of science dealing with the interrelationships of living organisms with one another and with their nonliving environment.

ecosystem **—**A community of organisms and their physical environment interacting as an ecological unit.

effective dose equivalent **—** The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from internal and external radiation sources. The effective dose equivalent is expressed in units of rem or sieverts. (See *committed dose equivalent* and *committed effective dose equivalen*t.)

effluent **—** A gas or fluid discharged into the environment.

electron **—**An elementary particle with a mass of 9.107×10^{-23} gram (or 1/1,837 of a proton) and a negative charge. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

emission **—**A material discharged into the atmosphere from a source operation or activity.

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."

engineered safety features **—** For a nuclear facility, features that prevent, limit, or mitigate the release of radioactive material from its primary containment.

enriched uranium **—** Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (See *uranium*, and *natural uranium*.)

Environment, Safety, and Health Program **—** In the context of DOE, encompasses those requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations that are concerned with: impacts on the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both the operating personnel and the general public; and protecting property 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, process and facility safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

environmental assessment**—**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 the 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 **—**The detailed written statement required by Section 102(2)(C) of the *National Environmental Policy Act* for a proposed major Federal action significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality *National Environmental Policy Act* regulations in 40 CFR 1500-1508 and the DOE *National Environmental Policy Act* regulations in 10 CFR 1021. The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives; adverse environmental effects that cannot be avoided should the proposal be implemented; the relationship between short-term uses of the human environment and enhancement of long-term productivity; and any irreversible and irretrievable commitments of resources.

environmental justice **—** The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.

ephemeral stream **—**A stream that flows only after a period of heavy precipitation.

epidemiology **—**Study of the occurrence, causes, and distribution of disease or other health-related states and events in human populations, often as related to age, sex, occupation, ethnic, and economic status, to identify and alleviate health problems and promote better health.

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 (milligrams or kilograms per day) for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur.

Reference concentration is the chronic exposure concentration (milligrams per cubic meter) for a given hazardous chemical at which or below which adverse human noncancer 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**—**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 materials **—**An isotope that readily fissions after absorbing a neutron of any energy. Fissile materials are uranium-233, uranium-235, plutonium-239, and plutonium-241. Uranium-235 is the only naturally occurring fissile isotope.

fission **—** The splitting of the nucleus of a heavy atom into two lighter nuclei. It is accompanied by the release of neutrons, gamma rays, and kinetic energy of fission products.

fission products **—** Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

floodplain **—**The lowlands and relatively flat areas adjoining inland and coastal waters and the flood-prone areas of offshore islands. Floodplains include, at a minimum, that area with at least a 1.0 percent chance of being inundated by a flood in any given year.

The *base floodplain* is defined as the area which has a 1.0 percent or greater chance of being flooded in any given year. Such a flood is known as a 100-year flood.

The *critical action floodplain* is defined as the area which has at least a 0.2 percent chance of being flooded in any given year. Such a flood is known as a 500-year flood. Any activity for which even a slight chance of flooding would be too great (e.g., the storage of highly volatile, toxic, or water-reactive materials) should not occur in the critical action floodplain.

The *probable maximum flood* is the hypothetical flood considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximumprecipitation and other hydrological factors favorable for maximum flood runoff (e.g., sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

flux — Rate of flow through a unit area; in reactor operation, the apparent flow of neutrons in a defined energy range. (See *neutron flux*.)

formation **—**In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

fugitive emissions **—**(1) Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device, or (2) any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, piles of stored material (e.g., coal); and road construction areas or other areas where earthwork is occurring.

gamma radiation **—**High-energy, short wavelength, electromagnetic radiation emitted from the nucleus of an atom during radioactive decay. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to, but are usually more energetic than, x-rays.

genetic effects — Inheritable changes (chiefly mutations) produced by exposure of the parts of cells that control biological reproduction and inheritance to ionizing radiation or other chemical or physical agents.

GENII — A computer code used to predict the radiological impacts on individuals and populations associated with the release of radioactive material into the environment during normal operations and postulated accidents.

geology **—**The science that deals with the Earth: the materials, processes, environments, and history of the planet, including rocks and their formation and structure.

gigaelectron volts **—**1,000 million electron volts (MeV). (See *million electron volts*.)

glovebox — A large enclosure that separates workers from equipment used to process hazardous material while allowing the workers to be in physical contact with the equipment; normally constructed of stainless steel, with large acrylic/lead glass windows. Workers have access to equipment through the use of heavy-duty, lead-impregnated rubber gloves, the cuffs of which are sealed in portholes in the glovebox windows.

gray **—**The International System of Units (SI) unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (1 gray is equal to 100 rad). (The joule is the SI unit of energy.) (See *absorbed dos*e.)

ground shine — The radiation dose received from an area on the ground where radioactivity has been deposited by a radioactive plume or cloud.

groundwater — Water below the ground surface in a zone of saturation.

habitat —The environment occupied by individuals of a particular species, population, or community.

half-life —The time in which one-half of the atoms of a particular radioactive isotope disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

***Hazard Index* —** A summation of the Hazard Quotients for all chemicals being used at a site and those proposed to be added to yield cumulative levels for a site. A Hazard Index value of 1.0 or less means that no adverse human health effects (noncancer) are expected to occur.

Hazard Quotient —The value used as an assessment of non-cancer-associated toxic effects of chemicals, e.g., kidney or liver dysfunction. It is a ratio of the estimated exposure to that exposure at which it would be expected that adverse health effects would begin to be produced. It is independent of cancer risk, which is calculated only for those chemicals identified as carcinogens.

***hazards classification* —** The process of identifying the potential threat to human health of a chemical substance.

hazardous air pollutants—Air pollutants not covered by National Ambient Air Quality Standards but which may present a threat of adverse human health or environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, hazardous air pollutants are any of the 188 pollutants to be regulated or renewed under Section 112(b) of the *Clean Air Act*. Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

hazardous 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.

***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 substance* —** Any substance subject to the reporting and possible response provisions of the *Clean Water Act* and the *Comprehensive Environmental Response, Compensation, and Liability Act.*

hazardous waste —A category of waste regulated under the *Resource Conservation and Recovery Act*. To be considered hazardous, a waste must be a solid waste under the *Resource Conservation and Recovery Act* and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31 through 261.33.

high-efficiency particulate air filter **—**An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inches) in diameter. These filters generally include a pleated fibrous medium, typically fiberglass, capable of capturing very small particles.

high-level radioactive waste **—**High-level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

high-multiplication devices **—**A critical assembly for producing nondestructive superprompt critical nuclear excursions. These types of devices are sometimes called prompt burst devices. (See *prompt critical device* and *nuclear excursion*.)

HIGHWAY **—**A computer code used for predicting routes for transporting radioactive material in the United States and calculating route-specific population density statistics.

historic resources **—**Physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later.

hot cell **—**A shielded facility that requires the use of remote manipulators for handling radioactive materials.

hydrology **—**The science dealing with the properties, distribution, and circulation of natural water systems.

impingement **—** The process by which aquatic organisms too large to pass through the screens of a water intake structure become caught on the screens and are unable to escape.

incident-free risk **—**The radiological or chemical impacts resulting from emissions during normal operations and 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 jobs **—** Within a regional economic area, jobs generated or lost in related industries as a result of a change in direct employment.

ion **—**An atom that has too many or too few electrons, causing it to be electrically charged.

ionizing radiation **—**Alpha particles, beta particles, gamma rays, high-speed electrons, high-speed protons, and other particles or electromagnetic radiation that can displace electrons from atoms or molecules, thereby producing ions.

irradiated —Exposure to ionizing radiation. The condition of reactor fuel elements and other materials in which atoms bombarded with nuclear particles have undergone nuclear changes.

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.

***joule* —** A metric unit of energy, work, or heat, equivalent to 1 watt-second, 0.737 foot-pounds, or 0.239 calories.

***latent cancer fatalities* —** Deaths from cancer occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

limestone —A sedimentary rock composed mostly of the mineral calcite, $CaCO_3$.

long-lived radionuclides —Radioactive isotopes with half-lives greater than 30 years.

low-income population —Low-income populations, defined in terms of U.S. Bureau of the Census annual statistical poverty levels *(Current Population Report*s, Series P-60 on Income and Poverty), may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. (See *environmental justice* and *minority populatio*n.)

low-level radioactive waste —Waste that contains radioactivity but is not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined by Section 11e (2) of the *Atomic Energy Act* of 1954, as amended. 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 radioactive waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram.

Magnitude —A number that reflects the relative strength or size of an earthquake. Magnitude is based on the logarithmic measurement of the maximum motion recorded by a seismograph. An increase of one unit of magnitude (for example, from 4.6 to 5.6) represents a 10-fold increase in wave amplitude on a seismograph recording or approximately a 30-fold increase in the energy released. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as "Richter magnitude," (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw). Each is valid for a particular type of seismic signal varying by such factors as frequency and distance. These magnitude scales will yield approximately the same value for any given earthquake within each scale's respective range of validity.

material access area —A type of security area that is authorized to contain a security Category I quantity of special nuclear material and which has specifically defined physical barriers, is located within a Protected Area, and is subject to specific access controls.

***material control and accountability* —** The part of safeguards that detects or deters theft or diversion of nuclear materials and provides assurance that all nuclear materials are accounted for appropriately.

***maximally exposed individual* —** A hypothetical individual receiving radiation doses from transporting radioactive materials on the road. For the incident-free transport operation, the maximally exposed individual would be an individual stuck in traffic next to the shipment for 30 minutes. For accident conditions, the maximally exposed individual is assumed to be an individual located approximately 33 meters (100 feet) directly downwind from the accident.

***maximally exposed offsite individual* —**A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (e.g., inhalation, ingestion, direct exposure).

***maximum contaminant level* —**The designation for U.S. Environmental Protection Agency standards for drinking water quality under the *Safe Drinking Water Act*. The maximum contaminant level for a given substance is the maximum permissible concentration of that substance in water delivered by a public water system. The primary maximum contaminant levels (40 CFR 141) are intended to protect public health and are federally enforceable. They are based on health factors, but are also required by law to reflect the technological and economic feasibility of removing the contaminant from the water supply. Secondary maximum contaminant levels (40 CFR 143) are set by the U.S. Environmental Protection Agency to protect the public welfare. The secondary drinking water regulations control substances in drinking water that primarily affect aesthetic qualities (such as taste, odor, and color) relating to the public acceptance of water. These regulations are not federally enforceable, but are intended as guidelines for the states.

***megawatt* —**A unit of power equal to 1 million watts. Megawatt-thermal is commonly used to define heat produced, while megawatt-electric defines electricity produced.

***meteorology* —** The science dealing with the atmosphere and its phenomena, especially as relating to weather.

***million electron volts (MeV)* —**A unit used to quantify energy. In this EIS, it describes a particle's kinetic energy, which is an indicator of particle speed.

***micron* —**One-millionth of 1 meter.

***migration* —** The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

***millirem* —**One-thousandth of 1 rem.

***minority population* —**Minority populations exist where either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than in the general population or other appropriate unit of geographic analysis (such as a governing body's jurisdiction, a neighborhood, census tract, or other similar unit). "Minority" refers to individuals who are members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. “Minority populations” include either a single minority group or the total of all minority persons in the affected area. They may consist of groups of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. (See *environmental justice* and *low-income population*.)

Miocene **—**An epoch of the upper Tertiary Period, spanning between about 24 and 5 million years ago.

mitigate **—**Mitigation includes: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

mixed waste **—**Waste that contains both nonradioactive 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 (nearly total damage). It is a unitless expression of observed effects.

multiplication factor (keff)**—**For a chain-reacting system, the mean number of fission neurons produced by a neutron during its life within the system. For the critical system, the multiplication factor is equal to 1. If the multiplication factor is less than 1, the system is called “subcritical.” Conversely, if the multiplication factor is greater than 1, the system is called “supercritical.”

National Emission Standards for Hazardous Air Pollutants **—** Standards set by the U.S. Environmental Protection Agency for air pollutants which are not covered by National Ambient Air Quality Standards and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR 61 and 63. National Emission Standards for Hazardous Air Pollutants are given for many specific categories of sources (e.g., equipment leaks, industrial process cooling towers, dry-cleaning facilities, petroleum refineries). (See *hazardous air pollutant*s.)

National Pollutant Discharge Elimination System **—**A provision of the *Clean Water Act* which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the U.S. Environmental Protection Agency, a state, or, where delegated, a tribal government. The National Pollutant Discharge Elimination System permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

National Register of Historic Places **—**The official list of the Nation’s cultural resources that are worthy of preservation. The National Park Service maintains the list under direction of the Secretary of the Interior. Buildings, structures, objects, sites, and districts are included in the National Register for their importance in American history, architecture, archaeology, culture, or engineering. Properties included on the National Register range from large-scale, monumentally proportioned buildings to smaller-scale, regionally distinctive buildings. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties on the National Register are found in 36 CFR 60.

natural uranium **—**Uranium with the naturally occurring distribution of uranium isotopes (approximately 0.7-weight percent uranium-235 with the remainder essentially uranium-238). (See *uranium*, *depleted uranium*, and *enriched uranium*.)

neutron **—**An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1.

***neutron flux* —** The product of neutron number density and velocity (energy), giving an apparent number of neutrons flowing through a unit area per unit time.

***nitrogen* —** A natural element with the atomic number 7. It is diatomic in nature and is a colorless and odorless gas that constitutes about four-fifths of the volume of the atmosphere.

nitrogen oxides **—**Refers to the oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. Nitrogen dioxide emissions contribute to acid deposition and the formation of atmospheric ozone.

***noise* —** Undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

***Non-attainment area* —** An area that the U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.

***nonproliferation* —** Preventing the spread of nuclear weapons, nuclear weapon materials, and nuclear weapon technology.

***normal operations* —** All normal (incident-free) conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

Notice of Intent **—**Announces the scoping process. The Notice of Intent is usually published in the *Federal Register* and a local newspaper. The scoping process includes holding at least one public meeting and requesting written comments on issues and environmental concerns that an EIS should address.

nuclear component **—**A part of a nuclear weapon that contains fissionable or fusionable material.

nuclear criticality **—**See *criticality*.

***nuclear excursion* —** A very short time period (in milliseconds) during which the fission rate of a supercritical system increases, peaks, and then decreases to a low value.

nuclear explosive —Any assembly containing fissionable and/or fusionable materials and main-charge high-explosive parts or propellants capable of producing a nuclear detonation.

nuclear facility —A facility subject to requirements intended to control potential nuclear hazards. Defined in DOE directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the general public.

***nuclear grade* —** Material of a quality adequate for use in a nuclear application.

***nuclear material* —** Composite term applied to: (1) special nuclear material; (2) source material such as uranium, thorium, or ores containing uranium or thorium; and (3) byproduct material, which is any radioactive material that is made radioactive by exposure to the radiation incident or to the process of producing or using special nuclear material.

Nuclear Posture Review—A report, led by the Department of Defense, which addresses possible changes in U.S. nuclear policy (e.g., deployment status, targeting, force structure). The recommendations and decisions in the report dictate further charges in the U.S. nuclear weapons program. The nuclear posture review commits the United States to maintaining a safe and reliable nuclear deterrent.

***nuclear radiation* —** Particles (alpha, beta, neutrons) or photons (gamma) emitted from the nucleus of unstable radioactive atoms as a result of radioactive decay.

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 Regulatory Commission —The Federal agency that regulates the civilian nuclear power industry in the United States.

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.

***nuclide* —** A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Occupational Safety and Health Administration —The U.S. Federal Government agency which oversees and regulates workplace health and safety; created by the *Occupational Safety and Health Act* of 1970.

***offsite* —** The term denotes a location, facility, or activity occurring outside of the boundary of a DOE Complex site.

onsite **—**The term denotes a location or activity occurring within the boundary of a DOE Complex site.

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 Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere, ozone is considered an air pollutant.

package **—**For radioactive materials, the packaging, together with its radioactive contents, as presented for transport (the packaging plus the radioactive contents equals the package).

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.

paleontological resources **—**The physical remains, impressions, or traces of plants or animals from a former geologic age; may be sources of information on ancient environments and the evolutionary development of plants and animals.

particulate matter (PM) **—**Any finely divided solid or liquid material, other than uncombined (i.e., pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, P_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inches) in diameter; $P_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inches) in diameter.

peak ground acceleration **—** A measure of the maximum horizontal acceleration (as a percentage of the acceleration due to the Earth's gravity) experienced by a particle on the surface of the earth during the course of earthquake motion.

Pennsylvanian **—**A geologic time period of the Paleozoic Era, spanning between about 320 and 286 million years ago.

perched aquifer/groundwater **—** A body of groundwater of small lateral dimensions separated from an underlying body of groundwater by an unsaturated zone.

Perchlorate - Perchlorate originates as a contaminant in the environment from the solid salts of ammonium, potassium, or sodium perchlorate. It can persist for many decades under typical groundwater and surface water conditions. Ammonium perchlorate is manufactured for use as the oxidizer component and primary ingredient in solid propellant for rockets, missiles, and fireworks. Other uses of perchlorate salts include their use in nuclear reactors and electronic tubes, as additives in lubricating oils, and in aluminum refining.

Permian **—**The final geologic time period of the Paleozoic Era, spanning between about 286 and 245 million years ago.

permeability **—**In geology, the ability of rock or soil to transmit a fluid.

perennial stream — A stream that flows throughout the year.

person-rem — The unit of collective radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

Perimeter Intrusion Detection and Assessment System (PIDAS) —A mutually supporting combination of barriers, clear zones, lighting, and electronic intrusion detection, assessment, and access control systems constituting the perimeter of the Protected Area and designed to detect, impede, control, or deny access to the Protected Area.

Pit—The central core of a nuclear weapon containing plutonium-239 and/or highly enriched uranium that undergoes fission when compressed by high explosives. The pit and the high explosive are known as the primary of a nuclear weapon.

placer — A surficial mineral deposit formed by mechanical concentration of valuable minerals from weathered debris, usually through the action of stream currents or waves.

playa —A dry lake bed in a desert basin or a closed depression that contains water on a seasonal basis.

Pleistocene —The geologic time period of the earliest epoch of the Quaternary Period, spanning between about 1.6 million years ago and the beginning of the Holocene epoch at 10,000 years ago. It is characterized by the succession of northern glaciations and also called the "Ice Age."

plume —The elongated pattern of contaminated air or water originating at a 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 by neutron bombardment of uranium. Plutonium has 15 isotopes with atomic masses ranging from 232 to 246 and half-lives from 20 minutes to 76 million years.

plutonium-239 —An isotope of plutonium with a half-life of 24,110 years which is the primary radionuclide in weapons-grade plutonium. When plutonium-239 decays, it emits alpha particles.

population dose —See *collective dos*e.

Precambrian —All geologic time before the beginning of the Paleozoic Era. This includes about 90 percent of all geologic time and spans the time from the beginning of the Earth, about 4.5 billion years ago, to about 570 million years ago.

prehistoric resources — The physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past.

Prevention of Significant Deterioration — Regulations required by the 1977 *Clean Air Act* amendments to limit increases in criteria air pollutant concentrations above baseline in areas that already meet the National Ambient Air Quality Standards. Cumulative increases in pollutant levels after specified baseline dates must not exceed specified maximum allowable amounts.

These allowable increases, also known as increments, are especially stringent in areas designated as Class I areas (e.g., national parks, wilderness areas) where the preservation of clean air is particularly important. All areas not designated as Class I are currently designated as Class II. Maximum increments in pollutant levels are also given in 40 CFR 51.166 for Class III areas, if any such areas should be so designated by the U.S. Environmental Protection Agency. Class III increments are less stringent than those for Class I or Class II areas. (See *National Ambient Air Quality Standard*s.)

prime farmland **—**Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oil seed, 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 Act* of 1981, 7 CFR 7, paragraph 658).

probabilistic risk assessment **—**A comprehensive, logical, and structured methodology that accounts for population dynamics and human activity patterns at various levels of sophistication, considering time-space distributions and sensitive subpopulations. The probabilistic method results in a more complete characterization of the exposure information available, which is defined by probability distribution functions. This approach offers the possibility of an associated quantitative measure of the uncertainty around the value of interest.

process **—**Any method or technique designed to change the physical or chemical character of the product.

prompt critical device **—**A critical assembly designed to reach the condition of prompt criticality. Prompt criticality is the nuclear physics supercriticality condition, due to neutrons released immediately during the fission process, in which a mass and geometric configuration of fissile material (uranium-233, uranium-235, plutonium-239, or plutonium-241) results in an extremely rapid increase in the number of fissions from one neutron generation to the next. Prompt criticality does not rely on the releases of delayed neutrons, which are not released immediately, but rather over a period of about one minute after fission. Prompt criticality describes the condition in which the nuclear fission reaction is not only self-sustaining, but also increasing at a very rapid rate.

Protected Area **—**A type of security area defined by physical barriers (i.e., walls or fences), to which access is controlled, used for protection of security Category II special nuclear materials and classified matter and/or to provide a concentric security zone surrounding a Material Access Area (security Category I nuclear materials) or a Vital Area.

proton **—**An elementary nuclear particle with a positive charge equal in magnitude to the negative charge of the electron; it is a constituent of all atomic nuclei, and the atomic number of an element indicates the number of protons in the nucleus of each atom of that element.

pulsed assemblies **—** A critical assembly designed to produce a brief emission of neutrons and gamma radiation associated with a critical condition which lasts a fraction of a second.

Quaternary **—**The second geologic time period of the Cenozoic era, dating from about 1.6 million years ago to the present. It contains two epochs: the Pleistocene and the Holocene. It is characterized by the first appearance of human beings on Earth.

rad **—**See *radiation absorbed dose*.

radiation (ionizing) **—**See *ionizing radiation*.

radiation absorbed dose (rad) **—**The basic unit of absorbed dose equal to the absorption of 0.01 joules per kilogram (100 ergs per gram) of absorbing material.

radioactive waste **—** In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or byproduct material is subject to regulation as radioactive waste under the *Atomic Energy Act*. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

radioactivity **—** *Defined as a process:* The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.

Defined as a property: The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotope or radionuclide **—**An unstable isotope that undergoes spontaneous transformation, emitting radiation. (See *isotopes*.)

radon **—**A gaseous, radioactive element with the atomic number 86, resulting from the radioactive decay of radium. Radon occurs naturally in the environment and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

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.

Record of Decision **—** A document prepared in accordance with the requirements of 40 CFR 1505.2 and 10 CFR 1021.315 that provides a concise public record of DOE's decision on a proposed action for which an EIS was prepared. A Record of Decision identifies the alternatives considered in reaching the decision; the environmentally preferable alternative; factors balanced by DOE in making the decision, and whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, the reasons they were not.

reference concentration **—** An estimate of a toxic chemical daily inhalation of the human population (including sensitive subgroups) likely to be without an appreciable risk of harmful effects during a lifetime. Those effects are both to the respiratory system (portal-of-entry) and the peripheral to the respiratory system (extra-respiratory effects). It is expressed in units of micrograms per cubic meter.

region of influence **—**A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur and are expected to be of consequence for local jurisdictions.

regulated substances — A general term used to refer to materials other than radionuclides that may be regulated by other applicable Federal, state, or local requirements.

Reliability—The ability of a nuclear weapon, weapon system, or weapon component to perform its required function under stated conditions for a specified period of time. (Essentially equivalent to performance.)

rem (roentgen equivalent man) — A unit of dose equivalent. The dose equivalent in rem equals the absorbed dose in rad in tissue multiplied by the appropriate quality factor and possibly other modifying factors. Derived from “roentgen equivalent man,” referring to the dosage of ionizing radiation that will cause the same biological effect as 1 roentgen of x-ray or gamma-ray exposure. (See *absorbed dose* and *dose equivalent*.)

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.

remote-handled waste —In general, refers to radioactive waste that must be handled at a distance to protect workers from unnecessary exposure (e.g., waste with a dose rate of 200 millirem per hour or more at the surface of the waste package). (See *contact-handled wast*e.)

rhyolite —A fine-grained silica-rich igneous rock, the extrusive equivalent of granite.

riparian —Of, on, or relating to the banks of a natural course of water.

risk — The probability of a detrimental effect from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (i.e., the product of these two factors).

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-ray or gamma radiation equal to or producing one electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad.

runoff —The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

safe, secure trailer —A specially modified semitrailer, pulled by an armored tractor truck, which DOE uses to transport nuclear weapons, nuclear weapons components, or special nuclear material over public highways.

safeguards — An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized access, possession, use, or sabotage of nuclear materials.

safety analysis report —A report that systematically identifies potential hazards within a nuclear facility, describes and analyzes the adequacy of measures to eliminate or control identified hazards, and analyzes potential accidents and their associated risks. Safety analysis reports are used to ensure that a nuclear facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. Safety analysis reports are required for DOE nuclear facilities and as a part of applications for U.S. Nuclear Regulatory Commission licenses. The U.S. Nuclear Regulatory Commission regulations or DOE orders and technical standards that apply to the facility type provide specific requirements for the content of safety analysis reports. (See *nuclear facilit*y.)

sandstone **—**A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

sanitary waste **—** Waste generated by normal housekeeping activities, liquid or solid (includes sludge), which is not hazardous or radioactive.

scope **—**In a document prepared pursuant to the *National Environmental Policy Act* of 1969, the range of actions, alternatives, and impacts to be considered.

scoping **—**An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a Proposed Action. The scoping period begins after publication in the *Federal Register* of a Notice of Intent to prepare an EIS. The public scoping process is that portion of the process where the public is invited to participate. DOE also conducts an early internal scoping process for environmental assessments or EISs. For EISs, this internal scoping process precedes the public scooping process. DOE's scoping procedures are found in 10 CFR 1021.311.

security **—**An integrated system of activities, systems, programs, facilities, and policies for the protection of restricted data and other classified information or matter, nuclear materials, nuclear weapons and nuclear weapons components, and/or DOE contractor facilities, property, and equipment.

seismic **—**Earth vibration caused by an earthquake or an explosion.

seismicity **—**The relative frequency and distribution of earthquakes.

severe accident **—** An accident with a frequency 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.

sewage **—**The total organic waste and wastewater generated by an industrial establishment or a community.

shielding **—**In regard to radiation, any material of obstruction (e.g., bulkheads, walls, or other construction) that absorbs radiation to protect personnel or equipment.

short-lived activation products **—** An element formed from neutron interaction that has a relatively short half-life that is not produced from the fission reaction (e.g., a cobalt isotope formed from impurities in the metal of the reactor piping).

short-lived nuclides **—**Radioactive isotopes with half-lives no greater than about 30 years (e.g., cesium-137 and strontium-90).

sievert **—**The International System of Units (SI) unit of radiation dose equivalent. The dose equivalent in sieverts equals the absorbed dose in grays multiplied by the appropriate quality factor (1 sievert is equal to 100 rem). (See *gray*.)

silica gel **—**An amorphous, highly adsorbent form of silicon dioxide.

soils **—**All unconsolidated materials above bedrock. Natural earthy materials on the Earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants out of doors.

somatic effect **—**Any effect that may manifest in the body of the exposed individual over his or her lifetime.

source material **—**Depleted uranium, normal uranium, thorium, or any other nuclear material determined, pursuant to Section 61 of the *Atomic Energy Act* of 1954, as amended, to be source material, or ores containing one or more of the foregoing materials in such concentration as may be determined by regulation.

source term **—**The amount of a specific pollutant (e.g., chemical, radionuclide) emitted or discharged to a particular environmental medium (e.g., air, water) from a source or group of sources. It is usually expressed as a rate (i.e., amount per unit time).

special nuclear materials **—** 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 U.S. Nuclear Regulatory Commission determines to be special nuclear material; or (2) any material artificially enriched by any of the above.

spectral (response) acceleration **—** An approximate measure of the acceleration (as a percentage of the acceleration due to Earth's gravity) experienced by a building, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building.

spectral characteristics **—**The natural property of a structure as it relates to the multidimensional temporal accelerations.

staging **—** The process of using two layers to achieve a combined effect greater than that of one layer.

START I and II **—**Terms which refer to negotiations between the United States and Russia (formerly the Soviet Union) during Strategic Arms Reduction Treaty (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. START II protocol, which has not been fully ratified, will attempt to further reduce the acceptable levels of nuclear weapons ratified in START I.

stockpile **—**The inventory of active nuclear weapons for the strategic defense of the United States.

***stockpile stewardship program* —** A program that ensures the operational readiness (i.e., safety and reliability) of the U.S. nuclear weapons stockpile by the appropriate balance of surveillance, experiments, and simulations.

***sulfur oxides* —**Common air pollutants, primarily sulfur dioxide, a heavy, pungent, colorless gas (formed in the combustion of fossil fuels, considered a major air pollutant), and sulfur trioxide. Sulfur dioxide is involved in the formation of acid rain. It can also irritate the upper respiratory tract and cause lung damage.

***surface water* —**All bodies of water on the surface of the earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

***Tertiary* —** The first geologic time period of the Cenozoic Era (after the Mesozoic Era and before the Quaternary Period), spanning between about 66 and 1.6 million years ago. During this period, mammals became the dominant life form on Earth.

***threat-1* —** (1) A person, group, or movement with intentions to use extant or attainable capabilities to undertake malevolent actions against DOE interests; (2) the capability of an adversary coupled with his intentions to undertake any actions detrimental to the success of program activities or operation.

***threatened species* —** Any plants or animals likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set in the *Endangered Species Act* and its implementing regulations (50 CFR 424). (See *endangered species*.)

***threshold limit values* —**The recommended highest concentrations of contaminants to which workers may be exposed according to the American Conference of Governmental Industrial Hygienists.

***total effective dose equivalent* —**The sum of the effective dose equivalent from external exposures and the committed effective dose equivalent from internal exposures.

***transuranic* —**Refers to any element whose atomic number is higher than that of uranium (atomic number 92), including neptunium, plutonium, americium, and curium. All transuranic elements are produced artificially and are radioactive.

***transuranic waste* —**Radioactive waste not classified as high-level radioactive waste and that contains more than 100 nanocuries (3,700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

***tuff* —** A fine-grained rock composed of ash or other material formed by volcanic explosion or aerial expulsion from a volcanic vent.

***Type B packaging* —** A regulatory category of packaging for transportation of radioactive material. The U.S. Department of Transportation and U.S. Nuclear Regulatory Commission require Type B packaging for shipping highly radioactive material. Type B packages must be designed and demonstrated to retain their containment and shielding integrity under severe accident conditions, as well as under the normal conditions of transport. The current U.S. Nuclear Regulatory Commission testing criteria for Type B package designs (10 CFR 71) are intended to simulate severe accident conditions, including impact, puncture, fire, and immersion in water. The most widely recognized Type B packages are the massive casks used for transporting spent nuclear fuel. Large-capacity cranes and mechanical lifting equipment are usually needed to handle Type B packages.

Type B shipping cask **—**A U.S. Nuclear Regulatory Commission-certified cask with a protective covering that contains and shields radioactive materials, dissipates heat, prevents damage to the contents, and prevents criticality during normal shipment and accident conditions. It is used for transport of highly radioactive materials and is tested under severe, hypothetical accident conditions that demonstrate resistance to impact, puncture, fire, and submersion in water.

uranium **—** A radioactive, metallic element with the atomic number 92; one of the heaviest naturally occurring elements. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission. (See *natural uranium*, *enriched uranium*, and *depleted uranium*.)

vault (special nuclear material) **—**A penetration-resistant, windowless enclosure having an intrusion alarm system activated by opening the door and which also has: (1) walls, floor, and ceiling substantially constructed of materials which afford forced-penetration resistance at least equivalent to that of 20.32-centimeter (8-inch) thick reinforced concrete; (2) a built-in combination-locked steel door which, for existing structures, is at least 2.54-centimeter (1-inch) thick exclusive of bolt work and locking devices and which, for new structures, meets standards set forth in Federal specifications and standards.

viewshed **—**The extent of an area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

vital area **—**A type of DOE security area that is located within the Protected Area and that has a separate perimeter and access controls to afford layered protection, including intrusion detection, for vital equipment.

Visual Resource Management Class **—** Any of the classifications of visual resources established through application of the Visual Resources Management process of the Bureau of Land Management. Four classifications are employed to describe different degrees of modification to landscape elements: Class I-areas where the natural landscape is preserved, including national wilderness areas and the wild sections of national wild and scenic rivers; Class II-areas with very limited land development activity, resulting in visual contrasts that are seen but do not attract attention; Class III-areas in which development may attract attention, but the natural landscape still dominates; and Class IV-areas in which development activities may dominate the view and may be the major focus in the landscape.

volatile organic compounds **—** A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol. In regard to air pollution, any organic compound that participates in atmospheric photochemical reaction, except for those designated by the U.S. Environmental Protection Agency administrator as having negligible photochemical reactivity.

waste classification **—**Waste is classified according to DOE Order 435.1, *Radioactive Waste Management* and includes high-level radioactive, transuranic, and low-level radioactive waste.

waste management **—**The planning, coordination, and direction of those functions related to the generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities.

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.

watt **—** A unit of power equal to 1 joule per second. (See *joule*.)

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 **—** Generally, a method of attaching different importance values to different items or characteristics. In the context of radiation protection, the proportion of the risk of effects resulting from irradiation of a particular organ or tissue to the total risk of effects when the whole body is irradiated uniformly (e.g., the organ dose weighting factor for the lung is 0.12, compared to 1.0 for the whole body). Weighting factors are used for calculating the effective dose equivalent.

wetland **—** Wetlands are "... those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

whole-body dose **—**In regard to radiation, dose resulting from the uniform exposure of all organs and tissues in a human body. (See *effective dose equivalent*.)

wind rose **—**A circular diagram showing, for a specific location, the percentage of the time the wind is from each compass direction. A wind rose for use in assessing consequences of airborne releases also shows the frequency of different wind speeds for each compass direction.

X/Q (Chi/Q) **—**The relative calculated air concentration due to a specific air release; units are seconds per cubic meter (sec/m^3).

yield **—**The force in tons of TNT of a nuclear or thermonuclear explosion.

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U.S. Department of Energy

Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

Volume II

Appendices A – H

May 2003

U.S. Department of Energy
National Nuclear Security Administration

COVER SHEET

***Responsible Agency*:** United States Department of Energy (DOE) National Nuclear Security Administration (NNSA)

***Title*:** Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

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Abstract: DOE's NNSA is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including production readiness required to maintain that stockpile. Since 1989, DOE has been without the capability to produce certified plutonium pits, which are an essential component of nuclear weapons. NNSA, the Department of Defense, and Congress have highlighted the lack of long-term pit production capability as a national security issue requiring timely resolution. While a small interim capacity is currently being established at the Los Alamos National Laboratory (LANL), classified analyses indicate that long-term support of the nuclear stockpile, which is a cornerstone of U.S. national security policy, will require a long-term pit production capability.

Pursuant to *National Environmental Policy Act* of 1969, as amended (42 USC 4321 et seq.), and DOE Regulations Implementing *National Environmental Policy Act* (10 CFR Part 1021), NNSA has prepared a Supplement to the Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility (hereafter, referred to as the MPF EIS) to support a Record of Decision (ROD) by the Secretary of Energy on: (1) whether to proceed with a Modern Pit Facility (MPF); and (2) if so, where to locate a MPF. This MPF EIS evaluates the environmental impacts associated with constructing a new MPF at the following sites: (1) Los Alamos Site, New Mexico; (2) Nevada Test Site; (3) Carlsbad Site, New Mexico; (4) Savannah River Site, South Carolina; and (5) Pantex Site, Texas. The MPF EIS also evaluates an upgrade to the plutonium pit manufacturing capabilities currently being established at Technical Area 55 (TA-55) at LANL, and the No Action Alternative of relying on the small interim capacity at LANL. The MPF EIS evaluates a range of pit production capabilities consistent with national security requirements. Additional NEPA analysis will be required for

the specific siting of such a facility should the decision be made that a MPF is required. For this MPF Draft EIS, constructing and operating a MPF is the preferred alternative. A preferred site for a MPF has not yet been determined, but will be identified in the Final EIS.

Public Comments: In preparing this MPF Draft EIS, NNSA considered comments received during the public scoping period from September 20, 2002, through November 22, 2002. In addition, six public hearings were held to assist NNSA in defining the scope of the analysis. The first of these public hearings was held on October 8, 2002, in Amarillo, Texas. Hearings were also held in Carlsbad, New Mexico, on October 10, 2002, in Washington, DC, on October 15, 2002, in Las Vegas, Nevada, on October 17, 2002, in Los Alamos, New Mexico, on October 24, 2002, and in North Augusta, South Carolina, on October 29, 2002. Comments made at these hearings, as well as each comment received by fax, e-mail, and mail during the scoping period, were considered in the preparation of the MPF Draft EIS. A summary of the comments is included in this draft.

The comment period for this MPF Draft EIS will be from June 6, 2003 to August 5, 2003. Public meetings will also be held during this 60-day comment period. The dates, times, and locations of these meetings will be announced in the *Federal Register* and in local newspapers. All comments received during the comment period will be considered by NNSA in the Final EIS.

ACRONYMS AND ABBREVIATIONS

AC/MC	Analytical Chemistry and Materials Characterization
ACHP	Advisory Council on Historic Preservation
ALARA	as low as reasonably achievable
ALOHA	Aerial Location of Hazardous Atmospheres
AQCR	Air Quality Control Region
ARF	airborne release fraction
Bison-m	Biota Information System of New Mexico
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BNM	Bandelier National Monument
CAA	*Clean Air Act*
CAIRS	Computerized Accident/Incident Reporting System
CD-0	critical decision on mission need
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CIF	Consolidated Incineration Facility
CMR	Chemistry and Metallurgy Research
CMRR	Chemistry and Metallurgy Research Building Replacement Project
CRT	Cargo Restraint Transporter
CWA	*Clean Water Act*
D&D	Decontamination and Decommissioning
DAF	Device Assembly Facility
DCGs	Derived Concentration Guidelines
DHHS	Department of Health and Human Services
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
DR	damage ratio
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
ECF	Entry Control Facility
EIS	Environmental Impact Statement
EOL	End-of-Life
EPA	U.S. Environmental Protection Agency

ER	Environmental Restoration
ESL	Effects Screening Level
EU	Enriched Uranium
FM	Farm-to-Market Road
FONSI	Finding of No Significant Impact
FPPA	*Farmland Protection Policy Act*
GB	glovebox
HAN	hydroxylamine nitrate
HANDSS-55	"handling and segregation system for 55-gallon drums"
HEPA	high efficiency particulate air
HEWTF	High Explosives Wastewater Treatment Facility
HI	Hazard Index
HQ	Hazard Quotient
HSC	Hazardous Materials Spill Center
HVAC	heating, ventilating, and air conditioning
HWDU	Hazardous waste disposal units
HWTPF	Hazardous Waste Treatment and Processing Facility
HYDEC	hydride/dehydride casting
I	Interstate Highway
ICD-9-CM	International Classification of Disease, 9^{th} Revision, Clinical Modification
ICRP	International Commission on Radiological Protection
INEEL	Idaho National Engineering and Environmental Laboratory
IOM	Institution of Medicine
ISCST	Industrial Source Complex Short Term
ISD	Independent School District
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
LAC	Los Alamos County
LANL	Los Alamos National Laboratory
LANL SWEIS	*Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory*
LANSCE	Los Alamos Neutron Science Center
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOS	Level of Service
LPF	leak path factor
MACCS2	MELCOR Accident Consequence Code System Version 2
MAR	material at risk

MC&A	Material Control & Accountability
MCL	Maximum Contamination Level
MEI	Maximally Exposed Individual
MEK	methyl ethyl ketone
MOX	Mixed Oxide
MPF	Modern Pit Facility
MPF EIS	Modern Pit Facility Environmental Impact Statement
MSGP	Multi-Sector General Permit
MWDU	Mixed Waste Disposal Unit
NAAQS	National Ambient Air Quality Standards
NCRP	National Council on Radiation Protection Measurements
NEPA	*National Environmental Policy Act*
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NHPA	*National Historic Preservation Act*
NMAQCR	New Mexico Air Quality Control Regulations
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPR	Nuclear Posture Review
NPT	Nuclear Nonproliferation Treaty
NRCS	Natural Resources Conservation Service
NRHP	National Registry of Historic Places
NTS	Nevada Test Site
NWSM	Nuclear Weapons Stockpile Memorandum
NWSP	Nuclear Weapons Stockpile Plan
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PAAA	*Price-Anderson Amendments Act*
Pantex	Pantex Site
PCB	polychlorinated biphenyls
pCi/L	picocuries per liter
PF-4	Plutonium Facility, Building 4
PIDAS	Perimeter Intrusion Detection and Assessment System
ppbv	parts per billion by volume
ppy	pits per year

PQL	Practical Quantitation Limit
PSD	Prevention of Significant Deterioration
Pu	Plutonium
PMDA	Plutonium Management and Disposition Agreement
PUREX	Plutonium-Uranium Extraction Process
R&D	Research and Development
RANT	Radioassay and Nondestructive Testing
RCRA	*Resource Conservation and Recovery Act*
RIMSII	Regional Input-Output Modeling System
RF	respirable fraction
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	Region of Influence
RRF	respirable release fraction
RWMS	Radioactive Waste Management Sites
S.C.	South Carolina State Highway
SCDHEC	South Carolina Department of Health and Environmental Control
SEIS	Supplemental Environmental Impact Statement
SFNF	Santa Fe National Forest
SGT	Safeguards Transporters
SHEO	sentinel health event for occupation
SHPO	State Historic Preservation Officer
SMR	standardized mortality rate
SRS	Savannah River Site
SS&C	sand, slag and crucible
SSM	Stockpile Stewardship and Management
SSM PEIS	*Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
SST	Safe Secure Trailers
SVOC	Semi-volatile organic compound
SWEIS	Site-Wide Environmental Impact Statement
SWSC	Sanitary Wastewater Systems Consolidation
TA	Technical Area
TA-55	Technical Area 55
TBP	tributylphosphate
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resource Conservation Commission
TPDES	Texas Pollutant Discharge Elimination System

TRAGIS	Transportation Routing Analysis Geographic Information System
TRU	transuranic
TRUPACT-II	Transuranic Package Transporter
TSCA	*Toxic Substance Control Act*
TSP	total suspended particulates
USACE	United States Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VPP	Voluntary Protection Program
WCRRF	Waste Compaction, Reduction, and Repackaging Facility
WIPP	Waste Isolation Pilot Plant
WSRC	Westinghouse Savannah River Company
WWTF	Wastewater Treatment Facility

CHEMICALS AND UNITS OF MEASURE

BTEX	benzene, toluene, ethylbenzene, and xylenes
Bq	Becquerel
C	Celsius
Ci	curie
cm	centimeters
CFC	chlorofluorocarbons
CO	carbon monoxide
dB	decibel
dBA	decibel A-weighted
DCE	1, 2-dichloroethylene
DNA	deoxyribonucleic acid
F	Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
ft^3/s	cubic feet per second
g	grams
gal	gallons
ha	hectares
hr	hour
in	inches
kg	kilograms
km	kilometers
km^2	square kilometers
kV	kilovolts
kVA	kilovolt-ampere
kW	kilowatts
kWh	kilowatt hours
L	liters
lb	pounds
m	meters
m^2	square meters
m^3	cubic meters
m/s	meters per second
mg	milligram (one-thousandth of a gram)
mg/L	milligrams per liter

MGD	million gallons per day
MGY	million gallons per year
mi	miles
mi^2	square miles
mph	miles per hour
mrem	millirem (one-thousandth of a rem)
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatt hour
NO_2	nitrogen dioxide
NOX	nitrogen oxides
O_3	ozone
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
rem	roentgen equivalent man
s	seconds
SO_2	sulfur dioxide
T	short ton
t	metric tons
TCA	1, 1, 1-trichloroethane
TCE	trichloroethylene
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
$\mu g/m^3$	micrograms per cubic 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
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	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-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}

APPENDIX A
DETAILS OF PIT PRODUCTION PROCESS AND REQUIREMENTS

A.1 FACILITY SUMMARY

A Modern Pit Facility (MPF) would be capable of producing certified pits for the U.S. Nuclear Weapons Stockpile as defined by the National Nuclear Security Administration. The scope of the facility being planned would be as follows.

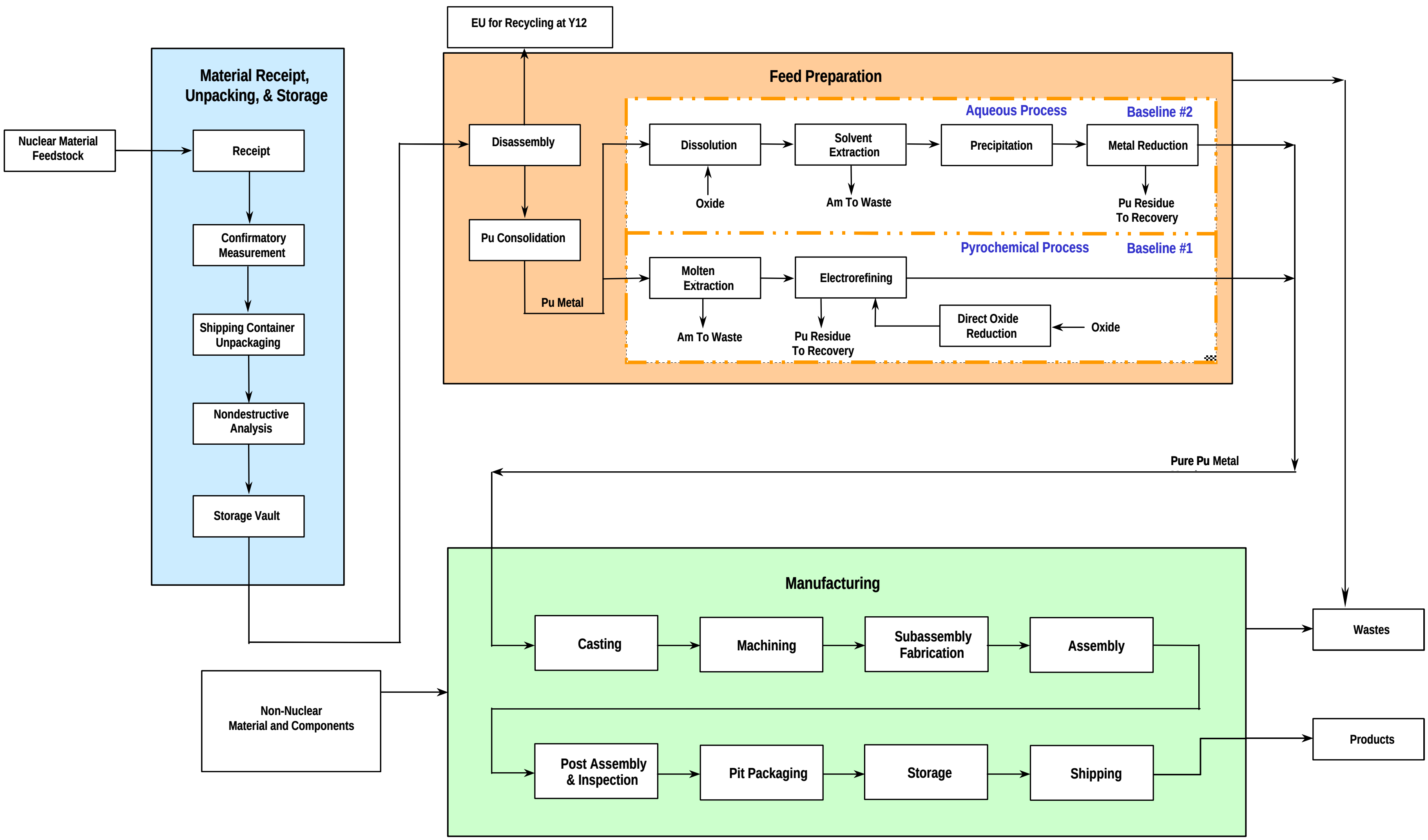
- MPF would be a newly constructed facility that provides long-term (past 2015) plutonium pit manufacturing capability.
- MPF would be designed with the goal of developing a safe, secure, and environmentally compliant facility based on modern manufacturing practices.
- MPF would be located at an existing DOE site and integrated, as appropriate, with other present and planned facilities at that site.
- MPF would be supported by one or more additional plutonium-capable facilities. Other plutonium facilities at Los Alamos National Laboratory or Lawrence Livermore National Laboratory are assumed to be available for complementary Research and Development or backup operations.
- MPF would be an integral part of a broader weapons production complex. It is assumed that existing production facilities now manufacturing some pit components (non-plutonium parts) would continue to be suppliers in the future.
- MPF would be capable of single-shift capacity of no less than 125, 250, or 450 pits per year (ppy) and surge capacity through the use of multiple shifts.
- MPF would be capable of manufacturing plutonium components and assembling all full pits (of current or new design) in the enduring stockpile. A full pit is defined as the complete assembly to be received by the Pantex Plant (Pantex) for incorporation into an operational weapon.

A.2 FACILITY OPERATIONS

Processing operations in the MPF plant would include the following major categories: Material Receipt, Unpacking, & Storage; Feed Preparation; and Manufacturing. Figure A.2–1 provides an overview of the MPF process.

A.2.1 Material Receipt, Unpacking & Storage

Plutonium feedstock material would be delivered from offsite sources in U.S. Department of Energy (DOE)/Department of Transportation-approved shipping containers. The shipping containers may be held in Cargo Restraint Transporters (CRT) and hauled by Safe Secure Trailers or Safeguards Transporters. The CRTs would be unloaded from the truck and the shipping packages unpacked from the CRT. Each shipment would be measured to confirm the plutonium content, entered into the facility's Material Control & Accountability database, and placed into temporary storage. The shipping packages would later be removed from storage and



Source: Modified from NNSA 2002.

Figure A.2–1. Modern Pit Facility Process Flow

opened to remove the inner containment vessel. The containment vessels with the feedstock material would be accountability measured and then transferred to the Receipt Storage Vault pending transfer to the Pit Disassembly and Feed Preparation Area. In addition to the pits, many other components from throughout the Nuclear Weapons Complex would be shipped to the MPF. These interfaces are shown graphically in Figure A.2.1–1.

A.2.2 Feed Preparation

The containers would then be transferred through a secure transfer corridor to an adjacent Feed Preparation Facility where site return pits would be disassembled and the recovered plutonium would then be purified using either an aqueous or a pyrochemical process.

A.2.2.1 Disassembly

In the Disassembly process, pits will first be removed from the primary containment vessels. The mechanical disassembly of the pits would involve cutting the pit in half and removing all non-plutonium components. The non-plutonium components would then be declassified, packaged, and assayed prior to removal from the facility as waste or recyclable material. The plutonium components, including non-plutonium items containing residual plutonium that could not be removed mechanically from the pit, would be transferred to the Plutonium Recovery and Purification Area.

Uranium components that could be mechanically separated would be decontaminated to remove any residual plutonium prior to packaging for shipment. The decontamination would be accomplished electrochemically. The residues from this process could be dried and disposed as waste, or re-dissolved if plutonium recovery would be desired.

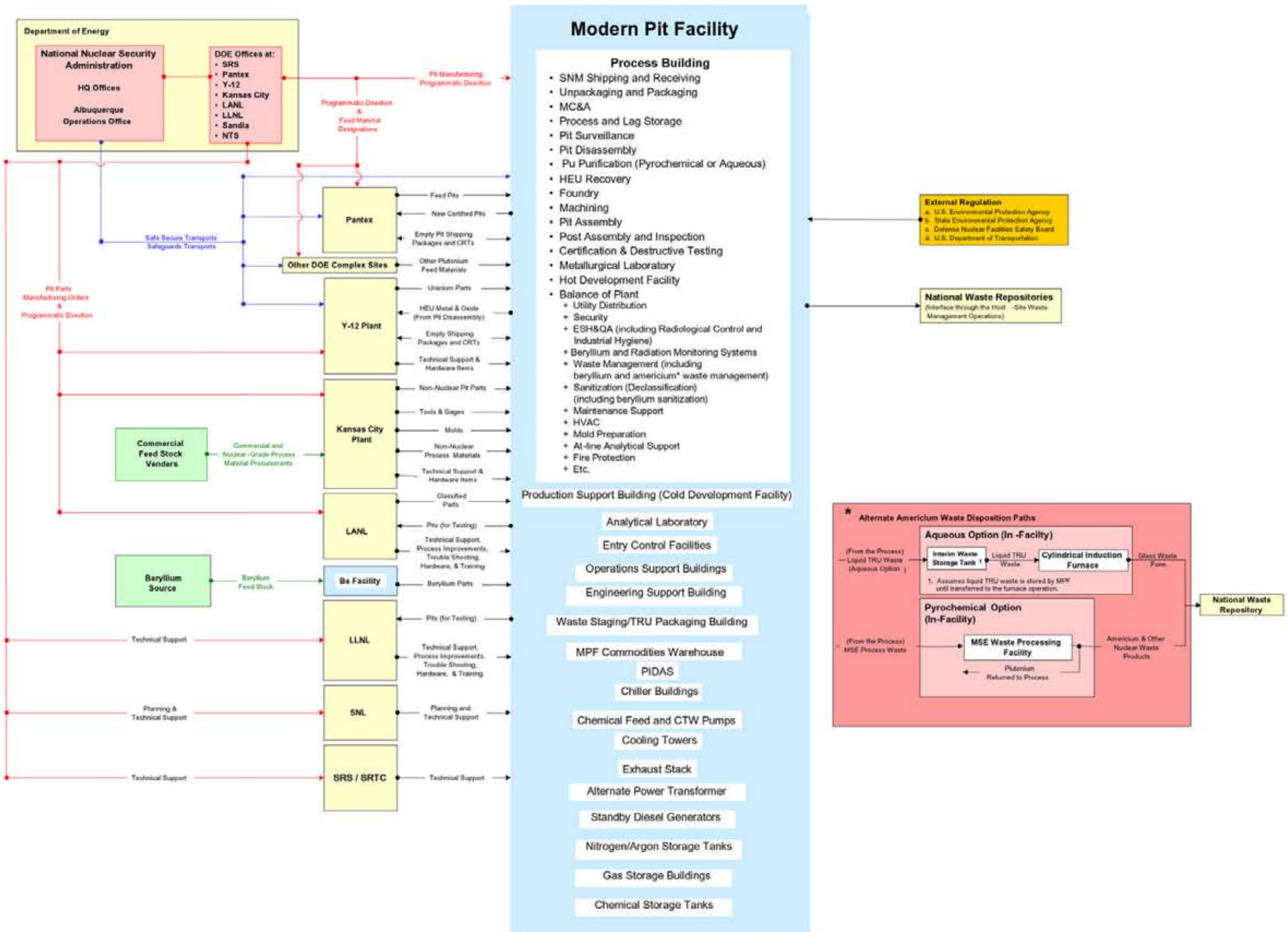
A.2.2.2 Plutonium Consolidation

Plutonium pieces would be charged to a casting furnace for conversion to a metal ingot. The metal ingot would then be transferred to the purification process.

A.2.2.3 Plutonium Purification

There are two baseline processes being evaluated for the purification of the plutonium metal. One baseline relies more heavily on aqueous chemistry (aqueous process) and the other on pyrochemical reactions (pyrochemical process). The primary difference between the two baselines is that the aqueous process does not employ chloride containing aqueous solutions which means conventional stainless steels can readily be used to contain all of its processes. On the other hand the pyrochemical process requires specialized materials to contain the corrosive chloride bearing solutions that it employs.

The primary process evaluated in this EIS is the aqueous process. This is a well-known process that has been successfully used at DOE sites for many years. It is comparatively simple and experiences few, well controlled corrosion problems. However, it is not as space efficient and does not produce as pure a product metal as the pyrochemical process. This lower purity



Source: NNSA 2002.

Figure A.2.1–1. Modern Pit Facility Interface with the Nuclear Weapons Complex

requires more complete processing and historically produces a great deal more waste. This provides a bounding analysis of the waste impact from the MPF. Residue from the aqueous process would be packaged, assayed, and sent to storage for recovery of plutonium during scrap recovery campaigns. If the plutonium content was acceptably low, this material could alternatively be packaged for disposal as waste.

The pyrochemical process is more complex than the aqueous process, employing seven versus four major processing steps. However, this can be done in less space with more processing flexibility. It also produces very pure metal and a lower volume of waste. The purity of metal allows the pyrochemical process to have the option of only partially processing metallic plutonium to obtain adequate production purity. Although it requires special materials of construction to contain the corrosive chloride solutions it appears to have the greatest potential for improvement based on the number and type of proposed development projects. Residue from the pyrochemical process would be packaged, assayed, and sent to storage for recovery of plutonium during scrap recovery campaigns. If the plutonium content was acceptably low, this material could alternatively be packaged for disposal as waste.

The pyrochemical process is being investigated because it has the potential to be environmentally more benign, thus having less environmental impact than the aqueous process. The impacts from both of these processes will therefore be bounded in this EIS. As the design of the MPF develops and a final purification method is chosen, the follow-on EIS will evaluate the impact of the actual process to be used.

A.2.3 Manufacturing

Plutonium metal from the recovery and purification processes would be used to fabricate new pits. Some plutonium metal from other sources could be used to supplement the plutonium recovered from the purification operations. The plutonium metal would then be transferred to the manufacturing area where it would be melted and cast into required shapes in a foundry operation. These castings would then be machined to proper dimensions, combined with other non-plutonium parts including beryllium and enriched uranium components and would be assembled into pits. Throughout the manufacturing operations, certification and inspection would be conducted to ensure that components meet specifications. The finished pits would then be prepared for storage and eventual shipment.

Residues from the manufacturing process would be recycled either to the melting/casting operation or sent back to the plutonium purification process to recycle the plutonium back through the entire process. Wastes from this process would be packaged, assayed, and sent to storage for recovery of plutonium during scrap recovery campaigns. If the plutonium content was acceptably low, this material could alternatively be packaged for disposal as waste.

A.3 FACILITY REQUIREMENTS

The design size of a MPF will be primarily affected by both the operational lifetime of pits and the size of the stockpile. Since there is uncertainty over both these issues, the final design size of a MPF has not yet been determined. These uncertainties have been evaluated in classified studies. Three levels of production are evaluated to provide a reasonable range for analysis in this MPF EIS. These are 125, 250, and 450 ppy in a single-shift operation. To accommodate these three production rates, this MPF EIS analyzes three different plant sizes. Another consideration is the contingency or surge use of two-shift operations for emergencies. The surge outputs of the 125 and 250 ppy plants would thus be approximately the same and have the same environmental impact as the 250 and 450 ppy single-shift scenarios. The impacts of surge output of the 450 ppy plant were evaluated in a qualitative manner for each resource.

A.3.1 Security

The majority of the facilities of a MPF would be located within a Perimeter Intrusion Detection and Assessment System (PIDAS). The PIDAS would be a multiple sensor system within a 9-m (30-ft) wide zone enclosed by two fences that runs around the entire Security Protection Area. In addition, there would be 6-m (20-ft) clear zones on either side of the PIDAS. There would be an Entry Control Facility at the entrance to the Security Protection Area.

A.3.2 Process Structures

The proposed concept being evaluated for a MPF divides the major plant components into three separate process buildings identified as Material Receipt, Unpacking & Storage, Feed Preparation, and Manufacturing that provide the services described in Chapter 3, Section 3.1.1. The process buildings would be two-story reinforced concrete structures located aboveground at grade. The exterior walls and roof would be designed to resist all credible man-made and natural phenomena hazards and comply with security requirements. The exterior walls of the first level would consist of a double reinforced concrete wall construction with loose aggregate backfill between the walls to satisfy security requirements.

The first level of each process building would include plutonium processing areas, manufacturing support areas, waste handling, control rooms, and support facilities for operations personnel. The second level of each of the three process buildings would include the heating, ventilation, and air conditioning (HVAC) supply fans, exhaust fans and high-efficiency particulate air filters, breathing/plant/instrument air compressor rooms, electrical rooms, process support equipment rooms, and miscellaneous support space. Interior walls would be typically reinforced concrete to provide personnel shielding and for durability in the 50-year facility design life. Each of these processing buildings would have its own Entry Control Facility, Truck Loading Docks, Operations Support Facility, and Safe Havens designed in accordance with applicable safety and security requirements. The three processing buildings would be connected with secure transfer corridors.

A.3.3 Support Structures Within the Perimeter Intrusion Detection and Assessment System

The major buildings located within the PIDAS would include the Analytical Support Building and the Production Support Building. The Analytical Support Building would contain laboratory equipment and instrumentation required to provide analytical support for the MPF processes, including radiological analyses. The Production Support Building would provide the capability for performing nonradiological classified work related to the development, testing, and troubleshooting of MPF processes and equipment during operations. A number of other smaller structures also supporting the MPF would include standby generator buildings, fuel and liquid gas storage tanks, HVAC chiller buildings, cooling towers, and the HVAC exhaust stack.

A.3.4 Support Structures Outside the Perimeter Intrusion Detection and Assessment System

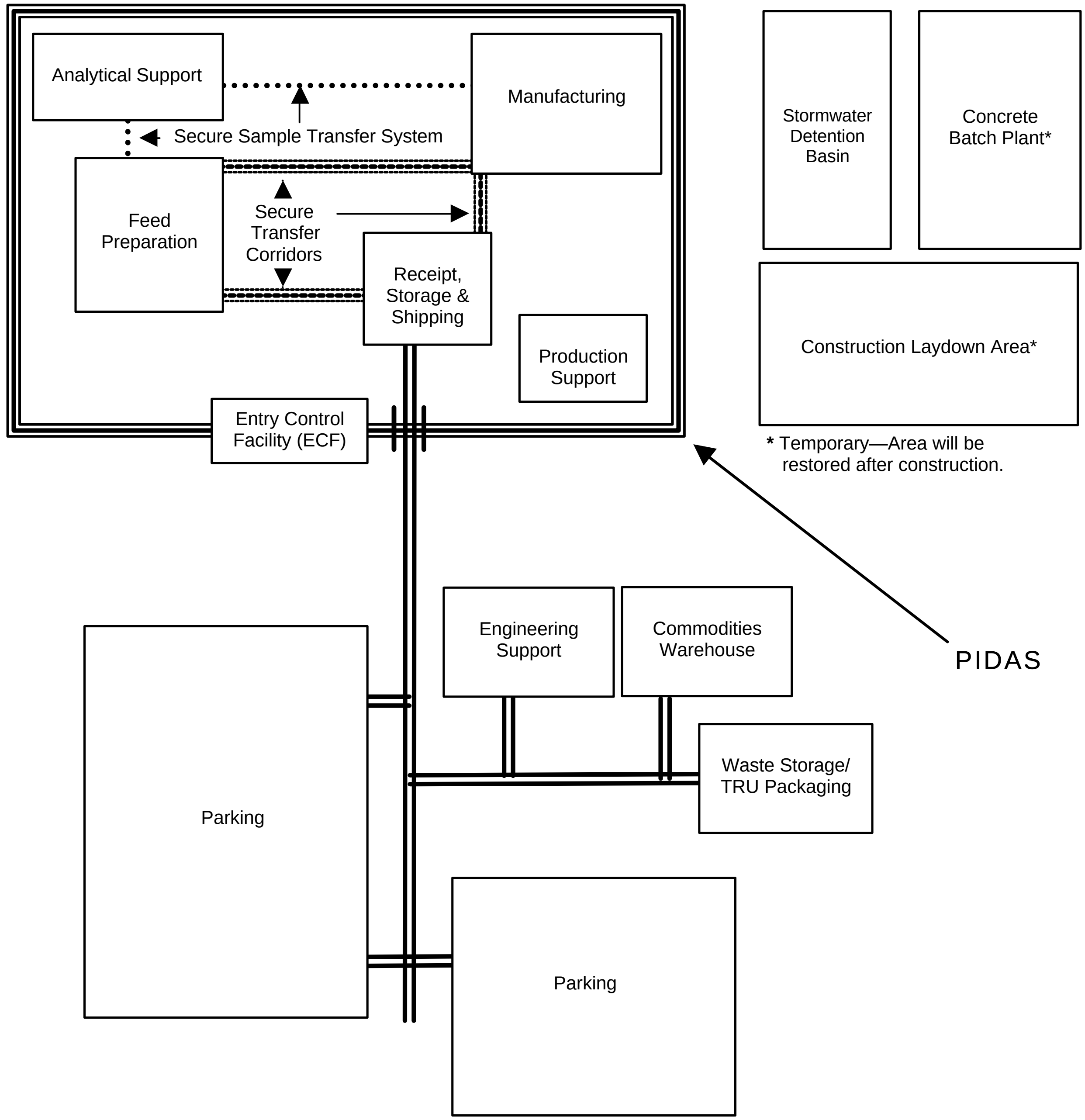
The major structures located outside the PIDAS would include the Engineering Support Building, the Commodities Warehouse, and the Waste Staging/TRU Packaging Building. This Waste Staging/TRU Packaging Building would be used for characterizing and certifying the TRU waste prior to packing and short-term lag storage prior to shipment to the TRU waste disposal site. Parking areas and stormwater detention basins would also be located outside the PIDAS. In addition, a temporary Concrete Batch Plant and Construction Laydown Area would be required during construction.

A generic layout showing the major structures and their relationship to each other is shown in Figure A.3.4–1. Table A.3.4–1 shows the dimensions involved with each of the plant capacities.

Table A.3.4–1. Dimensions for the Three Different MPF Capacities

	125 ppy	250 ppy	450 ppy
Processing Facilities Footprint (m^2)	28,600	32,800	44,900
Support Facilities Footprint (m^2)	26,000	26,200	29,900
Total Facilities Footprint (m^2)	54,600	59,000	74,800
Total Facilities Footprint (ha)	5.46	5.90	7.48
Area inside PIDAS (ha)	25.5	26.3	31.6
Area Developed During Construction (ha)	56.3	58.3	69.2
Post Construction Developed Area (ha)	44.5	46.5	55.8

Source: MPF Data 2003.



Source: Modified from MPF Data 2003.

Figure A.3.4–1. Generic Layout of the Modern Pit Facility

APPENDIX B
HUMAN HEALTH EFFECTS FROM NORMAL OPERATIONS

B.1 INTRODUCTION

This appendix provides a brief general discussion on radiation and its health effects. It also describes the methods and assumptions used for estimating the potential impacts and risks to individuals and the general public from exposure to releases of radioactivity during normal MPF operations.

B.2 RADIOLOGICAL IMPACTS ON HUMAN HEALTH

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this Environmental Impact Statement (EIS) places emphasis on the consequences of exposure to radiation, provides the reader with information on the nature of radiation, and explains the basic concepts used in the evaluation of radiation health effects.

B.2.1 Nature of Radiation and Its Effects on Humans

What Is Radiation?

Radiation is energy transferred in the form of particles or waves. Globally, human beings are exposed constantly to radiation from space and the Earth's rocks and soil. This radiation contributes to the natural background radiation that always surrounds us. Man-made sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

All matter in the universe is composed of atoms. Radiation comes from the activity of tiny particles within an atom. An atom consists of a positively charged nucleus (central part of an atom) with a number of negatively charged electron particles in various orbits around the nucleus. There are two types of particles in the nucleus: neutrons that are electrically neutral and protons that are positively charged. Atoms of different types are known as elements. There are more than 100 natural and man-made elements. An element has equal numbers of electrons and protons. When atoms of an element differ in their number of neutrons, they are called isotopes of that element. All elements have three or more isotopes, some or all of which could be unstable (i.e., decay with time).

Unstable isotopes undergo spontaneous change, known as radioactive disintegration or radioactive decay. The process of continuously undergoing spontaneous disintegration makes the material radioactive. The radioactivity of a material decreases with time. The time it takes a material to lose half of its original radioactivity is its half-life. An isotope's half-life is a measure of its decay rate. For example, an isotope with a half-life of 8 days will lose one-half of its radioactivity in that amount of time. In 8 more days, one-half of the remaining radioactivity will be lost, and so on. Each radioactive element has a characteristic half-life. The half-lives of various radioactive elements may vary from millionths of a second to millions of years.

As unstable isotopes change into more stable forms, they often emit electrically charged particles. These particles may be either an alpha particle (a helium nucleus) or a beta particle (an electron), with various levels of kinetic energy. Sometimes these particles are emitted in conjunction with gamma rays. The alpha and beta particles are frequently referred to as ionizing radiation. Ionizing radiation refers to the fact that the charged particle energy can ionize, or electrically charge, an atom by stripping off one of its electrons. Gamma rays, even though they do not carry an electric charge as they pass through an element, can ionize its atoms by causing it to eject electrons. Thus, they cause ionization indirectly. Ionizing radiation can cause a change in the chemical composition of many things, including living tissue (organs), which can affect the way they function.

When a radioactive isotope of an element emits a particle, it changes to an entirely different element, one that may or may not be radioactive. Eventually a stable element is formed. This transformation, which may take several steps, is known as a decay chain. For example, radium, which is a member of the radioactive decay chain of uranium, has 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 first to polonium, then through a series of further decay steps to bismuth, and ultimately to a stable isotope of lead. Meanwhile, the decay products will build up and eventually die away as time progresses.

The characteristics of various forms of ionizing radiation are briefly described below.

Radiation Type	Typical Travel Distance in Air	Barrier
Alpha (a)	Few centimeters	Sheet of paper or skin’s surface
Beta (ß)	Few meters	Thin sheet of aluminum foil or glass
Gamma (?)	Very large	Thick wall of concrete, lead, or steel
Neutrons (n)	Very large	Water, paraffin, graphite

Alpha (a)—Alpha particles are the heaviest type of ionizing radiation. They can travel only a few centimeters in air. Alpha particles lose their energy almost as soon as they collide with anything. They can be stopped easily by a sheet of paper or by the skin’s surface.

Beta (ß)—Beta particles are much (7,330 times) lighter than alpha particles. They can travel a longer distance than alpha particles in the air. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma (?)—Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma rays travel at the speed of light. Gamma radiation is very penetrating and requires a thick wall of concrete, lead, or steel to stop it.

Neutrons (n)—Neutrons are particles that contribute to radiation exposure both directly and indirectly. The most prolific source of neutrons is a nuclear reactor. Indirect radiation exposure occurs when gamma rays and alpha particles are emitted following neutron capture in matter. A neutron has about one-quarter the weight of an alpha particle. It will travel in the air until it is absorbed in another element.

Units of Radiation Measure

During the early days of radiological experience, there was no precise unit of radiation measure. Therefore, a variety of units were used to measure radiation. These units were used to determine the amount, type, and intensity of radiation. Just as heat can be measured in terms of its intensity or effects using units of calories or degrees, quantities of radioactive material can be measured in units of curies, and its effects can be measured in units of radiation absorbed dose (rad), or dose equivalent (rem). The following summarizes those units.

Curie—The curie is the basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion disintegrations per second, which is approximately the same rate of decay of 1 gram of radium. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second. The unit was named for Marie and Pierre Curie, who discovered radium in 1898.

Rad—The rad is the unit of measurement for the physical absorption of radiation. The total energy absorbed per unit quantity of tissue is referred to as absorbed dose (or simply dose). As sunlight heats pavement by giving up an amount of energy to it, radiation similarly gives up energy to objects in its path. 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.

Radiation Units and Conversions to International System of Units
1 curie = 3.7×10^{10} disintegrations per second
= 3.7×10^{10} becquerels
1 becquerel = 1 disintegration per second
1 rad = 0.01 gray
1 rem= 0.01 sievert
1 gray = 1 joule per kilogram

Rem—A rem is a measurement of the dose equivalent from radiation based on its biological effects. The rem is used in measuring the effects of radiation on the body as degrees centigrade are used in measuring the effects of sunlight heating pavement. Thus, 1 rem of one type of radiation is presumed to have the same biological effects as 1 rem of any other kind of radiation. This allows comparison of the biological effects of radionuclides that emit different types of radiation. One rem is equal to 1,000 millirem (mrem).

In the International System of Units, the unit of radioactivity (source intensity) is becquerel, the unit of absorbed dose is gray, and the unit of dose equivalent (biological effect) is the sievert.

An individual may be exposed to ionizing radiation externally (from a radioactive source outside the body) or internally (from ingesting or inhaling radioactive material). The external dose is different from the internal dose because an external dose is delivered only during the actual time of exposure to the external radiation source, while an internal dose continues to be delivered as long as the radioactive source is in the body. The dose from internal exposure is calculated over 50 years following the initial exposure. Dose delivered by external radiation and by internally deposited radionuclides (internal dose) is presumed to be biologically equivalent. In practice, for long-lived radionuclides, internal doses are delivered slowly over 50 years and the biological harm is likely to be less.

Sources of Radiation

The average American receives a total of approximately 360 millirem per year (mrem/yr) from all sources of radiation, both natural and manmade, of which approximately 300 mrem/yr are from natural sources. The sources of radiation can be divided into six different categories: (1) cosmic radiation, (2) terrestrial radiation, (3) internal radiation, (4) consumer products, (5) medical diagnosis and therapy, and (6) other sources (National Council on Radiation Protection and Measurements [NCRP] 1987). These categories are discussed in the following paragraphs.

Cosmic Radiation—Cosmic radiation is ionizing radiation resulting from energetic charged particles from space continuously hitting the Earth's atmosphere. These particles and the secondary particles and photons they create comprise cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with the altitude above sea level. The average dose to people in the United States from this source is approximately 27 mrem/yr.

External Terrestrial Radiation—External terrestrial radiation is the radiation emitted from the radioactive materials in the Earth's rocks and soils. The average dose from external terrestrial radiation is approximately 28 mrem/yr.

Internal Radiation—Internal radiation results from the human body metabolizing natural radioactive material that has entered the body by inhalation or ingestion. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributor to the annual dose equivalent for internal radioactivity is the short-lived decay products of radon, which contribute approximately 200 mrem/yr. The average dose from other internal radionuclides is approximately 39 mrem/yr.

Consumer Products—Consumer products also contain sources of ionizing radiation. In some products, such as smoke detectors and airport x-ray machines, the radiation source is essential to the product's operation. In other products, such as televisions and tobacco, the radiation occurs as the products function. The average dose from consumer products is approximately 10 mrem/yr.

Medical Diagnosis and Therapy—Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x-rays result in an average exposure of 39 mrem/yr. Nuclear medical procedures result in an average exposure of 14 mrem/yr.

Other Sources—There are a few additional sources of radiation that contribute minor doses to individuals in the United States. The dose from nuclear fuel cycle facilities (e.g., uranium mines, mills, and fuel processing plants) and nuclear power plants has been estimated to be less than 1 mrem/yr. Radioactive fallout from atmospheric atomic bomb tests, emissions from certain mineral extraction facilities, and transportation of radioactive materials contribute less than 1 mrem/yr to the average dose to an individual. Air travel contributes approximately 1 mrem/yr to the average dose.

Exposure Pathways

As stated earlier, an individual may be exposed to ionizing radiation both externally and internally. The different ways that could result in radiation exposure to an individual are called exposure pathways. Each type of exposure is discussed separately in the following paragraphs.

External Exposure—External exposure can result from several different pathways, all having in common the fact that the source of radiation causing the exposure is external to the body. These pathways include exposure to a cloud of radioactive material passing over the receptor (i.e., an individual member of the public), standing on ground that is contaminated with radioactivity, and swimming or boating in contaminated water. If the receptor departs from the source of radiation exposure, the dose rate will be reduced. It is assumed that external exposure occurs uniformly during the year. The appropriate dose measure is called the effective dose equivalent.

Internal Exposure—Internal exposure results from a radiation source entering the human body through either inhalation of contaminated air or ingestion of contaminated food or water. In contrast to external exposure, once a radiation source enters the body, it remains there for a period of time that varies depending on decay and biological half-life. The absorbed dose to each organ of the body is calculated for a period of 50 years following the intake. The calculated absorbed dose is called the committed dose equivalent. Various organs have different susceptibilities to harm from radiation. The quantity that takes these different susceptibilities into account is called the committed effective dose equivalent, and it provides a broad indicator of the risk to the health of an individual from radiation. The committed effective dose equivalent is a weighted sum of the committed dose equivalent in each major organ or tissue. The concept of committed effective dose equivalent applies only to internal pathways.

Radiation Protection Guides

Various organizations have issued radiation protection guides. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below.

International Commission on Radiological Protection (ICRP)—This Commission has the responsibility for providing guidance in matters of radiation safety. The operating policy of this organization is to prepare recommendations to deal with basic principles of radiation protection and to leave to the various national protection committees the responsibility of introducing the detailed technical regulations, recommendations, or codes of practice best suited to the needs of their countries.

National Council on Radiation Protection and Measurements—In the United States, this Council is the national organization that has the responsibility for adapting and providing detailed technical guidelines for implementing the ICRP recommendations. The Council consists of technical experts who are specialists in radiation protection and scientists who are experts in disciplines that form the basis for radiation protection.

National Research Council/National Academy of Sciences—The National Research Council is an organization within the National Academy of Sciences that associates the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the Federal government.

Environmental Protection Agency (EPA)—The EPA has published a series of documents, *Radiation Protection Guidance to Federal Agencies*. This guidance is used as a regulatory benchmark by a number of Federal agencies, including the U.S. Department of Energy (DOE), in the realm of limiting public and occupational work force exposures to the greatest extent possible.

Limits of Radiation Exposure

Limits of exposure to members of the public and radiation workers are derived from ICRP recommendations. The EPA uses the NCRP and the ICRP recommendations and sets specific annual exposure limits (usually less than those specified by the Commission) in *Radiation Protection Guidance to Federal Agencies* documents. Each regulatory organization then establishes its own set of radiation standards. The various exposure limits set by DOE and the EPA for radiation workers and members of the public are given in Table B.2.1–1.

Table B.2.1–1. Exposure Limits for Members of the Public and Radiation Workers

Guidance Criteria (Organization)	Public Exposure Limits at the Site Boundary	Worker Exposure Limits
10 CFR 835 (DOE)	—	5,000 mrem/yr [a]
10 CFR 835.1002 (DOE)	—	1,000 mrem/yr [b]
DOE Order 5400.5 (DOE) [c]	10 mrem/yr (all air pathways) 4 mrem/yr (drinking water pathway) 100 mrem/yr (all pathways)	—
40 CFR 61 (EPA)	10 mrem/yr (all air pathways)	—
40 CFR 141 (EPA)	4 mrem/yr (drinking water pathways)	—

[a] Although this is a limit (or level) which is enforced by DOE, worker doses must still adhere to as low as is reasonably achievable principles. Refer to footnote b.
[b] This is a control level. It was established by DOE to assist in effecting its goal to maintain radiological doses as low as is reasonably achievable. DOE recommends that facilities adopt a more limiting 500 mrem/yr Administrative Control Level (DOE 1999e). Reasonable attempts have to be made by the site to maintain individual worker doses below these levels.
[c] Derived from 40 CFR 61, 40 CFR 141, and 10 CFR 20.

B.2.2 Health Effects

Radiation exposure and its consequences are topics of interest to the general public. To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects.

Radiation can cause a variety of damaging health effects in people. The most significant effects are induced cancer fatalities. These effects are referred to as "latent" cancer fatalities because the cancer may take many years to develop. In the discussions that follow, all fatal cancers are considered latent; therefore, the term "latent" is not used.

The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) has prepared a series of reports to advise the U.S. Government on the health consequences of radiation exposures. *Health Effects of Exposure to Low Levels of Ionizing*

Radiation, BEIR V (NRC 1990), provides the most current estimates for excess mortality from leukemia and other cancers that are expected to result from exposure to ionizing radiation. BEIR V provides estimates that are consistently higher than those in its predecessor, BEIR III. This increase is attributed to several factors, including the use of a linear dose response model for cancers other than leukemia, revised dosimetry for the Japanese atomic bomb survivors, and additional followup studies of the atomic bomb survivors and associated others. BEIR III employs constant, relative, and absolute risk models, with separate coefficients for each of several sex and age-at-exposure groups. BEIR V develops models in which the excess relative risk is expressed as a function of age at exposure, time after exposure, and sex for each of several cancer categories. The BEIR III models were based on the assumption that absolute risks are comparable between the atomic bomb survivors and the U.S. population. BEIR V models were based on the assumption that the relative risks are comparable. For a disease such as lung cancer, where baseline risks in the United States are much larger than those in Japan, the BEIR V approach leads to larger risk estimates than the BEIR III approach.

The models and risk coefficients in BEIR V were derived through analyses of relevant epidemiologic data that included the Japanese atomic bomb survivors, ankylosis spondylitis patients, Canadian and Massachusetts fluoroscopy (breast cancer) patients, New York postpartummastitis (breast cancer) patients, Israeli tinea capitis (thyroid cancer) patients, and Rochester thymus (thyroid cancer) patients. Models for leukemia, respiratory cancer, digestive cancer, and other cancers used only the atomic bomb survivor data, although results of analyses of the ankylosis spondylitis patients were considered. Atomic bomb survivor analyses were based on revised dosimetry, with an assumed relative biological effectiveness of 20 for neutrons, and were restricted to doses less than 400 rads. Estimates of risks of fatal cancers, other than leukemia, were obtained by totaling the estimates for breast cancer, respiratory cancer, digestive cancer, and other cancers.

The NCRP (NCRP 1993), based on the radiation risk estimates provided in BEIR V and the ICRP Publication 60 recommendations (ICRP 1991), has estimated the total detriment resulting from low dose[1] or low dose rate exposure to ionizing radiation to be 5.6×10^{-4} per rem for the working population and 7.3×10^{-4} per rem for the general population. The total detriment includes fatal and nonfatal cancer, which is severe hereditary (genetic) effects. The major contribution to the total detriment is from fatal cancer, which is estimated to be 4×10^{-4} and 5×10^{-4} per rem for radiation workers and the general population, respectively. The breakdowns of the risk estimators for both workers and the general population are given in Table B.2.2–1. Nonfatal cancers and genetic effects are less probable consequences of radiation exposure. To simplify the presentation of the impacts, estimated effects of radiation are calculated only in terms of cancer fatalities. For higher doses to an individual (20 rem or more), as could be associated with postulated accidents, the risk estimators given in Table B.2.2–1 are doubled.

[1]Low dose is defined as the dose level where deoxyribonucleic acid (DNA) repair can occur in a few hours after irradiation induced damage. Currently, a dose level of about 0.2 grays (20 rad), or a dose rate of 0.1 milligrays (0.01 rad) per minute is considered low enough to allow the DNA to repair itself in a short period (EPA 1999a).

The numerical estimates of fatal cancers presented in this EIS were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality that results from a dose of 0.1 gray (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of fatal cancers. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation, and the possibility of no risk cannot be excluded (DOE 1996c).

Table B.2.2–1. Nominal Health Risk Estimators Associated with Exposure to 1 Rem of Ionizing Radiation

Exposed Individual	Fatal Cancer [a, c]	Nonfatal Cancer [b]	Genetic Disorders [b]	Total
Worker	0.0004	0.00008	0.00008	0.0005
Public	0.0005	0.0001	0.00013	0.00073

[a] For fatal cancer, the health effect coefficient is the same as the probability coefficient. When applied to an individual, the units are the lifetime probability of a cancer fatality per rem of radiation dose. When applied to a population of individuals, the units are the excess number of fatal cancers per person-rem of radiation dose.
[b] In determining a means of assessing health effects from radiation exposure, the ICRP has developed a weighting method for nonfatal cancers and genetic effects.
[c] For high individual exposures (greater than or equal to 20 rem), the health factors are multiplied by a factor of 2.
Source: NCRP 1993.

Health Effect Risk Estimators Used in This EIS

Health impacts from radiation exposure, whether from external or internal sources, generally are identified as "somatic" (i.e., affecting the exposed individual) or "genetic" (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects than genetic effects. The somatic risks of most importance are induced cancers. Except for leukemia, which can have an induction period (time between exposure to carcinogen and cancer diagnosis) of as little as 2-7 years, most cancers have an induction period of more than 20 years.

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. Such cancers, however, also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most probable serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities rather than cancer incidence are presented in this EIS. The numbers of fatal cancers can be used to compare the risks among the various alternatives.

Based on the preceding discussion and the values presented in Table B.2.2–1, the number of fatal cancers to the general public during normal operations and for postulated accidents in which individual doses are less than 20 rem are calculated using a health risk estimator of 5×10^{-4} per person-rem. For workers, a risk estimator of 4×10^{-4} excess fatal cancers per person-rem is used. (The risk estimators are lifetime probabilities that an individual would develop a fatal cancer per rem of radiation received.) The lower value for workers reflects the absence of children (who are more radiosensitive than adults) in the workforce. The risk estimators associated with nonfatal cancer and genetic disorders among the public are 20 and 26 percent, respectively, of the fatal cancer risk estimator. For workers, these health risk estimators are both 20 percent of the fatal cancer risk estimator. The nonfatal cancer and genetic disorder risk estimators are not used in this EIS.

For individual doses of 20 rem or more, as could be associated with postulated accidents, the risk estimators used to calculate health effects to the general public and to workers are double those given in the previous paragraph, which are associated with doses of less than 20 rem.

The fatal cancer estimators are used to calculate the statistical expectation of the effects of exposing a population to radiation. For example, if 100,000 people were each exposed to one-time radiation dose of 100 mrem (0.1 rem), the collective dose would be 10,000 person-rem. The exposed population would then be expected to experience five additional cancer fatalities from the radiation (10,000 person-rem $\times$ 5 $\times$ 10^{-4} lifetime probability of cancer fatalities per person-rem = 5 cancer fatalities).

Calculations of the number of excess fatal cancers associated with radiation exposure do not always yield whole numbers. These calculations may yield numbers less than 1, especially in environmental impact applications. For example, if a population of 100,000 were exposed to a total dose of only 0.001 rem per person, the collective dose would be 100 person-rem, and the corresponding estimated number of cancer fatalities would be 0.05 (100,000 persons $\times$ 0.001 rem $\times$ 5 $\times$ 10^{-4} cancer fatalities per person-rem = 0.05 cancer fatalities). The 0.05 means that there is one chance in 20 that the exposed population would experience one fatal cancer. In other words, the 0.05 cancer fatalities is the *expected* 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 fatal cancer from the 0.001 rem dose each member would have received. In a small fraction of the groups, one cancer fatality would result; in exceptionally few groups, two or more cancer fatalities would occur. The *average* expected number of deaths over all the groups would be 0.05 cancer fatalities (just as the average of 0, 0, 0, and 1 is 1/4, or 0.25). The most likely outcome is 0 cancer fatalities.

The same concept is applied to estimate the effects of radiation exposure on an individual member of the public. Consider the effects of an individual's exposure to a 360 mrem (0.36 rem) annual dose from all radiation sources. The probability that the individual will develop a fatal cancer from continuous exposure to this radiation over an average life of 72 years (presumed) is 0.013 (1 person $\times$ 0.36 rem per year $\times$ 72 years $\times$ 5 $\times$ 10^{-4} cancer fatality risk per person rem = 0.013). This correlates to one chance in 77 that the individual would develop a fatal cancer.

B.3 HEALTH EFFECTS STUDIES: EPIDEMIOLOGY

Various epidemiologic studies have been conducted at some of the sites evaluated in this EIS because of the concern for potential adverse health effects associated with the manufacture and testing of nuclear weapons. These studies focus on the DOE workforce and residents of communities surrounding DOE sites.

B.3.1 Background

The health effects associated with ionizing radiation exposure were first published about 60 years ago. Studies published in the 1930s first documented cancer among painters who used radium to paint watch dials back in 1910 to 1920. Radiation therapy for disease has been used since the 1930s and studies have shown that the risk of cancer was related to the amounts of radiation received. Nuclear weapons research and manufacture, and consequent exposure to radiation occurred beginning in the late 1930s. Exposure to radionuclides has changed over time with higher levels occurring in the early days of research and production. Numerous epidemiologic studies have been conducted among workers who manufactured and tested nuclear weapons due to the concern with potential adverse health effects. More recently, concerns about radiologic contaminants offsite have resulted in health studies among communities that surround DOE facilities. The following section briefly gives an overview of epidemiology followed by a review of epidemiologic studies of sites evaluated in this Programmatic Environmental Impact Statement (PEIS).

Epidemiology is the study of the distribution and determinants of disease in human populations. The distribution of disease is considered in relation to time, place, and person. Relevant population characteristics should include the age, race, and sex distribution of a population, as well as other characteristics related to health, such as social characteristics (e.g., income and education), occupation, susceptibility to disease, and exposure to specific agents. Determinants of disease include the causes of disease, as well as factors that influence the risk of disease.

B.3.1.1 Study Designs

Ecologic Studies

Ecologic studies compare the frequency of a disease in groups of people in conjunction with simple descriptive studies of geographical information in an attempt to determine how health events among populations vary with levels of exposure. These groups may be identified as the residents of a neighborhood, a city, or a county where demographic information and disease or mortality data are available. Exposure to specific agents may be defined in terms of residential location or proximity to a particular area, such as distance from a waste disposal site. An example of an ecologic study is a comparison of the rate of heart disease among community residents by drinking water quality.

The major disadvantage of ecologic 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. Ecologic studies do not take into account other factors such as age and race that may also be related to disease. These types of studies may lead to incorrect conclusions, an “ecologic fallacy.” For the above example, it would be incorrect to assume that the level of water hardness influences the risk of getting heart disease. Despite the obvious problems with ecologic studies, they can be a useful first step in identifying possible associations between the risk of disease and environmental exposures. However, because of their potential for bias they should never be considered more than an initial step in investigation of disease causation.

Cohort Studies

The cohort study design is a type of epidemiologic study frequently used to examine occupational exposures within a defined workforce. A cohort study requires a defined population that can be classified as being exposed or not exposed to an agent of interest, such as radiation or chemicals that influence the probability of occurrence of a given disease. Characterization of the exposure may be qualitative (e.g., high, low, or no exposure) or very quantitative (e.g., radiation measured in Sv, chemicals in parts per million [ppm]). Surrogates for exposure, such as job titles, are frequently used in the absence of quantitative exposure data.

Individuals enumerated in the study population are tracked for a period of time and fatalities recorded. In general, overall rates of death and cause-specific rates of death have been assessed for workers at the EIS sites. Death rates for the exposed worker population are compared with death rates of workers who did not have the exposure (internal comparison), or compared with expected death rates based on the U.S. population or state death rates (external comparison). If the rates of death differ from what is expected, an association is said to exist between the disease and exposure. In cohorts where the exposure has not been characterized, excess mortality can be identified, but these deaths cannot be attributed to a specific exposure, and additional studies may be warranted. More recent studies have looked at other disease endpoints, such as overall and cause-specific cancer incidence (newly diagnosed) rates.

Most cohort studies at EIS sites have been historical cohort studies, that is, the exposure occurred some time in the distant past. These studies rely on past records to document exposure. This type of study can be problematic if exposure records are incomplete or were destroyed. Cohort studies require extremely large populations that have been followed for many (20-30) years. They are generally difficult to conduct and are very expensive. These studies are not well suited to studying diseases that are rare. Cohort studies do, however, provide a direct estimate of the risk of death from a specific disease, and allow an investigator to look at many disease endpoints.

Case-Control Studies

The case-control study design starts with the identification of persons with the disease of interest (case) and a suitable comparison (control) population of persons without the disease. Controls must be persons who are at risk for the disease and are representative of the population that generated the cases. The selection of an appropriate control group is often quite problematic. Cases and controls are then compared with respect to the proportion of individuals exposed to the agent of interest. Case-control studies require fewer persons than cohort studies, and therefore, are usually less costly and less time consuming, but are limited to the study of one disease (or cause of death). These types of studies are well suited for the study of rare diseases and are generally used to examine the relationship between a specific disease and exposure.

B.3.1.2 Definitions

Terms used in epidemiologic studies, including those used in this document, are defined below.

Age, gender, and cigarette smoking are the principal determinants of mortality. *Standardization* is a statistical method used as a control for the effects of age, gender, or other characteristics so that death rates may be compared among different population groups. There are two ways to standardize rates, the indirect or direct methods. In general, the indirect method of standardization is most frequently used.

Indirect Standardization—The disease rates in the reference (comparison) population are multiplied by the number of individuals in the same age and gender groups in the study population to obtain the expected rate of disease for the study population.

Direct Standardization—The disease rates in the study population are multiplied by the number of individuals in the same age and gender group in the reference (comparison) population. This gives the expected rates of disease for the reference population if these rates had prevailed in that group.

Standardized Mortality Ratio—The standardized mortality rate (SMR) is the ratio of the number of deaths observed in the study population to the number of expected deaths. The expected number of deaths is based on a reference (or comparison population). Death rates for the U.S. (or state) population are most frequently used as the comparison to obtain expected rates. An SMR of 1 indicates a similar risk of disease in the study population compared with the reference population. An SMR greater than 1 indicates excess risk of disease in the study population compared with the reference group, and an SMR less than 1 indicates a deficit of disease.

Relative Risk—The ratio of the risk of disease among the exposed population to the risk of disease in the non-exposed population. Relative risks are estimated from cohort studies.

Odds Ratio—The ratio of the odds of disease if exposed, to the odds of disease if not exposed. Under certain conditions, the odds ratio approximates the relative risk. Odds ratios are estimated from case-control studies.

B.3.2 Los Alamos Site

Los Alamos and adjacent counties comprise a unique setting and history. Los Alamos Site, for much of its existence, was a closed community where most of the residents had direct economic ties to the laboratory. Nearly all male residents and some of the female residents are employed at Los Alamos National Laboratory (LANL). Medical care in Los Alamos County had been centralized at the laboratory and a single community hospital. This is a unique, highly educated community situated adjacent to lands populated by Native Americans.

Surrounding Communities

Selected cancer mortality and incidence (newly diagnosed cancer) rates between 1950 and 1969, for 11 selected cancers among white males in Los Alamos County were compared with rates for the State of New Mexico, U.S. rates, and with rates of 5 socioeconomic and occupational control counties and 5 high-education western counties, based on U.S. Bureau of the Census information (ER 1981). The comparisons were made to identify cancer types that were greater than expected while taking into account important factors, such as income and education, associated with cancer patterns. Six cancer types were identified that had rates greater than cancer rates for one or more of the four comparison groups; they are: cancer of the bile ducts and liver, bladder, prostate, brain and nervous system, lympho- and reticulo-sarcoma, and leukemia. Cancer rates of the prostate, bladder, and leukemia were also greater than expected.

Compared with New Mexico white males, Los Alamos County Anglo-white males show nonstatistically significant excesses in cancer incidence from 1969-1974 for the stomach, colon, rectum, pancreas, lung, and bladder (ER 1981). All cancers combined show a 35-percent statistically significant excess. Los Alamos County white females show nonstatistically significant excesses for cancer of the stomach, large intestine, lymphosarcoma and reticulasarcoma, and leukemia. All cancers combined show a statistically significant 40-percent excess.

In 1991, the New Mexico Department of Health initiated epidemiologic studies in response to citizen concerns about an apparent excess of brain tumors among residents of the western area neighborhood of Los Alamos County as a result of historical LANL nuclear operations. The New Mexico Department of Health conducted a descriptive study of brain cancer incidence in Los Alamos County and for 22 other sites (NM DOH 1993). The study showed that during the mid- to late-1980s an excess of approximately 80 percent of brain cancer had occurred in Los Alamos County compared with a New Mexico reference population and national statistics. The excess incidence had disproportionately occurred among persons who were residents of the western area at the time of diagnosis or death; however, there were only three cases, and they were confined to the 2-year time period, 1986-1987. Additional descriptive studies showed that the brain cancer rates for Los Alamos County were within the range of rates observed across New Mexico counties from 1983-1987 and 1988-1991. A review of mortality statistics for benign or unspecified neoplasms of the brain and nervous system showed no deaths from these causes in western area residents during 1984-1990.

Los Alamos County breast cancer incidence rates remained level, but higher than New Mexico rates from 1970-1990. Reproductive and demographic factors associated with the risk of breast cancer were thought to account for the higher rates. A special study was conducted to examine the recent increase in breast cancer since 1988 (DOE 1996c). The New Mexico Tumor Registry concluded that the increase seen between 1988 and 1992 was primarily due to increased detection of early stage disease.

The incidence of ovarian cancer in Los Alamos County women was elevated from the mid-1970s to 1990. From 1986-1990, ovarian cancer incidence in Los Alamos County was roughly twofold higher compared with New Mexico reference population rates. The excess ovarian cancer rate was confined to a census tract corresponding to two neighborhoods and was four- to sixfold higher than that observed in the remaining Los Alamos County census tracts.

The incidence rates for melanoma (cancer of the skin) in Los Alamos County were elevated from 1970-1990, with peak elevations occurring from the mid- to late-1980s. There was approximately a twofold excess risk compared with a New Mexico state reference population. The excess melanoma incidence observed in Los Alamos County was thought to be related to the high ambient solar ultraviolet radiation intensity due to its high altitude.

A fourfold increase in thyroid cancer incidence during the late-1980s was noted in a study by Athas (NM DOH 1996). A case-series records review was initiated to examine data relating to the detection, diagnosis, and known risk factors for thyroid cancer. All cases of thyroid cancer diagnosed among Los Alamos County residents between 1970 and 1995 were identified through the New Mexico Tumor Registry. The incidence rate for thyroid cancer in Los Alamos County was slightly higher than New Mexico rates between 1970 and the mid-1980s. There was a statistically significant fourfold increase during the late-1980s and early 1990s compared with the state, but the rate began to decline in 1994 and 1995.

The higher-than-expected number of thyroid cancer cases could not be explained by changes in diagnosis of thyroid cancer among Los Alamos County residents. Additional analyses suggested that increased medical surveillance and greater access to medical care were responsible for the recent excess in Los Alamos County.

Potential risk factors for thyroid cancer including therapeutic irradiation, genetic susceptibility, occupational radiation exposure, and weight were also examined. However, the investigation did not identify a specific cause for the elevated rate of thyroid cancer in Los Alamos County.

Male Workers

A mortality study of 224 white males with the highest internal depositions of plutonium-239 (10 nanocuries [nCi] or more) at Los Alamos Site were examined by Voelz et al. (DOE 1996c). Followup was through April 1980. SMRs were low for all cause of death (SMR: 0.56, 95 percent; Confidence Interval [CI]: 0.40-0.75), all malignant neoplasms (SMR: 0.54, 95 percent; CI: 0.23-1.06), compared with U.S. white males and lung cancer (SMR: 20, 95 percent; CI: 0-110).

A cohort mortality study by Wiggs et al. examined the causes of death among 15,727 white males hired at LANL between 1943 and 1977 (HP 1994). The purpose of the study was to determine if plutonium deposition and external ionizing radiation were related to worker mortality. After nearly 30 years of followup, the LANL workforce experienced 37 percent fewer deaths from all causes, and 36 percent fewer deaths due to cancer than expected when compared with death rates for the U.S. population.

The researchers identified a subset of 3,775 workers who had been monitored for plutonium exposure; of these, 303 workers were categorized as “exposed” based on a urine bioassay for plutonium; the remainder were non-exposed. One case of rare bone cancer, osteogenic sarcoma, a type of cancer related to plutonium exposure in animal studies, was noted among the plutonium exposed group. The overall mortality and site-specific rates of cancer did not differ significantly between the two groups of workers. A nonstatistically significant increase in lung cancer among the exposed group was noted, but there was no information on cigarette use among the workers.

When researchers examined data for the 10,182 workers who were monitored for exposure to external ionizing radiation (including 245 workers exposed to plutonium) they observed a dose-response relationship for cancers of the brain/central nervous system, cancer of the esophagus, and Hodgkin's disease. When the 225 plutonium-exposed workers were excluded from the analysis, there was a statistically significant dose response between external ionizing radiation and kidney cancer and lymphocytic leukemia.

A special lifetime medical study was conducted on 26 of the workers who have the largest internal depositions of plutonium at LANL. Voelz and Lawrence reported on the 42-year followup of the 26 white males who designed and built the first atomic bomb and were determined to have had a significant deposition of plutonium-239 sometime in 1944 or 1945 based on job assignment, working conditions, and urine levels of plutonium (HP 1991). Their mortality experience was compared to U.S. white males adjusted for age and calendar time. The mortality rates were also compared with rates for a cohort of LANL workers hired at the same time and born between the same years; no significant differences were for all cause mortality and all cancer mortality. One of the seven reported deaths was due to bone sarcoma, the most frequent radiation-induced cancer observed in persons with radium depositions.

Wiggs reported on 6,970 women employed at LANL for at least 6 months from 1943-1979, with deaths determined through 1981 (DOE 1996c). The mortality rates for all causes of death combined and all cancers combined were 24 and 22 percent below the rate for the U.S. population, respectively. Although the overall rates are low, women occupationally exposed to ionizing radiation have elevated rates for cancer of the ovary and of the pancreas relative to those not exposed. An unusual finding was that female radiation workers experienced a statistically significant excess of death from suicide. In a special in-depth study, the suicides were compared to two control groups, deaths from other injuries, and deaths from non-injuries. History of employment as a radiation worker was significantly associated with death from suicide for both comparison groups. No significant associations for duration of employment, plutonium exposure, or martial status were seen (DOE 1996c).

As result of a reported threefold excess of malignant melanoma among laboratory workers at Lawrence Livermore National Laboratory (LLNL) in California and similarities between occupational exposures and prevailing sunshine conditions at LANL and LLNL, an investigation was undertaken to assess the risk of melanoma at LANL (Lancet 1981). Incidence data were obtained from the New Mexico Tumor Registry. No excess risk for melanoma was detected at LANL among 11,308 laboratory workers between 1969 and 1978. Six cases were identified where about 5.7 were expected (Lancet 1982). The rate for the total cohort, Hispanic males and females, non-Hispanic males and females were not significantly different from the corresponding New Mexico rates.

A special in-depth study of 15 cases diagnosed through 1982 did not detect an association between melanoma and exposure to any type of external radiation as measured by film badges, neutron exposures, plutonium body burden based on urine samples, or employment as a chemist or physicist (HP 1983). However, the workers with melanoma were more educated than the comparison group using the college and graduate degree as a measure of education, a finding consistent with other reports of malignant melanoma according to the authors. The numbers in this study are too small to detect any but large excesses.

Memorandum of Understanding

DOE entered into a Memorandum of Understanding with the Department of Health and Human Services to conduct health studies at DOE sites. The National Institute for Occupational Safety and Health is responsible for managing or conducting the worker studies. The following multi-site studies that include LANL are currently underway: a study of mortality among female nuclear weapons workers, a case-control study of multiple myeloma, a leukemia study, and an exposure assessment of hazardous waste/cleanup workers.

B.3.3 Nevada Test Site

Surrounding Communities

Aboveground testing of nuclear weapons at Nevada Test Site (NTS) Test Range Complex in southern Nevada between 1951 and 1963 resulted in the dissemination of radioactive fallout over southeastern Nevada and southwestern Utah through wind dispersion. Several epidemiologic studies have been conducted to investigate possible adverse health effects of low-level radioactive fallout on residents of these states. These studies focused on leukemia and thyroid disease in children downwind of NTS.

A series of ecologic studies showed equivocal results in potentially exposed children. A cross-sectional review of thyroid nodularity among teenage children reported by Weiss et al. found no significant difference in the frequency of nodules among potentially exposed and non-exposed children (DOE 1996c). Exposure was defined in terms of county of residence. Rallison et al. reported no significant difference in any type of thyroid disease between Utah children exposed to fallout radiation in the 1950s and control groups drawn from Utah and Arizona (AJM 1974; JAMA 1975).

To investigate the possible relationship between childhood leukemia and radioactive fallout, Lyon et al. conducted a mortality study of Utah children under 15 years old who died in Utah between 1944 and 1975 (NEJM 1979). Lyon et al. selected this age group because of the reported increased susceptibility of children to the neoplastic effects of radiation and the lack of a comparison group over 14 years of age with suitable low exposures. Lyon et al. obtained death certificates from the Utah vital statistics registrar and based on year of death, categorized decedents into either high (fallout years) or low exposure periods (combined pre-fallout years and post-fallout years). From estimated fallout patterns contained in maps of 26 tests, Lyon et al. categorized 17 southern rural counties as high fallout area and the remaining northern urban counties as low fallout area. Age-specific mortality rates derived for deaths which occurred in the combined low exposure periods were compared with those in the high exposure period. For reasons unknown, leukemia mortality during the low exposure periods in high fallout counties was half that of the United States and Utah. A significant excess of leukemia occurred among children statewide who died during the high fallout period compared to those who died during the low fallout periods (SMR: 1.40, 95 percent; CI: 1.08-1.82, $p<0.01$). This excess was more pronounced among those who resided in the high fallout area (SMR: 2.44, 95 percent; CI: 1.18-5.03). No pattern was found for other childhood cancers in relation to fallout exposure. Actual radiation dosage was not available, and the effects of migration were not determined for this study.

Beck and Krey (Science 1983) reconstructed exposure of Utah residents studied by Lyon et al. (NEJM 1979) to external gamma-radiation from NTS fallout through measurements of residual cesium-137 and plutonium in soil. Beck and Krey found that residents in southwest Utah closest to NTS received the highest exposures, but noted that residents of urban northern areas received a higher mean dose and a significantly greater population dose than did residents of most counties closer to the test site. Northern Utah residents received higher average bone doses than southern Utah residents; therefore, distance from NTS should not be the sole criteria for dividing the state into geographic subgroups for the purpose of conducting epidemiologic studies. Beck and Krey concluded that bone doses to southern Utah residents were too low to account for the excess leukemia deaths identified by Lyon et al. They also determined that bone and whole body doses from NTS fallout were small relative to lifetime doses most Utah residents receive from background radiation, and that it was unlikely that these exposures would have resulted in any observed health effects.

Land et al. (Science 1984) attempted to confirm the association between leukemia and fallout reported by Lyon et al. (NEJM 1979) using cancer mortality data from the National Center for Health Statistics for the period 1950 through 1978. No statistically significant differences in mortality from leukemia or other childhood malignancies between northern and southern Utah were observed. The small observed difference in leukemia mortality between the border and interior counties was opposite in direction to that reported by Lyon et al. Results indicated a downward trend in childhood leukemia mortality over time. Eastern Oregon and the State of Iowa also were selected for comparison with Utah. The leukemia mortality rate for eastern Oregon was higher, and Iowa lower than the rate for Utah. Although both were not statistically significant, Land et al. concluded that these results suggest that the association reported by Lyon et al. merely reflects an unexplained low leukemia rate in southern Utah for the period 1944-1949.

Another study that assessed the development of cancer among individuals potentially exposed to radioactive fallout has been reported by Rallison et al. (HP 1990). This study examined the thyroid neoplasia risk in a cohort of children born between 1947-1954 in two counties near nuclear test sites, one in Utah and one in Nevada. A comparison group of Arizona children presumed to have no fallout exposures was also evaluated. The children (11-18 years of age) were examined between 1965-1968 for thyroid abnormalities and were re-examined in 1985 and 1986. Children living in the nuclear testing (Utah/Nevada) area had a higher rate of thyroid neoplasia than the comparison children (in Arizona), but the differences were not statistically significant. The authors concluded that living near NTS in the 1950s has not resulted in a statistically significant increase in thyroid neoplasms.

A study by Johnson examined cancer incidence in a cohort of Mormon families in southwest Utah near the NTS (JAMA 1984b). The study compared cancer incidence among all Utah Mormons during the period 1967-1975 with cancer incidence among two exposed populations: persons residing in a high fallout area and an exposure effects group residing in a broader area that received less intense exposure from radioactive fallout. Limitations of the study include: the inability to locate 40 percent of the defined population, the lack of verifying the reported diagnosis of cancer, and the inability to interview a comparable control group.

Cancer incidence for both exposed groups was compared with that of all Utah Mormons for two timeframes, 1958-1966 and 1972-1980. Johnson found an apparent increased incidence of leukemia and cancers of the thyroid and bone for residents of the high fallout area for both time periods. Additional analyses suggested that a higher proportion of the cancers among exposed groups were in radiosensitive tissues and the proportional excess increased with time compared with all Utah Mormons. The ratio of radiosensitive cancers to all other cancers from 1958-1966 was 24 percent higher among the high fallout area group and 29.6 percent higher among those in the fallout effects group. For 1972-80, the ratio was 53.3 percent higher in the high fallout area group and 300 percent higher in the fallout effects group.

Machado examined cancer mortality rates of a three-county region in southwestern Utah in comparison to the remainder of Utah (AJE 1987). There was no excess risk of cancer mortality in southwest Utah, with the exception of leukemia, which showed a statistically significant excess for all ages combined, and for children age 0-14. In fact, mortality from all cancer sites combined was lower in southwest Utah than the remainder of the state. The authors noted that their findings, including those for leukemia, were inconsistent with the cancer incidence study conducted by Johnson (JAMA 1984b).

Archer measured soil, milk, and bone strontium-90 levels to identify states with high-, intermediate-, and low-fallout contamination (AEH 1987). He then correlated the deaths from radiogenic and nonradiogenic leukemias with the time periods of aboveground nuclear testing both in the United States and Asia. The results show that leukemia deaths in children were higher in states with high exposure and lower in states with less exposure. He showed that leukemia deaths in children peaked approximately 5.5 years following nuclear testing peaks. The last leukemia peak in the United States occurred from 1968-1969, 5½ years after the last year of a 3-year period of intensive testing in Asia. The increases were seen in the radiogenic leukemias (myeloid and acute leukemias), and not with all other leukemias.

Kerber et al. updated a previously identified cohort of children living in portions of Utah, Nevada, and Arizona to estimate individual radiation doses and determine thyroid disease status through 1985-1986 (JAMA 1993). Of the 4,818 children originally examined between 1965-70, 2,473 were included in the followup exam. Outcomes of interest included thyroid cancers, neoplasms, and nodules based on physical examinations of the thyroid. Exposure of the thyroid to radioiodines was based on radionuclide deposition rates provided by DOE and surveys of milk producers. Children with questionable findings were referred to a panel of endocrinologists for further examination. The authors reported an excess number of thyroid neoplasms (combined benign and malignant) and a positive dose-response trend for neoplasms, both of which were statistically significant. The authors also reported a positive dose-response trend for thyroid nodules, not statistically significant, and a positive dose-response trend for thyroid carcinomas with marginal statistical significance. The authors estimated that an excess of between 1-12 neoplasms (between 0-6 excess malignancies) was probably caused by exposure to radioiodines from the nuclear weapons testing. A letter to the editor criticized Kerber et al. for relying on food histories obtained 22 years after the fact to depict radioiodine intake, and for the untested modeling approach for determining dose to the thyroid (JAMA 1994a). These concerns were addressed by Kerber et al., which acknowledged the uncertainties in the dose estimates, but concluded that their estimates were conservative (JAMA 1994b).

Till et al. estimated doses to the thyroid of 3,545 subjects who were exposed to radioiodine fallout from NTS (HP 1995). The U.S. Public Health Service first examined this cohort for thyroid disease between 1965-1970 and later in 1985-1986. Till et al. assigned individual doses based on age, residence histories, dietary histories, and lifestyle. Individualized dose and uncertainty was combined with the results of clinical examinations to determine the relationship between dose from NTS fallout and thyroid disease incidence.

Workers

Military personnel and civilian employees of the Department of Defense observed and participated in maneuvers at the NTS during atmospheric tests. An excess number of leukemia cases was reported (9 cases, 3.5 expected) among the 3,224 men who participated in military maneuvers in August 1957 at the time of the nuclear test explosion "Smoky" (JAMA 1980). The participants were located and queried on their health status, diseases, or hospitalizations as of December 1981. Various Federal records systems were linked, including clinical files, and next of kin were queried about cause of death for those participants who were deceased. Exposure information was available from film badges records, and the mean gamma dose for the entire cohort was 466.2 mrem. In a later report of the same cohort, the number of incident cases of leukemia had increased to 10 with 4 expected (JAMA 1983). No excess in "total cancers" was observed; however, four cases of polycythemia vera were reported where 0.2 were expected (JAMA 1984a). The excess in leukemia cancer incidence and mortality appear to be limited to the soldiers who participated in "Smoky."

The leukemia excess was not observed in a National Research Council mortality study of soldiers exposed to five series of tests at two sites: Nevada Test Site and the Pacific Proving Ground (DOE 1996c). The National Research Council reported that the number of leukemia cases in "Smoky" was greater, but the increase was considered nonsignificant when analyzed with the data from the other four tests. In 1989, however, it was discovered that the roster of the atomic veterans cohort on which the National Research Council based its 1985 study contained misclassification errors. As a result, this study was reanalyzed. In 1997, the Secretary of the Department of Health and Human Services (DHHS) asked the Institute of Medicine (IOM) and the National Research Council to undertake an independent assessment of the public health and medical implications of the estimated iodine-131 doses received by the American people from atmospheric testing and to advise the Department on steps that might be taken in response. Two committees were appointed to perform the assessment. Their results were published in 1999 in *Exposure of the American People to Iodine-131 from Nevada Nuclear-Bomb Tests: Review of the National Cancer Institute Report and Public Health Implications* (NAP 1999). The report's conclusions include:

- The estimate of the American people's collective dose from iodine-131 is consistent with the committee's analysis and is unlikely to greatly over- or understate the actual levels.

- The levels of detail presented in the report, specifically, county-specific estimates of iodine-131 thyroid doses, are probably too uncertain to be used in estimating individual exposure. For the most part, direct measures of fallout for any particular weapons test were made for only about 100 places nationwide (except near NTS itself). Estimates of county-specific exposures may also have little relevance to specific individuals for whom exposure depends on such critical factors as varying individual consumption of milk and other foods and variations in the source of those foods.

- Individual-specific estimates of past exposure to iodine-131 from the Nevada tests are possible but uncertain, often highly so, because critical data are often not available or of questionable reliability. A small minority of the population—those who were young children at the time of testing and who routinely drank milk from backyard cows or, especially, goats—had a significant exposure to iodine-131.

- Exposure to iodine-131 as a byproduct of nuclear reactions can cause thyroid cancer as shown conclusively by the 1986 nuclear accident in Chernobyl, which resulted in high level exposure for many people. The NCI dose reconstruction model indicates that the level of exposure to iodine-131 was sufficient to cause and continue to cause excess cases of thyroid cancer. Because of uncertainty about the doses and the estimates of cancer risk, the number of excess cases of thyroid cancer is impossible to predict except within a wide range.

- Epidemiological analyses of past thyroid cancer incidence and mortality rates provide little evidence of widespread increases in thyroid cancer risk related to the pattern of exposure to iodine-131 described in the NCI report. They suggest that any increase in the number of thyroid cancer cases is likely to be in the lower part of the ranges estimated by NCI. The epidemiologic analyses are, however, subject to many limitations and uncertainties.

- Given the uncertainties in both the dose reconstruction model and the epidemiological analyses, further epidemiologic studies will be necessary to clarify the extent to which Nevada tests increased the incidence of thyroid cancer. Pending these studies, it is prudent for DHHS to plan its responses as if excess cases of thyroid cancer have occurred.

- The type of thyroid cancer, papillary carcinoma, usually linked to radiation exposure is uncommon and rarely life threatening. Even among those with exposure to iodine-131, few will develop thyroid problems.

As a result of this assessment, the committee suggested that DHHS consider additional research in several areas. These areas include (1) the relative effectiveness of external radiation versus internal radiation in producing thyroid cancer; (2) the relative malignancy of radiation-related versus spontaneous thyroid neoplasms; (3) the role of genetic events in the development of thyroid cancer, in particular, the role of ret/PTC oncogene as it may affect the nature of the dose-response relationship for thyroid cancer; (4) people's perceptions of the benefits and risks of screening for thyroid and other cancers and the factors affecting such perceptions including the way quantitative information is presented; and (5) the effectiveness of existing programs to communicate radiation risks (NAP 1999).

B.3.4 Pantex Site

Surrounding Communities

A June 1994 study by the Texas Cancer Registry, Texas Department of Health, showed significant increases in prostate cancer mortality among Potter County and Randall County males, and leukemia mortality among Carson County males during the period between 1981-1992 (DOE 1996c). There were no statistically significant increases observed in site-specific cancer mortality among females during this period. For cancer incidence during the period between 1986-1992, no statistically significant excesses in males were seen; however, cancer of the prostate was slightly elevated in Potter/Randall County males. Analysis of the four major cell-specific types of leukemia, showed a significant excess in the incidence of chronic lymphocytic leukemia among Potter/Randall County females. This study was conducted in Carson, Potter, and Randall Counties, which are located near the Pantex Plant (Pantex). This study focused only on cancers of the breast, prostate, brain, thyroid, and leukemia, which were of specific concern to citizens in the area. Other radiation-associated cancers, such as bone and lung, were not included in this study. Although prostate cancer and chronic lymphocytic leukemia have not been linked to radiation exposure, further followup to this study was recommended.

Workers

An epidemiologic study of Pantex workers was published by Acquavella (HP 1985). This study compared total and cause-specific mortality for Pantex workers employed between 1951 and December 31, 1978, with expected cause-specific mortalities based on U.S. death rates. Significantly fewer deaths were observed in the workforce than would be expected based on U.S.

death rates for the following causes of death: all cancers, arteriosclerotic heart disease, and digestive diseases. No specific causes of death occurred significantly more frequently than expected. Slightly elevated mortality ratios were observed for brain cancer and leukemia; neither excess was statistically significant. The four deaths from brain cancer all occurred among those who had worked at the plant less than 5 years. The four deaths from leukemia occurred with equal frequency among those who had worked at the plant a short time and those who had worked more than 15 years.

Memorandum of Understanding

A followup of the 1985 mortality study of the Pantex workforce has been performed. The 1985 study of Pantex workers was limited by the small number of deaths and short followup, although the risk of several cancers was elevated. National Institute of Occupational Safety and Health performed an intramural study that updated vital status through 1995. An SMR analysis with examination of dose-response was conducted; however, it was not possible to update exposure information for the cohort (duration of employment was used as a surrogate for dose). A decision to return to the facility to conduct an updated analysis is pending. To date, study results have not been released pending communication to workers. As an operating facility that has not been downsized, Pantex will encounter similar exposures to both current and future workers.

Epidemiologic Surveillance

DOE's Office of Epidemiologic Studies Epidemiologic Surveillance Program was implemented at Pantex in 1993 in order to monitor the health of current workers. This program evaluates the occurrence of illness and injury in the workforce on a continuing basis and issues the results of the ongoing surveillance in annual reports. The program facilitates an ongoing assessment of the health and safety of the site's workforce and helps to identify any emerging health issues in a timely manner. Monthly data collection began on January 1, 1994, and the results of the first complete year of epidemiologic surveillance were presented to workers and other site stakeholder groups in spring 1996. The most recent annual report available for review if for the 2001 calendar year.

Currently operational at a number of DOE sites, including production sites and research and development laboratories, epidemiologic surveillance makes use of routinely collected health data including descriptions of illness resulting in absences lasting 5 or more consecutive workdays, disabilities, and OSHA-recordable injuries and illnesses abstracted from the OSHA 200 log. These health event data, coupled with demographic data about the active workforce at the participating sites, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at a site. As the program continues and data become available for an extended period of time, trend analysis will become an increasingly important part of the evaluation of worker health. Monitoring for changes in the health of the workforce provides both a baseline determination of the illness and injury experience of workers and a tool for monitoring the effects of changes made to improve the safety and health of workers. Noteworthy changes in the health of the workforce may indicate areas in need of more detailed study or increased health and safety measures to ensure adequate protection for workers.

Epidemiologic surveillance monitors all illnesses and injuries among active workers because it is not always possible to determine which health effects are due to occupational exposures and which are due to other causes. Most illness and injury diagnoses were reported to the occupational medicine clinic by workers who required return-to-work clearances. An absence due to illness or injury may involve more than one diagnosis, and epidemiologic surveillance includes all reported diagnoses. In addition, the OSHA 200 Log provides information on recorded occupational injuries and illnesses whether or not they involve absences. number of days lost. The report organizes illness and injury categories based on a standard reference, the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM). This reference is used to classify health events for statistical purposes.

Cancer rates presented in this report are based on reported absences during the year. A worker may experience several periods of absence from one cancer diagnosis due to medical complications or treatment regimens. The likelihood that an individual in the United States develops cancer increases with age. Pantex data tend to reflect this observation among men. Nine men reported 11 absences due to cancer. Four men reported skin cancer, three reported prostate cancer, and one reported thyroid cancer. One man reported cancer of the pancreas that spread to the liver. Among the seven women reporting cancer, only two were over 50 years old. Thirteen absences for cancer were reported. Four women had only one absence, and three women accounted for nine absences. Six women had cancer of only one type: larynx, thyroid, colon, cervix, breast, and Hodgkin's lymphoma. The other woman had malignant melanoma that spread to the lymph nodes. The women with cancer of the colon and Hodgkin's lymphoma reported these same cancers in previous years. None of the other workers who reported cancer in 2001 had reported it previously.

A sentinel health event for occupation (SHEO) is a disease, disability, or death that is likely to be occupationally related. Its occurrence may serve as a warning signal that materials substitution, engineering control, personal protection, or medical care may be required to reduce the risk of injury or illness among the work force. Sixty-four medical conditions associated with workplace exposures from studies of many different industries have been identified as sentinel health events. Although sentinel health events may indicate an occupational exposure, many may result from non-occupational exposures. Due to this uncertainty, sentinel health events are assessed in two categories:

Definite Sentinel Health Events—Diseases that are unlikely to occur in the absence of an occupational exposure. Asbestosis, a lung disease resulting from exposure to asbestos, is an example.

Possible Sentinel Health Events—Conditions such as lung cancer or carpal tunnel syndrome may or may not be related to occupation. Detailed occupational and nonoccupational information is required to determine the work-relatedness of the illness. For example, lung cancer may result from asbestos exposure or smoking. Carpal tunnel syndrome may result from a job requiring typing or from a hobby such as playing the piano.

Ten definite sentinel health diagnoses were identified among Pantex workers in 2001. Three workers reported five diagnoses of chronic beryllium disease. The five other diagnoses, reported by three workers, were identified as occupational injuries. One worker reported two absences resulting from a torn rotator cuff of the right shoulder. The other two workers each reported one absence for a knee injury and a fractured ankle with nerve damage. The 9 definite SHEO events accounted for 391 calendar days absent from work. Fifteen of 1,544 diagnoses (1 percent) were identified as possible sentinel health events. Ten of the possible sentinel health diagnoses were identified as carpal tunnel syndrome, reported by 8 workers (4 women and 4 men), and resulting in 175 lost calendar days. All these employees were aged 40 and older. Four of the workers were in the Office Management and Administration job category, two were in the Technical Support group, and two were Craft and Repair workers.

During 2001, four deaths occurred among Pantex workers. The two men and one woman were over 50 years old. The other woman was 40-49 years old. Each of the workers was in a different job category. The deaths were due to cancers of the colon and pancreas, respiratory failure, and a motor vehicle accident (Pantex 2001a).

Additionally, female workers at Pantex were included in a National Institute for Occupational Safety and Health funded multisite study of mortality among female nuclear weapons workers. A total of 67,976 women who worked at any of the following 12 Department of Energy sites before January 1, 1980: Oak Ridge (X-10, Y-12, K-25), Los Alamos National Laboratory, the Zia Company, Rocky Flats, Hanford, Mound, Savannah River, Fernald, Pantex, and Linde (closed in 1949).

The study examined the occurrence of deaths among female nuclear weapons workers who worked at any of the 12 sites included in the study. The number of deaths that occurred among these workers was compared with the number of deaths expected to occur based on the mortality experience of the United States female population. The study also attempted to determine if there is a relationship between exposure to ionizing radiation and deaths due to certain diseases. The study report and findings were externally peer reviewed.

For most causes of death, including cancers related to ionizing radiation, fewer female workers died than would be expected based on the U.S. female population. For the entire study population, researchers expected 18,106 deaths from the start of operations through 1993, but found only 13,671 deaths. At all of the sites, the number of deaths were either similar to or lower than expected. These findings are not unusual for worker populations.

A strong healthy worker effect, similar to that observed among male nuclear weapons workers is observed for the entire pooled cohort of female nuclear weapons workers, and for all of the individual subcohorts with the exception of Linde workers. Increased mortality from mental disorders (SMR=147, certain genito-urinary system diseases (SMR =129), as well as symptoms and ill-defined conditions (SMR=163) is found compared with deaths expected based on U.S. death rates. For most causes of death, mortality among female nuclear workers is lower than expected. The healthy worker effect is observed among workers who were badged and among those who were not badged for external radiation exposures. The SMR (observed/expected x 100) for all causes of death combined is 78 for unbadged and 69 for badged workers. Mortality is elevated among both badged and unbadged women for mental disorders. Increased mortality is experienced among unmonitored employees for deaths from symptoms and ill defined conditions, diseases of the genito-urinary system and for homicide. Among badged workers, deaths from ill-defined conditions does not differ from that expected, and is less than expected for diseases of the genito-urinary system and homicide.

The healthy worker effect is also observed in analyses that compare survival time among badged and unbadged workers. For instance, when we assess whether the hazard differs among workers who were issued a radiation badge compared with workers who were not issued a badge, an increased relative risk estimate is observed for all causes of death among women who were not monitored (RR=1.25). This relative risk estimate was slightly lower for deaths from all cancers (RR=1.17). The relative risk for unbadged women who were not monitored is also elevated for lung cancer deaths (RR=1.49).

For the entire pooled cohort, the relative risk of death from leukemia increases with increasing cumulative dose of external radiation (relative risk [RR]/rem = 1.13, 95 percent; CI=1.02- 1.25). Suggestive increases are observed for all cancers (RR/rem = 1.03, 95 percent; CI=0.99- 1.06), breast cancer (RR/rem = 1.05, 95 percent; CI=0.99-1.12), and for hematologic cancers (RR/rem = 1.08, 95 percent; CI=0.99-1.17) (Wilkinson et al. 2000).

B.3.5 Savannah River Site

SRS, established in 1953 in Aiken, South Carolina, produces plutonium, tritium, and other nuclear materials. There are reports that millions of curies of tritium have been released over the years both in plant exhaust plumes and in surface and groundwater streams (DOE 1996c).

Surrounding Communities

In 1984, Sauer and Associates examined mortality rates in Georgia and South Carolina by distance from the Savannah River Plant (now known as SRS) (DOE 1996c). Rates for areas near the plant were compared with U.S. rates and with rates for counties located more than 80 km (50 mi) away. Breast cancer, respiratory cancer, leukemia, thyroid cancer, bone cancer, malignant melanoma of the skin, nonrespiratory cancer, congenital anomalies or birth defects, early infancy death rates, stroke, or cardiovascular disease in the populations living within 80 km (50 mi) of the Plant did not show any excess risk compared with the reference populations.

State Health Agreement Program

Under the State Health Agreement Program managed by DOE's Office of Epidemiologic Studies, a grant was awarded to the Medical University of South Carolina in 1991 to develop the Savannah River Region Health Information System. The purpose of the Savannah River Region Health Information System database was to assess the health of populations surrounding SRS by tracking cancer rates and birth defects rates in the area. Information from the registry is available to public and private health care providers for use in evaluating cancer control efforts. A steering committee provides advice to the Savannah River Region Health Information System and communicates public concerns to the System. It consists of 12 community members and persons with technical expertise representing South Carolina and Georgia. The meetings are open to the public.

Workers

A descriptive mortality study was conducted that included 9,860 white male workers who had been employed at least 90 days at the Savannah River Plant between 1952 and the end of 1974 (DOE 1996c). Vital status was followed through the end of 1980 and mortality was compared with the U.S. population. SMRs were computed separately for hourly and salaried employees. For hourly employees, nonstatistically significant increases were seen for cancer of the rectum (SMR: 1.09, 5 observed), cancer of the pancreas (SMR: 1.08, 10 observed), leukemia and aleukemia (SMR: 1.63, 13 observed), other lymphatic tissue (SMR: 1.06, 5 observed), benign neoplasms (SMR: 1.33, 4 observed), and motor vehicle accidents (SMR: 1.10, 63 observed). Salaried employees exhibited nonstatistically significant increases in cancer of the liver (SMR: 1.84, 3 observed), cancer of the prostate (SMR: 1.35, 5 observed), cancer of the bladder (SMR: 1.87, 4 observed), brain cancer (SMR: 1.06, 4 observed), leukemia and aleukemia (SMR: 1.05, 4 observed), and other lymphatic tissue (SMR: 1.23, 3 observed). No trends between increasing duration of employment and SMRs were observed. A statistically significant excess of leukemia deaths was observed for hourly workers employed at least 5, but less than 15 years (SMR: 2.75, 6 observed). Review of the plant records and job duties of the workers who died from leukemia indicated that two of the cases had potential routine exposure to solvents, four had potential occasional exposure to solvents, and one had potential for minimal exposure. Benzene, a known carcinogen, was reportedly not used at the plant.

Epidemiologic Studies

DOE's Office of Epidemiologic Studies has implemented an Epidemiologic Surveillance Program at SRS to monitor the health of current workers. This program evaluates the occurrence of illness and injury in the workforce on a continuing basis, and the results will be issued in annual reports. The implementation of this program facilitates an ongoing assessment of the health and safety of the SRS workforce and will help identify emerging health issues.

Epidemiologic Surveillance has been conducted at SRS since 1994, and as a pilot project from 1992. The most current available annual report provides a summary of epidemiologic surveillance data collected from SRS from January 1, 2000, through December 31, 2000. The data were collected and submitted to the Epidemiologic Surveillance Data Center located at Oak Ridge Institute for Science and Education, where quality control procedures and preliminary data analyses were carried out. The analyses were interpreted and the final report prepared by the DOE Office of Health Programs. In addition, many factors can affect the completeness and accuracy of health information reported at the sites, thereby affecting the observed patterns of illness and injury.

Currently operational at a number of DOE sites, including production sites and research and development laboratories, epidemiologic surveillance makes use of routinely collected health data including descriptions of illness resulting in absences lasting 5 or more consecutive workdays, disabilities, and Occupational Safety and Health Administration (OSHA)-recordable injuries and illnesses abstracted from the OSHA 200 log. These health event data, coupled with demographic data about the active workforce at the participating sites, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at a site. As the program continues and data become available for an extended period of time, trend analysis will become an increasingly important part of the evaluation of worker health. Monitoring for changes in the health of the workforce provides both a baseline determination of the illness and injury experience of workers and a tool for monitoring the effects of changes made to improve the safety and health of workers. Noteworthy changes in the health of the workforce may indicate areas in need of more detailed study or increased health and safety measures to ensure adequate protection for workers.

Epidemiologic surveillance monitors all illnesses and injuries among active workers because it is not always possible to determine which health effects are due to occupational exposures and which are due to other causes. Most illness and injury diagnoses were reported to the occupational medicine clinic by workers who required return-to-work clearances. An absence due to illness or injury may involve more than one diagnosis, and epidemiologic surveillance includes all reported diagnoses. In addition, the OSHA 200 Log provides information on recorded occupational injuries and illnesses whether or not they involve absences. The report organizes illness and injury categories based on a standard reference, ICD-9-CM. This reference is used to classify health events for statistical purposes.

Cancer rates presented in this report are based on reported absences during the year. A worker may experience several periods of absence from one cancer diagnosis due to medical complications or treatment regimens. The likelihood that an individual in the United States develops cancer increases with age. SRS data reflect this observation, with higher rates noted among men and women aged 50 or older. Forty-two 5-day absences related to cancer were reported, 24 diagnoses among 19 men and 18 diagnoses among 15 women. One woman who reported cancer in 2000 reported the same cancer in 1998. No apparent relationship was noted between any specific type of cancer and a particular job category.

No consistent relationship between injuries (including non-occupational injuries) and age was seen among men or women. The highest injury rates were among women in the Nuclear Specialties/Power Operator group and among men in the Technical Support group. Compared with other job categories, Technical Support workers were 40 percent more likely to report an injury. These workers had the same increased risk of injury in 1999.

A SHEO is a disease, disability, or death that is likely to be occupationally related. Its occurrence may serve as a warning signal that materials substitution, engineering control, personal protection, or medical care may be required to reduce the risk of injury or illness among the work force. Sixty-four medical conditions associated with workplace exposures from studies of many different industries have been identified as sentinel health events. Although sentinel health events may indicate an occupational exposure, many may result from non-occupational exposures. Due to this uncertainty, sentinel health events are assessed in two categories:

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Twelve definite sentinel health diagnoses reported by four men and two women were identified in 2000. Diagnoses included three sprains and strains (shoulder and upper arm and neck), two open wounds (head and finger), two fainting episodes, and one each for back disorder, bruise of the chest wall, inguinal hernia, seizure disorder, and genito-urinary condition. The causes of these events included falls, overexertion and strenuous movements, being struck by an object, and being cut by a powered hand tool. Twenty-seven of 3,361 (1 percent) diagnoses were identified as possible sentinel health events. Twenty of the 27 diagnoses were carpal tunnel syndrome, reported by 19 workers and resulting in 366 lost calendar days. Ten of the workers reporting carpal tunnel syndrome worked in the Technical Support group. All the workers with this diagnosis were aged 40 or older.

Sixteen deaths occurred among SRS workers in 2000. The causes of death included five cancers (lung, stomach, breast, brain, and multiple myeloma); three injuries (one aircraft accident, one motor vehicle accident, and one self-inflicted gunshot wound); two heart attacks; and one each for heart/circulatory disorder, brain damage, viral infection, psychological disorder, and digestive (liver) condition. The cause of one death was not known. The variety of causes of death did not indicate a pattern among these workers (SRS 2000).

Additionally, female workers at SRS were included in a National Institute for Occupational Safety and Health funded multisite study of mortality among female nuclear weapons workers. A total of 67,976 women who worked at any of the following 12 DOE sites before January 1, 1980: Oak Ridge (X-10, Y-12, K-25), LANL, the Zia Company, Rocky Flats, Hanford, Mound, SRS, Fernald, Pantex, and Linde (closed in 1949).

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Memorandum of Understanding

DOE entered into a Memorandum of Understanding with the DHHS to conduct health studies at DOE sites. The Centers for Disease Control and Prevention's National Center for Environmental Health is responsible for dose reconstruction studies and the National Institute for Occupational Safety and Health is responsible for worker studies. These activities are funded by DOE.

A study of mortality among SRS workers employed from 1952-1974 to examine whether risks of death due to selected causes may be related to occupational exposures at SRS is being conducted by the National Institute for Occupational Safety and Health. SRS is also included in several multi-site studies managed by the institute. The first study is to assess the potential association between paternal work-related exposure to ionizing radiation and the risk of leukemia in offspring of exposed male workers. The second study is to examine causes of death among female workers at nuclear weapons facilities to develop risk estimates based on exposures to external and internal ionizing radiation and to hazardous chemicals. A third multisite project is a case-control study of multiple myeloma, a type of blood cell cancer.

A dose reconstruction project around SRS is being conducted by the National Center for Environmental Health to determine the type and amount of contaminants to which people living around the site may have been exposed, to identify exposure pathways of concern, and to quantify the doses people may have received as a result of SRS operations. The study will attempt to determine if the health of people who lived near the Site was affected by past releases of chemicals and radioactive materials from the Site. The study is divided into several stages, which are completed in a phased approach:

- Review historical records (Phase I)
- Select key materials to be evaluated further (Phase I)
- Reconstruct historical releases of key radioactive materials and chemicals (Phase II)
- Develop detailed methods for calculating environmental concentrations
- Estimate doses and risks from exposure to contaminants in the environment.

The study's release estimates are snapshots of what was studied during Phase II of this project. During this Phase II study, details on reactor, reprocessing canyon, and tritium production were located, which will be used in future phases of the study to fill data gaps. Uncertainties in release estimates are also reported, which had not previously been calculated. Some general statements can be made about what has been found. One objective of the Phase II study was to find out if there was enough information in the SRS records to make estimates about the key materials released to the environment. For the key radioactive materials, the answer to this question is yes. The available information for radioactive materials is adequate to develop estimates of dose to individuals living offsite during past SRS operations. However, for the key chemicals, information before the 1980s is very sparse. Rough estimates of chemical releases from SRS operations have been made, and it may be feasible to develop general ranges of chemical risk estimates for offsite residents living near the Site in the past. The Center for Disease Control will carefully evaluate all of this information to carry out Phase III of the study. Another finding of the study is that there are some differences between the estimates of releases reported for this study and those reported by the Site. For the important radioactive materials, these differences are not large in most cases. However, the release estimates to air for iodine-131 reported for this study correct for a measurement problem found in the early records, and they are larger than the SRS-reported values. For similar reasons, plutonium release values to air reported for this study are about 4 times higher than reported SRS numbers during certain time periods. At this time a draft report of Phase II activities has been produced. Dose reconstruction activities based on the site release determinations have not been completed (SRS 1999).

B.3.6 Carlsbad Site

Waste Isolation Pilot Plant (WIPP) received its first shipment of waste on March 26, 1999. Epidemiological reports related to DOE activities are primarily sponsored or conducted in conjunction with NIOSH-CDC and/or DOE-ES&H Health Programs. Since WIPP operations began in 1999, insufficient time has elapsed to generate data appropriate for an epidemiological evaluation. To date, neither NIOSH nor DOE-ES&H Health Programs have issued epidemiological reports for the Carlsbad Site. However, there are two independent DOE-funded research organizations that are currently monitoring the WIPP site from an environmental and epidemiological perspective. Brief descriptions of each organization and their research follow.

Carlsbad Environmental Monitoring & Research Center

The Carlsbad Environmental Monitoring & Research Center (CEMRC) was created in 1991, as a division of the Waste-Management Education & Research Consortium (WERC), in the College of Engineering at New Mexico State University (NMSU). The CEMRC was established with a grant entitled "Carlsbad Environmental Monitoring and Research Program" (CEMRP) from DOE to NMSU (CEMRC 2003).

The primary goals of the CEMRP are to establish a permanent center to anticipate and respond to emerging health and environmental needs, and to develop and implement an independent health and environmental monitoring program in the vicinity of the WIPP and make the results easily accessible to all interested parties (CEMRC 2003).

The CEMRC is monitoring the local residents and studying the environment through a project entitled the "WIPP Environmental Monitoring Project" which includes monitoring of air, soil, surface water, sediments, drinking water, plants, animals, and the human population (CEMRC 2003).

Additionally, the CEMRC, as part of its internal dosimetry program, is conducting an in vivo radiobioassay research project entitled "Lie Down and Be Counted." The "Lie Down and Be Counted"project serves as a component of the WIPP EM that directly addresses the general concern about personal exposure to contaminants shared by residents who live near many DOE sites. The objective of the research is to characterize and monitor for internally deposited radionuclides in the general population living around the WIPP. The sampling design included solicitation of volunteers from all segments of the community, with sample sizes sufficient to meet or exceed a 15 percent range margin of error for comparisons between major population ethnicity and gender categories as identified in the 1990 census. The minimum sample size threshold was achieved for the major categories early in 1998, and is as low as 8 percent margin of error range for some categories. The data collected prior to the opening of the WIPP facility (March 26, 1999) serve as a baseline for comparisons with periodic follow-up measurements that are slated to continue throughout the 35-year operational phase of the WIPP. Participants in the project are monitored every 2 years (CEMRC 2003).

The Table B.3.6–1 summarizes the number of lung and whole body counts performed at CEMRC since the in vivo bioassay facility was commissioned in August 1997 (CEMRC 2003).

Table B.3.6–1. **Lung and Whole Body Count Totals as of June 1, 2001**

Total number of individuals who have participated in the project	546
Total number of counts of LD&BC participants (includes recounts of some individuals)	677
Total number of lung and whole body counts performed at the Center since July 1997	1832

Source: CEMRC 2003.

Results

The most current results, published June 1, 2001, indicate that operational monitoring results for all radionuclides are consistent with the baseline results. Based on these data, there is no evidence of a change in the frequency of detection of internally deposited radionuclides for citizens living within the vicinity of WIPP, since WIPP began receipt of radioactive waste (CEMRC 2003).

Environmental Evaluation Group of New Mexico

The Environmental Evaluation Group of New Mexico (EEG) is an interdisciplinary group of scientists and engineers that provides independent technical evaluation of the WIPP to ensure the protection of public health and safety, and the environment of New Mexico. The EEG was established in 1978 through a contract between the State of New Mexico and DOE (EEG 2003). A 1981 Agreement for Consultation and Cooperation (C&C) between DOE and the State of New Mexico and the *WIPP Land Withdrawal Act*, PL 102-579, also established EEG as an oversight organization for the WIPP Project on behalf of the State of New Mexico. Then, in 1989, Public Law 100-456, the *National Defense Authorization Act*, Fiscal Year (FY) 1989, Section 1433, assigned EEG to the New Mexico Institute of Mining and Technology and continued the original DOE contract. Finally, the *National Defense Authorization Act* for FY 1994, Public Law 103-

160, and the *National Defense Authorization Act* for FY 2000, Public Law 106-65, continued the authorization for an additional five years (EEG 2003).

EEG began its Environmental Monitoring Program in 1984 under the terms of the July 1981 C&C Agreement and a December 1982 Supplemental Stipulated Agreement. Environmental data collected by EEG before the opening of the WIPP has provided a baseline of environmental radionuclide background concentrations. Now that the facility is receiving waste, analytical results obtained from the effluent air and effluent water are being used to evaluate WIPP's regulatory compliance. EEG's Environmental Monitoring Program independently measures radioactivity in the air, water, and soil at the WIPP and in surrounding communities. Samples are analyzed for Americium-241, Cesium-137, Plutonium-238, Plutonium-239+240, and Strontium-90 (EEG 2003).

These particular radionuclides account for more than 98 percent of the potential public radiation dose from WIPP operations. In the event of WIPP-related transportation accidents or releases from WIPP facility operations, contamination of communities surrounding the WIPP facility can be assessed (EEG 2003).

Results

The most current results of EEG's Environmental Monitoring Program indicate that operations at the WIPP site during 2001 did not result in detectable releases of radionuclides to the environment. There "was no increase when compared with 1993-1998 baseline measurements and operational measurements taken during 2001" (EEG 2003).

B.4 DESCRIPTION OF THE CAP-88 COMPUTER CODE

Emission monitoring and compliance procedures for DOE facilities (40 CFR 61.93 [a]) require the use of CAP-88 (which stands for *Clean Air Act* Assessment Package-1988) or AIRDOS-PC computer models, or other approved procedures, to calculate effective dose equivalents to members of the public. The CAP-88 computer model is a set of computer programs, databases, and associated utility programs for estimation of dose and risk from radionuclide emissions to air.

CAP88-PC provides the CAP-88 methodology for assessments of both collective populations and maximally exposed individuals. CAP88-PC differs from the dose assessment software AIRDOS-PC in that it estimates risk as well as dose, offers a wider selection of radionuclide and meteorological data, provides the capability for collective population assessments, and allows users greater freedom to alter values of environmental transport variables. CAP88-PC version 1.0 was approved for demonstrating compliance with 40 CFR 61.93 (a) in February 1992.

B.4.1 Model Summary

CAP88-PC uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from up to six emitting sources. The sources may be either elevated stacks, such as a smokestack, or uniform area sources, such as a pile of uranium mill tailings. Plume rise can be calculated assuming either a momentum or buoyant-driven plume.

Assessments are done for a circular grid of distances and directions for a radius of up to 80 km (50 mi) around the facility. The Gaussian plume model produces results that agree with experimental data as well as any model, is fairly easy to work with, and is consistent with the random nature of turbulence.

Sample population files are supplied with CAP88-PC, which the user may modify to reflect their own population distributions. When performing population dose assessments, CAP88-PC uses the distances in the population array to determine the sector midpoint distances where the code calculates concentrations. CAP88-PC only uses circular grids; square grids are not an option.

Agricultural arrays of milk cattle, beef cattle, and agricultural crop area are generated automatically, requiring the user to supply only the state name or agricultural productivity values. When a population assessment is performed, the arrays are generated to match the distances used in the population arrays supplied to the code, and use state-specific or user-supplied agricultural productivity values. Users are given the option to override the default agricultural productivity values by entering the data directly on the Agricultural Data tab form.

Organs and weighting factors follow the ICRP 26/30 Effective Dose Equivalent calculations, which eliminates flexibility on specifying organs and weighting factors. The calculation of deposition velocity and the default scavenging coefficient is also modified to incorporate current EPA policy. Deposition velocity is set to 3.5×10^{-2} meters per second (m/s) for iodine, 1.8×10^{-3} m/s for particulates, and 0.0 m/s for gases. The default scavenging coefficient is calculated as a function of annual precipitation.

Seven organs are valid for the Effective Dose Equivalent as follows: gonads: 25 percent; breast: 15 percent; red bone marrow: 12 percent; lungs: 12 percent; thyroid: 3 percent; lung, thyroid, bone surfaces: 3 percent; and remainder: 30 percent.

B.4.2 Validation

The CAP88-PC programs represent one of the best available validated codes for the purpose of making comprehensive dose and risk assessments. The Gaussian plume model used in CAP88-PC to estimate dispersion of radionuclides in air is one of the most commonly used models in government guidebooks. It produces results that agree with experimental data as well as any model, is fairly easy to work with, and is consistent with the random nature of turbulence.

The EPA Office of Radiation and Indoor Air has made comparisons between the predictions of annual-average ground-level concentration to actual environmental measurements, and found very good agreement. In the paper “Comparison of AIRDOS-EPA Prediction of Ground-Level Airborne Radionuclide Concentrations to Measured Values,” environmental monitoring data at five DOE sites were compared to AIRDOS-EPA predictions. EPA concluded that as often as not, AIRDOS-EPA predictions are within a factor of 2 of actual concentrations.

APPENDIX C
HUMAN HEALTH EFFECTS FROM FACILITY ACCIDENTS

C.1 INTRODUCTION

Accident analyses were performed to estimate the impacts on workers and the public from reasonably foreseeable accidents associated with the Modern Pit Facility (MPF). The analyses were performed in accordance with *National Environmental Policy Act* (NEPA) guidelines, including the process followed for the selection of accidents, definition of accident scenarios, and estimation of potential impacts. The sections that follow describe the methodology and assumptions, accident selection process, selected accident scenarios, and consequences and risks of the accidents evaluated.

C.2 OVERVIEW OF METHODOLOGY AND BASIC ASSUMPTIONS

An accident is a sequence of one or more unplanned events with potential unmitigated outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.
- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.
- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, the dispersion of released hazardous materials and their effects are predicted. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident itself.

C.3 ACCIDENT ANALYSIS METHODOLOGY AND DATA SOURCES

The analysis of accidents followed a systematic process beginning with the identification of potentially hazardous conditions associated with the MPF, followed by the selection and definition of a representative set of accident scenarios, development of data requirements (source term, release duration, and estimate of frequency of accident condition), and the calculation of postulated accident consequences for the environment, members of the public, and site workers.

The accident analysis includes conservative assumptions to bound potential consequences and risks to workers and the public as well as to compensate for any uncertainties in the data and methods as required for NEPA purposes. In particular, no credit is taken for facility design features that would reduce accident damage to the material at risk (damage ratio = 1.0) and to confinement barriers that prevent materials from reaching the environment (leak path factor = 1.0). Realistically, the MPF would be designed and operated to protect the material at risk and confinement barriers that would significantly reduce the potential consequences and risks of accidents to workers and the public compared to the results presented in this EIS.

Data Sources

Major sources of data and information used for the development of accident scenarios included: (1) the best available documentation on postulated accidents at similar facilities, including recently completed NEPA documents for similar facilities; and (2) meetings and discussions with expert site representatives. Initial data regarding the MPF and its processing steps were obtained from the document *Modern Pit Facility Request for Approval of Mission Need—Critical Decision–0* (NNSA 2002).

Source Documents

Documentation on postulated accidents at similar facilities was the initial source of accident scenarios. Documents such as safety analysis reports and NEPA documents were reviewed for applicable accident scenarios. The review sought to identify a spectrum of accidents, initiated internally by operations or initiated externally. This spectrum of accidents included low-consequence/high-probability events (evaluation basis accidents) and high-consequence/low-probability events (beyond evaluation basis accidents). The initial set of documents that were reviewed included the following:

- *Topical Report – Supporting Documentation for the Accident Impacts Presented in the Modern Pit Facility Environmental Impact Statement* (Tetra Tech 2003)
- *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996c)
- *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999a)
- *Final Supplement Analysis for Pit Manufacturing Facilities at Los Alamos National Laboratory, Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (DOE 1999f)

- *TA-55 Final Safety Analysis Report* (LANL 1995a)
- *Topical Report – Supporting Documentation for the Accident Impacts Presented in the Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (Maltese et al., 1996)
- *Modern Pit Facility Pre-Conceptual Design Radiological Hazards Evaluation* (WSRC 2002d)

Based on these documents, a candidate set of facility hazards and accident scenarios were defined that was judged to provide an adequate representation of the potential accidents that might occur at the MPF. This initial set of candidate accidents was screened to arrive at a final set of accident scenarios for analysis and documentation in this Environmental Impact Statement (EIS).

Following the review of applicable documents, the accident scenarios and source terms were further refined and confirmed through meetings and discussions with knowledgeable personnel familiar with similar facilities and processes.

C.4 ACCIDENT SCENARIO SELECTION PROCESS

This section describes the development of accident scenarios that were used to estimate the impacts of MPF operations. As discussed in Section C.2, accident scenarios were developed using all known applicable sources of information including safety analysis reports, previous NEPA documents and related backup information, and discussions with experts familiar with potential accidents for MPF operations.

Development of Accident Scenarios

A preliminary hazard evaluation for a MPF was performed that identified potential hazards associated with nuclear weapons pit manufacturing (WSRC 2002d). These identified hazards formed the basis for the selection and definition of a set of accident scenarios analyzed in the MPF EIS. The steps in the process were:

1) Assemble and review all available information and technical resources applicable to the MPF buildings, equipment, processes, and operations
2) Identify potential hazardous and accident conditions
3) Define a preliminary set of candidate accident scenarios
4) Select a final set of accidents, develop scenarios, and derive applicable data for analysis in the MPF EIS

Four general guidelines, listed below, were followed in the selection of the MPF accident scenarios.

1) Hazardous and accident conditions should include the largest source terms at risk and conditions for worker and public impacts.

2) The accident scenarios selected should cover a spectrum of accident situations ranging from high-probability/low-consequence events to low-probability/high-consequence events.
3) For each probability range the accident with bounding consequences should be selected as representative for the range.
4) The accident scenarios should reflect differences resulting from site-specific initiators, meteorology, and characteristics (e.g., distance from site boundary and other adjacent facilities). The accidents do not take credit for any of the safety systems required for the facility.

Hazards Evaluation

Based on available documentation and technical resources, potential hazard, and accidents associated with MPF site conditions, facilities, processes, and operations were identified. These fall in to three categories:

1) Accidents initiated internal to the MPF (e.g. MPF processes, equipment, operations and workers)
2) Accidents initiated external to the MPF
3) Accidents initiated by natural phenomena events (e.g. earthquake, flooding, high winds)

Internally initiated accidents in Category 1 will generally be the same for all sites where new construction is planned. Externally initiated accidents and natural phenomena events in Categories 2 and 3 are site specific.

Internally Initiated Hazards

Detailed design information was not yet available for use in the MPF EIS. However, for purposes of EIS hazards evaluation, the following process steps were assumed.

- Shipment/Storage
- Disassembly
- Enriched Uranium Processing
- Dissolution
- Solvent Extraction
- Precipitation
- Metal Reduction
- Electrorefining
- Accountability and Button Storage
- Foundry
- Machining

- Assembly, Post Assembly, and Inspection
- Laboratory
- Balance of Plant

MPF-related facility radiological and chemical accidents for three production cases (125 pits per year [ppy], 250 ppy, and 450 ppy) are described in Tables C.4–1 through C.4–4. These tables also identify the estimated maximum material at risk (MAR) and source term and accident frequency. Section C.5 provides additional data on release fractions such as damage ratio, leak path factor, and estimated respirable release fraction (RRF) for each postulated accident. The RRF is the mathematical product of the airborne release fraction (ARF) and the respirable fraction (RF) calculated by the equation RRF = ARF × RF (Tetra Tech 2003).

Natural Phenomena Accidents

Natural phenomena events have the potential for causing damage to the facility and the release of radioactive and other hazardous materials. Natural phenomena events that were considered include earthquake, tornado, high winds, flooding, wild fires, snow, and ice. Tables C.4–1 through C.4–4 identify natural phenomena accidents that were selected for further analysis based on their potential for causing the release of radioactive materials that would bound other natural phenomena events. These tables and Section C.5 also provide data on accident scenarios pertaining to MAR, source term, frequency, and release fractions.

Postulated Accidents

The accident scenarios shown in Tables C.4–1 through C.4–4 cover the types of hazardous situations appropriate for the MPF EIS. The list includes fires, spills, criticality and explosions events, site-specific externally initiated events, and natural phenomena events. For radiological accidents, the material at risk is plutonium and the predominant form of exposure is through inhalation. For some plutonium processes, such as pit disassembly and conversion, tritium, whose predominant form of exposure is through ingestion, may also be present. However, the pits associated with the MPF Facility do not present a tritium hazard because they do not contain residual amounts of tritium. For radiological accidents, the material at risk is plutonium and the predominant form of exposure is through inhalation. The list also includes the potential release of toxic chemicals used in MPF processes.

The results of the accident analysis indicate potential consequences that exceed the DOE exposure guidelines of 25 rem for a member of the public at the nearest site boundary. The analyses in these cases for NEPA purposes are based on unmitigated releases of radioactive material to select a site for the MPF. Following the ROD and selection of a site, additional NEPA action would be taken that would identify specific mitigating features that would be incorporated in the MPF design to ensure compliance with DOE exposure guidelines. These could include procedural and equipment safety features, HEPA filtration systems, and other design features that would protect radioactive materials from accident conditions and contain any material that might be released. Upon completion of MPF NEPA actions, DOE would prepare safety analysis documentation such as a safety analysis report to further ensure that DOE exposure guidelines would not be exceeded. The results of the safety analysis report are reflected in facility and equipment design and defines an operating envelope and procedures to ensure public and worker safety. Once specific mitigation measures are incorporated into the MPF design and operating procedures, the potential consequences will not exceed the DOE exposure guidelines of 25 rem for a member of the public at the nearest site boundary for any of the site alternatives.

The accident source terms shown in Tables C.4–1 through C.4–4 indicate the quantity of radioactive and chemical material released to the environment with a potential for harm to the public and onsite workers. The radiological source terms are calculated by the equation:

Source Term = MAR × ARF × RF × DR × LPF, where:

MAR—the amount and form of radioactive material at risk of being released to the environment under accident conditions.

ARF—the airborne release fraction reflecting the fraction of damaged MAR that becomes airborne as a result of the accident.

RF—the respirable fraction reflecting the fraction of airborne radioactive material that is small enough to be inhaled by a human.

DR—the damage ratio reflecting the fraction of MAR that is damaged in the accident and available for release to the environment.

LPF—the leak path factor reflecting the fraction of respirable radioactive material that has a pathway out of the facility for dispersal in the environment.

Table C.4–1. Postulated MPF-Related Facility Radiological Accidents for the 125 ppy Case

Accident	Accident Description	Material at Risk	Source Term	Event Frequency
Natural Phenomena Events				
1. Beyond Evaluation Basis Earthquake with Fire	A seismic event is postulated causing failure of interior nonstructural walls. The collapsed walls cause a loss of confinement and a potential release of materials in multiple areas of the facility. Combustible materials in the area are ignited and the fire propagates to multiple areas and storage vaults containing the largest quantity of plutonium metal.	16,988 kg plutonium-239 equivalent: 99.65% metal 0.21 % powder, 0.14 % solution	4.23 kg metal 0.0021 kg oxide 0.048 kg solution	1.0×10^{-6} to 1.0×10^{-5} /yr
Externally Initiated Events				
1. Air Transportation Accident	Addressed in Official Use Only Document			
Internal Process Events				
1. Fire in a Single Building	A fire is postulated to start within a glovebox, processing room or storage vault. The fire propagates to multiple areas involving the largest quantities of plutonium metal.	7685 kg plutonium metal	1.92 kg plutonium	1.0×10^{-6} to 1.0×10^{-4} /yr
2. Explosion in a Feed Casting Furnace	A steam explosion/over-pressurization is postulated to occur in a feed casting furnace in the foundry. The steam explosion occurs due to a cooling water leak or an over-pressurization event. The explosion/over-pressurization impacts molten plutonium metal in seven furnaces. Negligible impacts from the shock/blast are postulated for the solid plutonium metal in the glovebox.	4.5 kg molten plutonium metal	2.25 kg molten plutonium metal	1.0×10^{-4} to 1.0×10^{-2} /yr

Table C.4–1. Postulated MPF-Related Facility Radiological Accidents for the 125 ppy Case *(continued)*

Accident	Accident Description	Material at Risk	Source Term	Event Frequency
Internal Process Events *(continued)*				
3. Nuclear Criticality	An inadvertent criticality is postulated based on several potential events involving handling errors. Accumulation of fissile material in excess of criticality safety limits, addition of a moderator causing a critical configuration, or a seismic event causing collapse of storage vault racks are potential scenarios.	See Table 3–1[a]	See Table 3–1[a]	1.0×10^{-2} /yr
4. Fire-induced Release in the CRT Storage Room	A fire is postulated to occur in the cargo restraint transporter storage room.	600 kg plutonium metal	0.15 kg plutonium	1.0×10^{-4} to 1.0×10^{-2} /yr
5. Radioactive Material Spill	A loss of confinement and spill of molten plutonium into the metal reduction glovebox is postulated. The spill occurs due to a failure or rupture of the feed casting furnace.	4.5 kg molten plutonium metal	0.045 kg plutonium	1.0×10^{-4} to 1.0×10^{-2} /yr

[a] Tetra Tech 2003.
Source: Tetra Tech 2003.

Table C.4–2. Postulated MPF-Related Facility Radiological Accidents for the 250 ppy Case

Accident	Accident Description	Material at Risk	Source Term	Event Frequency
Natural Phenomena Events				
1. Beyond Evaluation Basis Earthquake with Fire	A seismic event is postulated causing failure of interior nonstructural walls. The collapsed walls cause a loss of confinement and a potential release of materials in multiple areas of the facility. Combustible materials in the area are ignited and the fire propagates to multiple areas and to storage vaults containing the largest quantity of plutonium metal.	17,319 kg plutonium-239 equivalent: 99.44% metal 0.28 % powder 0.28 % solution	4.31 kg metal 0.00296 kg oxide 0.096 kg solution	1.0×10^{-6} to 1.0×10^{-5} /yr
Externally Initiated Events				
1. Air Transportation Accident	Addressed in Official Use Only Document			
Internal Process Events				
1. Fire in a Single Building	A fire is postulated to start within a glovebox, processing room, or storage vault. The fire propagates to multiple areas involving the largest quantities of plutonium metal.	7943 kg plutonium metal	1.99 kg plutonium	1.0×10^{-6} to 1.0×10^{-4} /yr
2. Explosion in a Feed Casting Furnace	A steam explosion/over-pressurization is postulated to occur in a feed casting furnace in the foundry. The steam explosion occurs due to a cooling water leak or an over pressurization event. The explosion/over-pressurization impacts molten plutonium metal in seven furnaces. Negligible impacts from the shock/blast are postulated for the solid plutonium metal in the glovebox.	4.5 kg molten plutonium metal	2.25 kg molten plutonium metal	1.0×10^{-4} to 1.0×10^{-2} /yr

Table C.4–2. Postulated MPF-Related Facility Radiological Accidents for the 250 ppy Case *(continued)*

Accident	Accident Description	Material at Risk	Source Term	Event Frequency
Internal Process Events *(continued)*				
3. Nuclear Criticality	An inadvertent criticality is postulated based on several potential events involving handling errors. Accumulation of fissile material in excess of criticality safety limits, addition of a moderator causing a critical configuration, or a seismic event causing collapse of storage vault racks are potential scenarios.	See Table 3-1[a]	See Table 3–1[a]	1.0×10^{-2} /yr
4. Fire-induced Release in the CRT Storage Room	A fire is postulated to occur in the cargo restraint transporter storage room.	600 kg plutonium metal	0.15 kg plutonium	1.0×10^{-4} to 1.0×10^{-2} /yr
5. Radioactive Material Spill	A loss of confinement and spill of molten plutonium into the metal reduction glovebox is postulated. The spill occurs due to a failure or rupture of the feed casting furnace.	4.5 kg molten plutonium metal	0.045 kg plutonium	1.0×10^{-4} to 1.0×10^{-2} /yr

[a] Tetra Tech 2003.
Source: Tetra Tech 2003.

Table C.4–3. Postulated MPF-Related Facility Radiological Accidents for the 450 ppy Case

Accident	Accident Description	Material at Risk	Source Term	Event Frequency
Natural Phenomena Events				
1. Beyond Evaluation Basis Earthquake with Fire	A seismic event is postulated causing failure of interior nonstructural walls. The collapsed walls cause a loss of confinement and a potential release of materials in multiple areas of the facility. Combustible materials in the area are ignited and the fire propagates to multiple areas and to storage vaults containing the largest quantity of plutonium metal.	33,447 kg plutonium-239 equivalent 99.51% metal 0.24 % powder 0.25 % solution	8.32 kg metal 0.0048 kg oxide 0.17 kg solution	1.0×10^{-6} to 1.0×10^{-5} /yr
Externally Initiated Events				
1. Air Transportation Accident	Addressed in Official Use Only Document			
Internal Process Events				
1. Fire in a Single Building	A fire is postulated to start within a glovebox, processing room, or storage vault. The fire propagates to multiple areas involving the largest quantities of plutonium metal.	15420 kg plutonium metal	3.86 kg plutonium	1.0×10^{-6} to 1.0×10^{-4} /yr
2. Explosion in a Feed Casting Furnace	A steam explosion/over-pressurization is postulated to occur in a feed casting furnace in the foundry. The steam explosion occurs due to a cooling water leak or an over- pressurization event. The explosion/over-pressurization impacts molten plutonium metal in seven furnaces. Negligible impacts from the shock/blast are postulated for the solid plutonium metal in the glovebox.	4.5 kg molten plutonium metal	2.25 kg molten plutonium metal	1.0×10^{-4} to 1.0×10^{-2} /yr

Table C.4–3. Postulated MPF-Related Facility Radiological Accidents for the 450 ppy Case *(continued)*

Accident	Accident Description	Material at Risk	Source Term	Event Frequency
Internal Process Events *(continued)*				
3. Nuclear Criticality	An inadvertent criticality is postulated based on several potential events involving handling errors. Accumulation of fissile material in excess of criticality safety limits, addition of a moderator causing a critical configuration, or a seismic event causing collapse of storage vault racks are potential scenarios.	See Table 3–1[a]	See Table 3-1[a]	1.0×10^{-2} /yr
4. Fire-induced Release in the CRT Storage Room	A fire is postulated to occur in the cargo restraint transporter storage room.	1200 kg plutonium metal	0.3 kg plutonium	1.0×10^{-4} to 1.0×10^{-2} /yr
5. Radioactive Material Spill	A loss of confinement and spill of molten plutonium into the metal reduction glovebox is postulated. The spill occurs due to a failure or rupture of the feed casting furnace.	4.5 kg molten plutonium metal	0.045 kg plutonium	1.0×10^{-4} to 1.0×10^{-2} /yr

[a] Tetra Tech 2003.
Source: Tetra Tech 2003.

Table C.4–4. Postulated MPF-Related Facility Chemical Accidents for All Production Cases

Chemical Release Events				
1. Nitric Acid release from bulk storage	Nitric acid is inadvertently released from bulk storage due to natural phenomena, equipment failure, mechanical impact, or human error during storage, handling, or process operations.	125 ppy – 10,500 kg 250 ppy – 21,000 kg 450 ppy – 40,000 kg	125 ppy – 10,500 kg 250 ppy – 21,000 kg 450 ppy – 40,000 kg	1.0×10^{-5} to 1.0×10^{-4} /yr
2. Hydrofluoric Acid Release from Bulk Storage	Hydrofluoric acid is inadvertently released from bulk storage due to natural phenomena, equipment failure, mechanical impact, or human error during storage, handling, or process operations.	125 ppy – 550 kg 250 ppy – 1,100 kg 450 ppy – 2,000 kg	125 ppy – 550 kg 250 ppy – 1,100 kg 450 ppy – 2,000 kg	1.0×10^{-5} to 1.0×10^{-4} /yr
3. Formic Acid Release from Bulk Storage	Formic acid is inadvertently released from bulk storage due to natural phenomena, equipment failure, mechanical impact, or human error during storage, handling, or process operations.	125 ppy – 1,500 kg 250 ppy – 3,000 kg 450 ppy – 5,500 kg	125 ppy – 1,500 kg 250 ppy – 3,000 kg 450 ppy – 5,500 kg	1.0×10^{-5} to 1.0×10^{-4} /yr

Source: Tetra Tech 2003.

The accident source terms for chemical accidents are shown in Table C.4–4. The impacts of chemical accidents are measured in terms of ERPG-2 and ERPG-3 concentration limits established by the American Industrial Hygiene Association. ERPG-2 is defined as the maximum airborne concentration below which it is believed 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 ability to take protective actions. ERPG-3 is defined as 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.

C.5 ACCIDENT SCENARIO DESCRIPTIONS AND SOURCE TERMS

The final set of accidents scenarios for the MPF Alternative are described in Section C.5.1 for three pit production cases (125, 250, and 450 ppy). They include potential radiological and chemical accidents that are initiated by internal MPF mechanisms, events external to MPF and natural phenomena. The selected accidents are based on conservative assumptions in order to obtain bounding impacts. A summary of accident data for the MPF Alternative is presented in Table C.5–1. Accident information pertaining to the No Action Alternative and the TA-55 Upgrade Alternative are provided in Sections C.5.2 and C.5.3, respectively.

Table C.5–1. Summary of Potential Facility Accidents for the MPF Alternative

Accident	Material at Risk[a]	Source Term[a]
Beyond Evaluation Basis Earthquake with Fire	<u>125 ppy</u> 16,929 kg plutonium metal 35 kg plutonium oxide 24 kg plutonium solution <u>250 ppy</u> 17,221.9 kg plutonium metal 49.1 kg plutonium oxide 48 kg plutonium solution <u>450 ppy</u> 33,282.5 kg plutonium metal 80.5 kg plutonium oxide 84 kg plutonium solution	<u>125 ppy</u> 4.23 kg plutonium metal 0.0021 kg plutonium oxide 0.048 kg plutonium solution <u>250 ppy</u> 4.31 kg plutonium metal 0.00295 kg plutonium oxide 0.096 kg plutonium solution <u>450 ppy</u> 8.32 kg plutonium metal 0.00483 kg plutonium oxide 0.168 kg plutonium solution
Fire in a Single Building	125 ppy – 7,685 kg plutonium metal 250 ppy – 7,943 kg plutonium metal 450 ppy – 15,420 kg plutonium metal	125 ppy – 1.92 kg plutonium metal 250 ppy – 1.99 kg plutonium metal 450 ppy – 3.86 kg plutonium metal
Explosion in a Feed Casting Furnace	125 ppy – 31.5 kg molten plutonium metal 250 ppy – 31.5 kg molten plutonium metal 450 ppy – 31.5 kg molten plutonium metal	125 ppy – 2.25 kg molten plutonium metal 250 ppy – 2.25 kg molten plutonium metal 450 ppy – 2.25 kg molten plutonium metal

Table C.5–1. Summary of Potential Facility Accidents for the MPF Alternative (*continued*)

Accident	Material at Risk[a]	Source Term[a]
Nuclear Criticality	See Table 3-1	5 x 10^{17} fissions
Fire-Induced Release in the CRT Storage Room	125 ppy – 600 kg plutonium metal 250 ppy – 600 kg plutonium metal 450 ppy – 1,200 kg plutonium metal	125 ppy – 0.15 kg molten plutonium metal 250 ppy – 0.15 kg molten plutonium metal 450 ppy – 0.30 kg molten plutonium metal
Radioactive Material Spill	125 ppy – 4.5 kg molten plutonium metal 250 ppy – 4.5 kg molten plutonium metal 450 ppy – 4.5 kg molten plutonium metal	125 ppy – 0.045 kg molten plutonium metal 250 ppy – 0.045 kg molten plutonium metal 450 ppy – 0.045 kg molten plutonium metal
Nitric Acid Release from Bulk Storage[b]	125 ppy – 10,500 kg 250 ppy – 21,000 kg 450 ppy – 40,000 kg	125 ppy – 10,500 kg 250 ppy – 21,000 kg 450 ppy – 40,000 kg
Hydrofluoric Acid Release from Bulk Storage[b]	125 ppy – 550 kg 250 ppy – 1,100 kg 450 ppy – 2,000 kg	125 ppy – 550 kg 250 ppy – 1,100 kg 450 ppy – 2,000 kg
Formic Acid Release from Bulk Storage[b]	125 ppy – 1,500 kg 250 ppy – 3,000 kg 450 ppy – 5,500 kg	125 ppy – 1,500 kg 250 ppy – 3,000 kg 450 ppy – 5,500 kg
Hydrochloric Acid[c]	125 ppy – 600 kg 250 ppy – 1,200 kg 450 ppy – 2,200 kg	125 ppy – 600 kg 250 ppy – 1,200 kg 450 ppy – 2,200 kg

[a] Plutonium-239 equivalent.
[b] Chemicals are used in the aqueous processing method.
[c] Chemical is used in the pyrochemical processing method.
Source: Tetra Tech 2003.

C.5.1 Modern Pit Facility Alternative

Postulated accident scenarios applicable to the MPF are described below. The accidents shown were analyzed and their consequences are presented in the Section C.7. The accidents shown are generally applicable to all sites although some reflect unique site-specific conditions that are not applicable to all sites.

C.5.1.1 Beyond Evaluation Basis Earthquake with Fire

The earthquake accident scenario postulates a seismic event and seismically induced failure of interior nonstructural walls. The collapsed walls cause a loss of confinement and a potential release of materials in multiple areas in the facility. Combustible materials in the area are ignited and the resulting fire propagates to multiple areas of the facility and including storage vaults in three buildings containing the largest quantity of plutonium metal. The plutonium-239 equivalent MAR for the 125 ppy production case includes 16,988 kilograms (kg) (37,452 pounds [lb]) metal, 35 kg (77 lb) oxide, and 24 kg (53 lb) solution. The plutonium-239 equivalent MAR for the 250 ppy production case includes 17,319 kg (38,182 lb) metal, 49.1 kg (108 lb) oxide, and 48 kg (106 lb) solution. The plutonium-239 equivalent MAR for the 450 ppy production case includes 33,447 kg (73,738 lb) of metal, 80.5 kg (177.5 lb) oxide, and 84 kg (185 lb) solution. The bounding seismic accident with fire conservatively assumes a damage ratio (DR) = 1.0 resulting in all of the MAR to be affected by the fire. The collapsed walls cause a loss of confinement resulting in an assumed leak path factor (LPF) = 1.0. The airborne respirable release fraction is estimated to be ARF*RF = 2.5×10^{-4} (metal), 6×10^{-5} (oxide), and 2×10^{-3} (solution). No credit is taken for the mitigating effects of safety systems, fire suppression efforts and equipment, plutonium cladding, the shipping containers or the final building state (building collapse and rubble bed). The resulting plutonium-239 equivalent source term for the 125 ppy case is 4.23 kg (9.3 lb) of metal, 0.0021 kg (0.0046 lb) of oxide, and 0.048 kg (0.11 lb) of solution. The resulting plutonium-239 equivalent source term for the 250 ppy case is 4.31 kg (9.5 lb) metal, 0.00295 kg (0.0065 lb) oxide, and 0.096 kg (0.212 lb) solution. The resulting plutonium-239 equivalent source term for the 450 ppy case is 8.32 kg (18.3 lb) metal, 0.00483 kg (0.11 lb) oxide, and 0.168 kg (0.37 lb) solution. The accident frequency is estimated to be in the range of 1×10^{-6} to 1×10^{-5} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-5} per year is assumed.

C.5.1.2 Air Transportation Accident

The air transportation accident is addressed in an Official Use Only document.

C.5.1.3 Ground Transportation Accident

The ground transportation accidents are addressed in Appendix D.

C.5.1.4 Fire in a Single Building

A fire is postulated to start within a glovebox, processing room, or storage vault. Possible causes of the fire include an electrical short, equipment failure, welding equipment, or human error. The fire propagates to multiple areas of the facility involving the largest quantities of plutonium metal. The material at risk is a maximum 7,685 kg (16,943 lb) of plutonium metal for the 125 ppy case; 7,943 kg (17,511 lb) plutonium metal for the 250 ppy case; and 15,420 kg (33,995 lb) plutonium for the 450 ppy case. The bounding fire accident conservatively assumes a DR = 1.0 resulting in all of the MAR to be affected by the fire. No credit is taken for safety systems, building confinement, or filtration resulting in an assumed LPF = 1.0. The airborne respirable release fraction is estimated to be ARF*RF = 2.5×10^{-4}. No credit is taken for the mitigating effects of fire suppression efforts and equipment, plutonium cladding or the shipping containers. The resulting source term is a ground level, thermal release of 1.92 kg (4.23 lb), 1.99 kg (4.39 lb), and 3.86 kg (8.5 lb) of plutonium-239 equivalent for the three production cases 125, 250, and 450 ppy, respectively. The accident frequency is estimated to be in the range of 1×10^{-6} to 1×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-4} per year is assumed.

C.5.1.5 Explosion in a Feed Casting Furnace

A steam explosion/over-pressurization is postulated to occur in a feed casting furnace in the foundry. The steam explosion occurs due to a cooling water leak or an over-pressurization event. The explosion/over-pressurization impacts molten plutonium metal in seven furnaces. The material at risk is the same for all three pit production cases. The furnace is assumed to contain 4.5 kg (9.9 lb) of plutonium in the form of molten metal. The airborne respirable release fraction was estimated to be ARF*RF = 0.5 for the 4.5 kg (9.9 lb) of plutonium. Negligible impacts from the shock/blast are postulated for 9 kg (19.8 lb) of solid plutonium metal in the glovebox. The bounding scenario assumes a DR = 1.0 and an LPF = 1.0. The resulting source for each of the three pit production cases is 2.25 kg (5.0 lb) plutonium-239 equivalent. The frequency of the accident is estimated to be in the range 1×10^{-4} to 1×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-2} was used.

C.5.1.6 Nuclear Criticality

An inadvertent criticality is postulated based on any one of several potential events involving handling errors. Accumulation of fissile material in excess of criticality safety limits, addition of a moderator causing a critical configuration, or a seismic event causing collapse of storage vault racks are potential scenarios. Table 3–1 of Chapter 3 in Volume I of this EIS (Tetra Tech 2003) provides the radionuclide distribution for a 5×10^{17} fissions criticality involving weapons grade plutonium. The estimated frequency of a criticality is 1×10^{-2} per year.

C.5.1.7 Fire-Induced Release in the Cargo Restraint Transporter Storage Room

A fire is postulated to start in cargo restraint transporter storage room. The fire is confined to the room. The MAR in the room is 600 kg (1,322.8 lb) plutonium metal for the 125 and 250 ppy production cases and 1200 kg (2,645.6 lb) plutonium metal for the 450 ppy production case. The bounding scenario assumes a DR = 1.0 resulting in all of the MAR to be affected by the fire. No credit is taken for building confinement or filtration resulting in an assumed LPF = 1.0. The airborne respirable fraction is estimated to be ARF*RF = 2.5×10^{-4}. No credit is taken for the mitigating effects of fire suppression efforts and equipment, plutonium cladding or shipping containers. The resulting source term is a ground level, thermal release of 0.15 kg (0.33 lb), 0.15 kg (0.33 lb), and 0.3 kg (0.66 lb) of plutonium-239 equivalent for the three production cases 125, 250, and 450 ppy, respectively. The accident frequency is estimated to be in the range of 1×10^{-4} to 1×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-2} per year is assumed.

C.5.1.8 Radioactive Material Spill

A spill of radioactive material occurs in the metal reduction glovebox. A loss of confinement and spill of molten plutonium into the metal reduction glovebox is postulated. The spill occurs due to a failure or rupture of the feed casting furnace. The event does not impact any other material that may be in the glovebox. The spill is assumed to involve 4.5 kg (9.9 lb) molten plutonium metal for each of the three production cases. An airborne release from disturbed metal surfaces is assumed the release mechanism. The airborne respirable release fraction is estimated to be ARF*RF = 1×10^{-2}. A DR = 1.0 was conservatively assumed. For a bounding scenario, no credit is taken for safety systems, building confinement, or ventilation/filtration corresponding to LPF = 1.0. The resulting source term is a ground level release of 0.045 kg (9.9 lb) plutonium-239 equivalent for each of the three pit production cases. The accident frequency is estimated to be in the range of 1×10^{-4} to 1×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-2} per year is assumed.

C.5.1.9 Nitric Acid Release

An accidental release of nitric acid from bulk storage is postulated due to equipment failure, mechanical impact, or human error. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Nitric acid is corrosive and can cause severe burns to all parts of the body. Its vapors may burn the respiratory tract and may cause pulmonary edema, which could prove fatal. The nitric acid is assumed to be stored in bulk quantity in an outdoor facility at MPF. The maximum amount of nitric acid that could be released is 10,500 kg (23,149 lb) for the 125 ppy production case, 21,000 kg (46,297 lb) for the 250 ppy production case, and 40,000 kg (88,185 lb) for the 450 ppy production case. The nitric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 6 and 78 parts per million (ppm), respectively. The estimated frequency of this accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-4} is assumed.

C.5.1.10 Hydrofluoric Acid Release

An accidental release of hydrofluoric acid from bulk storage is postulated due to equipment failure, mechanical impact, or human error. Hydrofluoric acid is extremely toxic and may be fatal if inhaled or ingested. It is readily absorbed through the skin and skin contact may be fatal. It acts as a systemic poison, causes severe burns and is a possible mutagen. The hydrofluoric acid is assumed to be stored in bulk quantity in an outdoor facility at MPF. The maximum amount of hydrofluoric acid that could be released is 550 kg (1,212.5 lb) for the 125 ppy production case, 1,100 kg (2,425 lb) for the 250 ppy production case, and 2,000 kg (4,409 lb) for the 450 ppy production case. The hydrofluoric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 20 and 50 ppm, respectively. The estimated frequency of this accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-4} per year is assumed.

C.5.1.11 Formic Acid Release

An accidental release of formic acid from bulk storage is postulated due to equipment failure, mechanical impact, or human error. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Formic acid is corrosive and will cause severe burns. It is harmful by inhalation, ingestion, and readily absorbed through skin. It is very destructive to mucous membranes and the upper respiratory tract, eyes, and skin. Inhalation may be fatal. The formic acid is assumed to be stored in bulk quantity in an outdoor facility at MPF. The maximum amount of formic acid that could be released is 1,500 kg (3,307 lb) for the 125 ppy production case, 3,000 kg (6,614 lb) for the 250 ppy production case, and 5,500 kg (12,125 lb) for the 450 ppy production case. The formic acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 10 and 30 ppm, respectively. The estimated frequency of this accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-4} per year is assumed.

C.5.1.12 Hydrochloric Acid Release

An accidental release of hydrochloric acid from bulk storage is postulated due to natural phenomena, equipment failure, mechanical impact, or human error. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Hydrochloric acid is corrosive and will cause severe burns. It is harmful by inhalation, ingestion, and readily absorbed through skin. Inhalation may be fatal. The hydrochloric acid is assumed to be stored in bulk quantity in an outdoor facility at MPF. The maximum amount of hydrochloric acid that could be released is 1,497 kg (3,300 lb) for the 80 ppy production case. The hydrochloric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 10 and 30 ppm, respectively. The estimated frequency of this accident is in the range of $1.0 \text{ x } 10^{-5}$ to $1.0 \text{ x } 10^{-4}$ per year. For the purpose of risk calculations, a conservative frequency of $1.0 \text{ x } 10^{-4}$ per year is assumed.

C.5.2 No Action Alternative

Under the No Action Alternative, plutonium pit fabrication capabilities would be maintained at existing levels. Potential accident scenarios for the No Action Alternative are addressed in existing documentation included by reference (DOE 1999f, DOE 1996c, LANL 1995a).

C.5.3 TA-55 Upgrade Alternative

Under the TA-55 Upgrade Alternative, the Plutonium Facility, Building 4 (PF-4) at TA-55 would be upgraded to provide a capability to manufacture up to 80 ppy. The changes to PF-4 to achieve this capability are assumed to be equivalent to the operations, processes, and technology and safety systems planned for a MPF. As such, the potential hazards and accidents postulated for a MPF would be applicable to the upgraded PF-4 with appropriate adjustments for the reduced production capacity. Table C.5.3–1 summarizes the accident scenarios for the TA-55 Upgrade Alternative.

Table C.5.3–1. Summary of Potential Facility Accidents for the Upgrade Alternative

Accident	MAR[a]	Source Term[a]
Beyond Evaluation Basis Earthquake and Fire	11,160 kg plutonium metal 22.4 kg plutonium oxide 15.4 kg plutonium solution	2.7 kg plutonium metal 0.0014 kg plutonium oxide 0.03 kg plutonium solution
Fire in a Single Building	4,918 kg plutonium metal	1.23 kg plutonium-239 equivalent
Explosion in a Feed Casting Furnace	31.5 kg molten plutonium metal	2.52 kg plutonium-239 equivalent
Nuclear Criticality	See Table 3-1[b]	5 x 10^{17} fissions
Fire-Induced Release in the CRT Storage Room	384 kg plutonium metal	0.096 kg plutonium-239 equivalent
Radioactive Material Spill	4.5 kg molten plutonium metal	0.045 kg plutonium-239 equivalent
Nitric Acid Release from Bulk Storage	3,420 kg	3,420 kg
Hydrofluoric Acid Release from Bulk Storage	340 kg	340 kg
Hydrochloric Acid Release from Bulk Storage	1,497 kg	1,497 kg

[a] Plutonium-239 equivalent.
[b] Tetra Tech 2003.

C.5.3.1 Beyond Evaluation Basis Earthquake and Fire

The earthquake accident scenario postulates a seismic event and seismically induced failure of interior nonstructural walls. The collapsed walls cause a loss of confinement and a potential release of materials in multiple areas in the facility. Combustible materials in the area are ignited and the resulting fire propagates to multiple areas of the facility including storage vaults in three buildings containing the largest quantity of plutonium metal. The plutonium-239 equivalent material at risk for the 80 ppy production case is 11,160 kg (24,603 lb) metal, 22.4 kg (49.4 lb) oxide, and 15.4 kg (34 lb) solution. The bounding seismic accident with fire conservatively assumes a DR = 1.0 resulting in all of the MAR to be affected by the fire. The collapsed walls cause a loss of confinement resulting in an assumed LPF = 1.0. The airborne respirable release fraction is estimated to be ARF*RF = 2.5×10^{-4} (metal), 6.0×10^{-5} (oxide), and 2.0×10^{-3} (solution). No credit is taken for the mitigating effects of safety systems, fire suppression efforts, and equipment, plutonium cladding, or the shipping containers. The resulting plutonium-239 equivalent source term is 2.7 kg (6.0 lb) of metal, 0.0014 kg (0.0031 lb) of oxide, and 0.03 kg (0.066 lb) of solution. The accident frequency is estimated to be in the range of 1×10^{-6} to 1×10^{-5} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-5} per year is assumed.

C.5.3.2 Air Transportation Accident

The air transportation accident is addressed in an Official Use Only document.

C.5.3.3 Ground Transportation Accident

The ground transportation accidents are addressed in Appendix B.

C.5.3.4 Fire in a Single Building

A fire is postulated to start within a glovebox, processing room or storage vault. Possible causes of the fire include an electrical short, equipment failure, welding equipment, or human error. The fire propagates to multiple areas of the facility involving the largest quantities of plutonium metal. The MAR is a maximum 4,918 kg (10,842 lb) of plutonium metal for the 80 ppy case. The bounding fire accident conservatively assumes a DR = 1.0 resulting in all of the MAR to be affected by the fire. No credit is taken for safety systems, building confinement, or filtration resulting in an assumed LPF = 1.0. The airborne respirable release fraction is estimated to be ARF*RF = 2.5×10^{-4}. No credit is taken for the mitigating effects of fire suppression efforts and equipment, plutonium cladding or the shipping containers. The resulting source term is a ground-level, thermal release of 1.23 kg (2.7 lb) of plutonium-239 equivalent. The accident frequency is estimated to be in the range of 1.0×10^{-6} to 1×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-4} per year is assumed.

C.5.3.5 Explosion in a Feed Casting Furnace

A steam explosion/over-pressurization is postulated to occur in a feed casting furnace in the foundry. The steam explosion occurs due to a cooling water leak or an over-pressurization event. The explosion/over-pressurization impacts molten plutonium metal in seven furnaces. The furnace is assumed to contain 4.5 kg (9.9 lb) of plutonium in the form of molten metal. The airborne respirable release fraction was estimated to be ARF*RF = 0.5 for the 4.5 kg (9.9 lb) of plutonium. Negligible releases from the shock/blast are postulated for 9 kg (19.8 lb) of solid plutonium metal in the glovebox. The bounding scenario assumes a DR = 1.0 and an LPF = 1.0. The resulting source for each of the three pit production cases is 2.25 kg (5.0 lb) plutonium-239 equivalent. The frequency of the accident is estimated to be in the range 1.0×10^{-4} to 1.0×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-2} was used.

C.5.3.6 Nuclear Criticality

An inadvertent criticality is postulated based on any one of several potential events involving handling errors. Accumulation of fissile material in excess of criticality safety limits, addition of a moderator causing a critical configuration, or a seismic event causing collapse of storage vault racks are potential scenarios. Table 3-1 provides the radio nuclide distribution for a 5×10^{17} fissions criticality involving weapons grade plutonium. The estimated frequency of a criticality is 1.0×10^{-2} per year.

C.5.3.7 Fire-Induced Release in the Cargo Restraint Transporter Storage Room

A fire is postulated to start in cargo restraint transporter storage room. The fire is confined to the room. The MAR in the room is 384 kg (847 lb) plutonium metal for the 80 ppy production case. The bounding scenario assumes a DR = 1.0 resulting in all of the MAR to be affected by the fire. No credit is taken for building confinement or filtration resulting in an assumed LPF = 1.0. The airborne respirable fraction is estimated to be ARF*RF = 2.5×10^{-4}. No credit is taken for the mitigating effects of fire suppression efforts and equipment, plutonium cladding or shipping containers. The resulting source term is a ground-level, thermal release of 0.096 kg (0.21 lb) of plutonium metal. The accident frequency is estimated to be unlikely in the range of 1.0×10^{-4} to 1.0×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-2} per year is assumed.

C.5.3.8 Radioactive Material Spill

A spill of radioactive material occurs in the metal reduction glovebox. A loss of confinement and spill of molten plutonium into the metal reduction glovebox is postulated. The spill occurs due to a failure or rupture of the feed casting furnace. The event does not impact any other material that may be in the glovebox. The spill is assumed to involve 4.5 kg (9.9 lb) molten plutonium metal. An airborne release from disturbed metal surfaces is assumed the release mechanism. The airborne respirable release fraction is estimated to be ARF*RF = 1.0×10^{-2}. A DR =1.0 was conservatively assumed. For a bounding scenario, no credit is taken for building confinement or ventilation/filtration corresponding to LPF = 1.0. The resulting source term is a ground-level release of 0.045 kg (0.099 lb) plutonium-239 equivalent. The accident frequency is estimated to be unlikely in the range of 1.0×10^{-4} to 1.0×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-2} per year is assumed.

C.5.3.9 Nitric Acid Release

An accidental release of nitric acid from bulk storage is postulated due to natural phenomena, equipment failure, mechanical impact, or human error. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Nitric acid is corrosive and can cause severe burns to all parts of the body. Its vapors are corrosive to the respiratory tract and may cause pulmonary edema, which could prove fatal. The nitric acid is assumed to be stored in bulk quantity in an outdoor facility at MPF. The maximum amount of nitric acid that could be released is 3,420 kg (7,540 lb) for the 80 ppy, production case. The nitric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 6 and 78 ppm, respectively. The estimated frequency of this accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-4} per year is assumed.

C.5.3.10 Hydrofluoric Acid Release

An accidental release of hydrofluoric acid from bulk storage is postulated due to natural phenomena, equipment failure, mechanical impact, or human error. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Hydrofluoric acid is extremely toxic and may be fatal if inhaled or ingested. It is readily absorbed through the skin and skin contact may be fatal. It acts as a systemic poison, causes severe burns, and is a possible mutagen. The hydrofluoric acid is assumed to be stored in bulk quantity in an outdoor facility at MPF. The maximum amount of hydrofluoric acid that could be released is 340 kg (750 lb) for the 80 ppy, production case. The hydrofluoric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 20 and 80 ppm, respectively. The estimated frequency of this accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-4} per year is assumed.

C.5.3.11 Hydrochloric Acid Release

An accidental release of hydrochloric acid from bulk storage is postulated due to natural phenomena, equipment failure, mechanical impact, or human error. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. Hydrochloric acid is corrosive and will cause severe burns. It is harmful by inhalation, ingestion, and readily absorbed through skin. It is very destructive to mucous membranes and the upper respiratory tract, eyes, and skin. Inhalation may be fatal. The hydrochloric acid is assumed to be stored in bulk quantity in an outdoor facility at MPF. The maximum amount of formic acid that could be released is 1,497 kg (3,300 lb) for 80 ppy production case. The hydrochloric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 10 and 30 ppm, respectively. The estimated frequency of this accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1.0×10^{-4} per year is assumed.

C.6 CONSEQUENCE ANALYSIS METHODOLOGY

Radiological Releases

Consequences of accidental radiological releases were determined using the MACCS2 computer code (Chanin and Young 1998). MACCS2 is a DOE/Nuclear Regulatory Commission (NRC)-sponsored computer code that has been widely used in support of probabilistic risk assessments for the nuclear power industry and in support of safety and NEPA documentation for facilities throughout the DOE complex.

The MACCS2 code uses three distinct modules for consequence calculations. The ATMOS module performs the calculations pertaining to atmospheric transport, including dispersion, deposition, and decay. The EARLY module performs the exposure calculations corresponding to the period immediately following the release; this module also includes the capability to simulate evacuation from areas surrounding the release. The EARLY module exposure pathways include inhalation, cloud shine, and groundshine. The CHRONC module considers the time period following the early phase, i.e., after the plume has passed (usually 7 days). CHRONC exposure pathways include groundshine, resuspension inhalation, and ingestion of contaminated food and water; land use interdiction (e.g., decontamination, interdiction) can be simulated in this module. Other supporting input files include a meteorological data file and a site data file containing distributions of the population and agriculture surrounding the release site.

All of the code's capabilities were not used because of assumptions used in the MPF EIS analysis. It was assumed that there would be no evacuation or protection of the surrounding population following an accidental release of radionuclides. In addition, the food pathway was not included. The former assumption is not expected to significantly affect the calculated doses; the amount of warning preceding a release is likely to be small. The latter assumption is made to simplify the calculation process and yet not significantly affect the results. A conservative assumption, that the deposition velocity of all radioactive material was set to zero, was instead made.

The source terms were handled by the code by considering the MAR as the inventory. The release fraction of each scenario was then the product of the various factors (DR, ARF, RF, and LPF) that describe the material available to actually impact a receptor. The meteorological data consisted of sequential hourly wind speed, wind direction, stability class and precipitation for one year.

Each 4-hour period of the annual meteorological site specific data set for each site was randomly sampled, assuring a good representation of the entire meteorological data set. The results from each of these samples were then ranked and combined (according to their frequency of occurrence) and a distribution of results is presented by the code. This distribution includes statistics such as 95th percentile, 50th percentile, and mean dose. The latter is presented in the MPF EIS. The doses were converted into latent cancer fatalities (LCFs) using the International Commission on Radiological Protection (ICRP) factor of 5×10^{-4} LCF/person-rem for members of the general public. For workers, the ICRP factor of 4×10^{-4} LCF/person-rem was used.

Chemical Releases

Consequences of accidental chemical releases were determined using the ALOHA computer code (EPA 1999b). ALOHA is an EPA/National Oceanic and Atmospheric Administration (NOAA)-sponsored computer code that has been widely used in support of chemical accident responses and also in support of safety and NEPA documentation for DOE facilities.

The ALOHA code is a deterministic representation of atmospheric releases of toxic and hazardous chemicals. The code can predict the rate at which chemical vapors escape (e.g., from puddles or leaking tanks) into the atmosphere; a specified direct release rate is also an option. In the case of the MPF EIS, the chemical direct release rates were determined based on a 30-minute release as part of the scenario development.

Either of two dispersion algorithms are applied by the code, depending on whether the release is neutrally buoyant or heavier than air. The former is modeled similarly to radioactive releases in that the plume is assumed to advect with the wind velocity. The latter considers the initial slumping and spreading of the release because of its density. As a heavier-than-air release becomes more dilute, its behavior tends towards that of a neutrally buoyant release.

The ALOHA code uses a constant set of meteorological conditions (e.g., wind speed, stability class) to determine the downwind atmospheric concentrations. The sequential meteorological data sets used for the radiological accident analyses were re-ordered from high to low dispersion by applying a Gaussian dispersion model (such as that used by ALOHA) to the closest site boundary at each site. The median set of hourly conditions for each site (i.e., mean wind speed and mean stability) was used for the analysis; this is roughly equivalent to the conditions corresponding to the mean radiological dose estimates of MACCS2.

ALOHA contains physical and toxicological properties for the chemical spills included in the EIS and for approximately 1,000 additional chemicals. The physical properties were used to determine which of the dispersion models and accompanying parameters were applied. The toxicological properties were used to determine the levels of concern. Atmospheric concentrations at which health effects are of concern (e.g., ERPG-2) are used to define the footprint of concern because the meteorological conditions specified do not account for wind direction (i.e., it is not known *a priori* in which direction the wind would be blowing in the event of an accident) the areas of concern are defined by a circle of radius equivalent to the downwind distance at which the concentration decreases to levels less than the level of concern. The fraction of the area of concern actually exposed to the concentration of concern (footprint area/circle area) was noted. In addition, the concentration at 1,000 m (3,281 ft) (potential exposure to a non-involved worker) and at the nearest site boundary distance (exposure to maximum exposed offsite individual) are calculated and presented.

C.7 ACCIDENT ANALYSES CONSEQUENCES AND RISK RESULTS

The following sections describe the radiological and chemical impacts of potential accidents associated with MPF alternatives at LANL, NTS, Pantex, SRS, and WIPP and with the TA-55 Upgrade Alternative at LANL. Impacts for the MPF alternatives are provided for 125 ppy, 250 ppy, and 450 ppy production cases. Impacts for the TA-55 Upgrade Alternative are provided for an 80 ppy production case.

The impacts to humans that could result from potential radiological accident scenarios were evaluated in terms of dose units (such as rem or person-rem) and excess LCFs. The dose-to-risk conversion factors used were 0.0005 LCFs per rem (or person-rem) and 0.0004 LCFs per rem, respectively, for the public and workers. The lower value for workers reflects the absence of children (who are more radiosensitive than adults) in the workforce. For individuals, such as a worker or the maximum exposed offsite individual, the dose-to-rem conversion factors were doubled to 0.0008 and 0.001, respectively, when the dose exceeded 20 rem.

C.7.1 Modern Pit Facility Radiological Accident Frequency and Consequences

This section describes the impacts for each of the five MPF site alternatives. Impacts are shown in terms of dose and LCFs for the maximally exposed offsite individual, offsite population, and non-involved worker. The risks of LCFs are also shown for the maximally exposed offsite individual, offsite population, and non-involved worker.

C.7.1.1 Los Alamos Site Alternative

Table C.7.1.1–1. MPF Alternative Radiological Accident Frequency and Consequences at LANL for 125 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	41.4	0.041	36,300	18.2	244	0.2
1.0×10^{-5}						
Fire in a Single Building	32.7	0.033	21,400	10.7	301	0.24
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	38.3	0.038	25,100	12.5	353	0.28
1.0×10^{-2}						
Nuclear Criticality	0.00012	5.8×10^{-8}	0.11	5.3×10^{-5}	0.0012	4.7×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	2.4	0.0012	1,670	0.84	23.5	0.019
1.0×10^{-2}						
Radioactive Material Spill	0.77	0.00036	502	0.25	7.1	0.0028
1.0×10^{-2}						

CRT = Cargo Restraint Transporter.
[a] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.1–2. Annual Cancer Risks for the MPF Alternative at LANL for 125 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	4.1×10^{-7}	0.00018	2.0×10^{-6}
Fire in a Single Building	3.3×10^{-6}	0.0011	2.4×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.125	0.0028
Nuclear Criticality	5.8×10^{-10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	1.2×10^{-5}	0.0084	0.00019
Radioactive Material Spill	3.6×10^{-6}	0.0025	2.8×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

Table C.7.1.1–3. MPF Alternative Radiological Accident Frequency and Consequences at LANL for 250 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	42.6	0.043	37,400	18.7	251	0.2
1.0×10^{-5}						
Fire in a Single Building	33.9	0.034	22,200	11.1	312	0.25
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	38.3	0.038	25,100	12.5	353	0.28
1.0×10^{-2}						
Nuclear Criticality	0.00012	5.8×10^{-8}	0.11	5.3×10^{-5}	0.0012	4.7×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	2.4	0.0012	1,670	0.84	23.5	0.019
1.0×10^{-2}						
Radioactive Material Spill	0.77	0.00036	502	0.25	7.1	0.0028
1.0×10^{-2}						

a Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
b Increased likelihood of a LCF.
c Increased likelihood of LCFs.

Table C.7.1.1–4. Annual Cancer Risks for the MPF Alternative at LANL for 250 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	4.3×10^{-7}	0.00019	2.0×10^{-6}
Fire in a Single Building	3.4×10^{-6}	0.0011	2.5×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.125	0.0028
Nuclear Criticality	5.8×10^{-10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	1.2×10^{-5}	0.0084	0.00019
Radioactive Material Spill	3.6×10^{-6}	0.0025	2.8×10^{-5}

a Increased likelihood of a LCF.
b Increased likelihood of LCFs.
c Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

Table C.7.1.1–5. MPF Alternative Radiological Accident Frequency and Consequences at LANL for 450 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	82.1	0.082	72,000	36	484	0.39
1.0×10^{-5}						
Fire in a Single Building	65.7	0.066	43,000	21.5	605	0.48
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	38.3	0.038	25,100	12.5	353	0.28
1.0×10^{-2}						
Nuclear Criticality	0.00012	5.8×10^{-8}	0.11	5.3×10^{-5}	0.0012	4.7×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	5.1	0.0024	3,340	1.67	47	0.038
1.0×10^{-2}						
Radioactive Material Spill	0.77	0.00036	502	0.25	7.05	0.0028
1.0×10^{-2}						

[a] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.1–6. Annual Cancer Risks for the MPF Alternative at LANL for 450 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	8.2×10^{-7}	0.00036	3.9×10^{-6}
Fire in a Single Building	6.6×10^{-6}	0.0022	4.8×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.125	0.0028
Nuclear Criticality	5.8×10^{10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	2.4×10^{-5}	0.017	0.00038
Radioactive Material Spill	3.6×10^{-6}	0.0025	2.8×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

C.7.1.2 Nevada Test Site Alternative

Table C.7.1.2–1. MPF Alternative Radiological Accident Frequency and Consequences at NTS for 125 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	2.71	0.0014	1,120	0.56	239	0.19
1.0×10^{-5}						
Fire in a Single Building	1.27	0.00064	504	0.25	124	0.099
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	1.49	0.00074	591	0.3	145	0.12
1.0×10^{-2}						
Nuclear Criticality	3.4×10^{-6}	1.7×10^{-9}	0.0012	5.8×10^{-7}	0.00049	2.5×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	0.099	5.0×10^{-5}	39.4	0.02	9.69	0.0048
1.0×10^{-2}						
Radioactive Material Spill	0.03	1.5×10^{-5}	11.8	0.0059	2.91	0.0015
1.0×10^{-2}						

a Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.
b Increased likelihood of a LCF.
c Increased likelihood of LCFs.

Table C.7.1.2–2. Annual Cancer Risks for the MPF Alternative at NTS for 125 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.4×10^{-8}	5.6×10^{-6}	1.9×10^{-6}
Fire in a Single Building	6.4×10^{-8}	2.5×10^{-5}	9.9×10^{-6}
Explosion in a Feed Casting Furnace	7.4×10^{-6}	0.003	0.0012
Nuclear Criticality	1.7×10^{-11}	5.8×10^{-9}	2.5×10^{-9}
Fire-induced Release in the CRT Storage Room	5.0×10^{-7}	0.0002	4.8×10^{-5}
Radioactive Material Spill	1.5×10^{-7}	5.9×10^{-5}	1.5×10^{-5}

a Increased likelihood of a LCF.
b Increased likelihood of LCFs.
c Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.

Table C.7.1.2–3. MPF Alternative Radiological Accident Frequency and Consequences at NTS for 250 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	2.8	0.0014	1,150	0.58	246	0.2
1.0×10^{-5}						
Fire in a Single Building	1.32	0.00066	522	0.26	129	0.1
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	1.49	0.00074	591	0.3	145	0.12
1.0×10^{-2}						
Nuclear Criticality	3.4×10^{-6}	1.7×10^{-9}	0.0012	5.8×10^{-7}	0.00049	2.5×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	0.099	5.0×10^{-5}	39.4	0.02	9.69	0.0048
1.0×10^{-2}						
Radioactive Material Spill	0.03	1.5×10^{-5}	11.8	0.0059	2.91	0.0015
1.0×10^{-2}						

[a] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.2–4. Annual Cancer Risks for the MPF Alternative at NTS for 250 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.4×10^{-8}	5.8×10^{-6}	2.0×10^{-6}
Fire in a Single Building	6.6×10^{-8}	2.6×10^{-5}	1.0×10^{-5}
Explosion in a Feed Casting Furnace	7.4×10^{-6}	0.003	0.0012
Nuclear Criticality	1.7×10^{-11}	5.8×10^{-9}	2.5×10^{-9}
Fire-induced Release in the CRT Storage Room	5.0×10^{-7}	0.0002	4.8×10^{-5}
Radioactive Material Spill	1.5×10^{-7}	5.9×10^{-5}	1.5×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.

Table C.7.1.2–5. MPF Alternative Radiological Accident Frequency and Consequences at NTS for 450 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	5.38	0.0027	2,220	1.11	474	0.38
1.0×10^{-5}						
Fire in a Single Building	2.55	0.0013	1,010	0.51	249	0.2
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	1.49	0.00074	591	0.3	145	0.12
1.0×10^{-2}						
Nuclear Criticality	3.5×10^{-6}	1.7×10^{-9}	0.0012	5.8×10^{-7}	0.00049	2.5×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	0.20	9.9×10^{-5}	78.8	0.039	19.4	0.0097
1.0×10^{-2}						
Radioactive Material Spill	0.030	1.5×10^{-5}	11.8	0.0059	2.91	0.0015
1.0×10^{-2}						

a Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.
b Increased likelihood of a LCF.
c Increased likelihood of LCFs.

Table C.7.1.2–6. Annual Cancer Risks for the MPF Alternative at NTS for 450 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	2.7×10^{-8}	1.1×10^{-5}	3.8×10^{-6}
Fire in a Single Building	1.3×10^{-7}	5.1×10^{-5}	2.0×10^{-5}
Explosion in a Feed Casting Furnace	7.4×10^{-6}	0.003	0.0012
Nuclear Criticality	1.7×10^{-11}	5.8×10^{-9}	2.5×10^{-9}
Fire-induced Release in the CRT Storage Room	9.9×10^{-7}	0.00039	9.7×10^{-5}
Radioactive Material Spill	1.5×10^{-7}	5.9×10^{-5}	1.5×10^{-5}

a Increased likelihood of a LCF.
b Increased likelihood of LCFs.
c Based on a year-2043 population of 69,501 persons residing within 80 km (50 mi) of NTS.

C.7.1.3 Pantex Site Alternative

Table C.7.1.3–1. MPF Alternative Radiological Accident Frequency and Consequences at Pantex for 125 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	29.1	0.029	8,320	4.16	232	0.19
1.0×10^{-5}						
Fire in a Single Building	15	0.0075	3,920	1.96	140	0.11
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	17.6	0.0088	4,590	2.3	164	0.13
1.0×10^{-2}						
Nuclear Criticality	6.4×10^{-5}	3.2×10^{-8}	0.012	6.0×10^{-6}	0.0006	2.4×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	1.2	0.00059	306	0.15	10.9	0.0044
1.0×10^{-2}						
Radioactive Material Spill	0.35	0.00018	91.9	0.046	3.28	0.0013
1.0×10^{-2}						

[a] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.3–2. Annual Cancer Risks for the MPF Alternative at Pantex for 125 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	2.9×10^{-7}	4.2×10^{-5}	1.9×10^{-6}
Fire in a Single Building	7.5×10^{-7}	0.0002	1.1×10^{-5}
Explosion in a Feed Casting Furnace	8.8×10^{-5}	0.023	0.0013
Nuclear Criticality	3.2×10^{-10}	6.0×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	5.9×10^{-6}	0.0015	4.4×10^{-5}
Radioactive Material Spill	1.8×10^{-6}	0.00046	1.3×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.

Table C.7.1.3–3. MPF Alternative Radiological Accident Frequency and Consequences at Pantex for 250 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	30	0.03	8,570	4.29	239	0.19
1.0×10^{-5}						
Fire in a Single Building	15.5	0.0078	4,060	2.0	145	0.12
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	17.6	0.0088	4,590	2.3	164	0.13
1.0×10^{-2}						
Nuclear Criticality	6.4×10^{-5}	3.2×10^{-8}	0.012	6.0×10^{-6}	0.0006	2.4×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	1.2	0.00059	306	0.15	10.9	0.0044
1.0×10^{-2}						
Radioactive Material Spill	0.35	0.00018	91.9	0.046	3.28	0.0013
1.0×10^{-2}						

[a] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.3–4. Annual Cancer Risks for the MPF Alternative at Pantex for 250 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	3.0×10^{-7}	4.3×10^{-5}	1.9×10^{-6}
Fire in a Single Building	7.8×10^{-7}	0.0002	1.2×10^{-5}
Explosion in a Feed Casting Furnace	8.8×10^{-5}	0.023	0.0013
Nuclear Criticality	3.2×10^{-10}	6.0×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	5.9×10^{-6}	0.0015	4.4×10^{-5}
Radioactive Material Spill	1.8×10^{-6}	0.00046	1.3×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.

Table C.7.1.3–5. MPF Alternative Radiological Accident Frequency and Consequences at Pantex for 450 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	57.7	0.058	16,500	8.25	460	0.37
1.0×10^{-5}						
Fire in a Single Building	30.2	0.03	7,880	3.94	281	0.23
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	17.6	0.0088	4,590	2.0	164	0.13
1.0×10^{-2}						
Nuclear Criticality	6.3×10^{-5}	3.2×10^{-8}	0.012	6.0×10^{-6}	0.0006	2.4×10^{-6}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	2.34	0.0012	6.3	0.31	21.9	0.018
1.0×10^{-2}						
Radioactive Material Spill	0.35	0.00018	91.9	0.046	3.28	0.0013
1.0×10^{-2}						

[a] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.3–6. Annual Cancer Risks for the MPF Alternative at Pantex for 450 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	5.8×10^{-7}	8.3×10^{-5}	3.7×10^{-6}
Fire in a Single Building	3.0×10^{-6}	0.0004	2.3×10^{-5}
Explosion in a Feed Casting Furnace	8.8×10^{-5}	0.023	0.0013
Nuclear Criticality	3.2×10^{-10}	6.0×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	1.2×10^{-5}	0.0031	0.00018
Radioactive Material Spill	1.8×10^{-6}	0.00046	1.3×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 422,287 persons residing within 80 km (50 mi) of Pantex.

C.7.1.4 Savannah River Site Alternative

Table C.7.1.4–1. MPF Alternative Radiological Accident Frequency and Consequences at SRS for 125 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	3.16	0.0016	13,100	6.55	207	0.17
1.0×10^{-5}						
Fire in a Single Building	1.64	0.00082	5,930	3.0	127	0.1
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	1.92	0.00096	6,950	3.5	149	0.12
1.0×10^{-2}						
Nuclear Criticality	3.4×10^{-6}	1.7×10^{-9}	0.013	6.3×10^{-6}	0.00061	2.4×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	0.13	6.4×10^{-5}	463	0.23	9.92	0.004
1.0×10^{-2}						
Radioactive Material Spill	0.038	1.9×10^{-5}	139	0.07	2.98	0.0012
1.0×10^{-2}						

[a] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.4–2. Annual Cancer Risks for the MPF Alternative at SRS for 125 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.6×10^{-8}	6.6×10^{-5}	1.7×10^{-6}
Fire in a Single Building	8.2×10^{-8}	0.0003	1.0×10^{-5}
Explosion in a Feed Casting Furnace	9.6×10^{-6}	0.035	0.0012
Nuclear Criticality	1.7×10^{-11}	6.3×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	6.4×10^{-7}	0.0023	4.0×10^{-5}
Radioactive Material Spill	1.9×10^{-7}	0.0007	1.2×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.

Table C.7.1.4–3. MPF Alternative Radiological Accident Frequency and Consequences at SRS for 250 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	3.26	0.0016	13,500	6.75	213	0.17
1.0×10^{-5}						
Fire in a Single Building	1.7	0.00085	6,150	3.07	132	0.11
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	1.92	0.00096	6,950	3.47	149	0.12
1.0×10^{-2}						
Nuclear Criticality	3.4×10^{-6}	1.7×10^{-9}	0.013	6.3×10^{-6}	0.00061	2.4×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	0.13	6.4×10^{-5}	463	0.23	9.92	0.004
1.0×10^{-2}						
Radioactive Material Spill	0.038	1.9×10^{-5}	139	0.07	3.0	0.0012
1.0×10^{-2}						

[a] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.4–4. Annual Cancer Risks for the MPF Alternative at SRS for 250 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.6×10^{-8}	6.8×10^{-5}	1.7×10^{-6}
Fire in a Single Building	8.5×10^{-8}	0.00031	1.1×10^{-5}
Explosion in a Feed Casting Furnace	9.6×10^{-6}	0.035	0.0012
Nuclear Criticality	1.7×10^{-11}	6.3×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	6.4×10^{-7}	0.0023	4.0×10^{-5}
Radioactive Material Spill	1.9×10^{-7}	0.0007	1.2×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.

Table C.7.1.4–5. MPF Alternative Radiological Accident Frequency and Consequences at SRS for 450 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	6.27	0.0031	26,000	13	411	0.33
1.0×10^{-5}						
Fire in a Single Building	3.3	0.0017	11,900	5.96	255	0.2
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	1.92	0.00096	6,950	3.47	149	0.12
1.0×10^{-2}						
Nuclear Criticality	3.4×10^{-6}	1.7×10^{-9}	0.013	6.3×10^{-6}	0.00061	2.4×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	0.26	1.3×10^{-4}	927	0.46	19.8	0.0079
1.0×10^{-2}						
Radioactive Material Spill	0.038	1.9×10^{-5}	139	0.07	2.98	0.0012
1.0×10^{-2}						

[a] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.4–6. Annual Cancer Risks for the MPF Alternative at SRS for 450 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	3.1×10^{-8}	0.00013	3.3×10^{-6}
Fire in a Single Building	1.7×10^{-7}	0.0006	2.0×10^{-5}
Explosion in a Feed Casting Furnace	9.6×10^{-6}	0.035	0.0012
Nuclear Criticality	1.7×10^{-11}	6.3×10^{-8}	2.4×10^{-9}
Fire-induced Release in the CRT Storage Room	1.3×10^{-6}	0.0046	7.9×10^{-5}
Radioactive Material Spill	1.9×10^{-7}	0.0007	1.2×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 1,085,852 persons residing within 80 km (50 mi) of SRS.

C.7.1.5 Carlsbad Site Alternative

Table C.7.1.5–1. MPF Alternative Radiological Accident Frequency and Consequences at the Carlsbad Site for 125 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	50.3	0.05	3,000	1.5	331	0.27
1.0×10^{-5}						
Fire in a Single Building	26.5	0.027	1,380	0.69	206	0.17
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	31.1	0.031	1,620	0.81	241	0.19
1.0×10^{-2}						
Nuclear Criticality	9.9×10^{-5}	5.0×10^{-8}	0.0046	2.3×10^{-6}	0.00076	3.0×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	2.1	0.001	108	0.054	16.1	0.0064
1.0×10^{-2}						
Radioactive Material Spill	0.62	0.00031	32.3	0.016	4.83	0.0019
1.0×10^{-2}						

[a] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of WIPP.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.1.5–2. Annual Cancer Risks for the MPF Alternative at the Carlsbad Site for 125 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	5.0×10^{-7}	1.5×10^{-5}	2.7×10^{-6}
Fire in a Single Building	2.7×10^{-6}	6.9×10^{-5}	1.7×10^{-5}
Explosion in a Feed Casting Furnace	0.00031	0.0081	0.0019
Nuclear Criticality	5.0×10^{-10}	2.3×10^{-8}	3.0×10^{-9}
Fire-induced Release in the CRT Storage Room	1.0×10^{-5}	0.00054	6.4×10^{-5}
Radioactive Material Spill	3.1×10^{-6}	0.00016	1.9×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs.
[c] Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of WIPP.

Table C.7.1.5–3. MPF Alternative Radiological Accident Frequency and Consequences at the Carlsbad Site for 250 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	51.8	0.052	3,090	1.55	341	0.27
1.0×10^{-5}						
Fire in a Single Building	27.5	0.028	1,430	0.72	214	0.17
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	31.1	0.031	1,620	0.81	241	0.19
1.0×10^{-2}						
Nuclear Criticality	9.9×10^{-5}	5.0×10^{-8}	0.0046	2.3×10^{-6}	0.0076	3.0×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	2.1	0.001	108	0.054	16.1	0.0064
1.0×10^{-2}						
Radioactive Material Spill	0.62	0.00031	32.3	0.016	4.83	0.0019
1.0×10^{-2}						

a Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of WIPP.
b Increased likelihood of a LCF.
c Increased likelihood of LCFs.

Table C.7.1.5–4. Annual Cancer Risks for the MPF Alternative at the Carlsbad Site for 250 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	5.2×10^{-7}	1.6×10^{-5}	2.7×10^{-6}
Fire in a Single Building	2.8×10^{-6}	7.2×10^{-5}	1.7×10^{-5}
Explosion in a Feed Casting Furnace	0.00031	0.0081	0.0019
Nuclear Criticality	5.0×10^{-10}	2.3×10^{-8}	3.0×10^{-9}
Fire-induced Release in the CRT Storage Room	1.0×10^{-5}	0.00054	6.4×10^{-5}
Radioactive Material Spill	3.1×10^{-6}	0.00016	1.9×10^{-5}

a Increased likelihood of a LCF.
b Increased likelihood of LCFs.
c Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of WIPP.

Table C.7.1.5–5. MPF Alternative Radiological Accident Frequency and Consequences at the Carlsbad Site for 450 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	99.8	0.1	5,950	2.98	657	0.53
1.0×10^{-5}						
Fire in a Single Building	53.3	0.053	2,770	1.39	414	0.33
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	31.1	0.031	1,620	0.81	241	0.19
1.0×10^{-2}						
Nuclear Criticality	9.9×10^{-5}	5.0×10^{-8}	0.0046	2.3×10^{-6}	0.00076	3.0×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	4.14	0.0021	216	0.11	322	0.026
1.0×10^{-2}						
Radioactive Material Spill	0.62	0.00031	32.3	0.016	4.83	0.0019
1.0×10^{-2}						

a Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of WIPP.
b Increased likelihood of a LCF.
c Increased likelihood of LCFs.

Table C.7.1.5–6. Annual Cancer Risks for the MPF Alternative at the Carlsbad Site for 450 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	1.0×10^{-6}	3.0×10^{-5}	5.3×10^{-6}
Fire in a Single Building	5.3×10^{-6}	0.00014	3.3×10^{-5}
Explosion in a Feed Casting Furnace	0.00031	0.0081	0.0019
Nuclear Criticality	5.0×10^{-10}	2.3×10^{-8}	3.0×10^{-9}
Fire-induced Release in the CRT Storage Room	2.1×10^{-5}	0.0011	0.00026
Radioactive Material Spill	3.1×10^{-6}	0.00016	1.9×10^{-5}

a Increased likelihood of a LCF.
b Increased likelihood of LCFs.
c Based on a year-2043 population of 117,796 persons residing within 80 km (50 mi) of WIPP.

C.7.2 Modern Pit Facility Chemical Accident Frequency and Consequences

The chemicals selected for evaluation are based on the aqueous feed preparation process, as noted in each table, and are considered the most hazardous of all the chemicals used in this process. Determination of a chemical's hazardous ranking takes into account quantities available for release, protective concentration limits (ERPG-2) and evaporation rate. The most hazardous chemical used in an alternative method, the pyrochemical processing method is also analyzed as noted in the tables.

This section describes the impacts of potential chemical accidents at each of the five MPF alternatives and for the 125 ppy, 250 ppy, and 450 ppy production cases. The tables show the name of the chemical and the quantity released during a severe accident. The impacts of chemical releases are measured in terms of ERPG-2 protective concentration limits given in ppm. The distances at which the limit is reached are also provided for the ERPG-2 limit. The concentration of the chemical at 1,000 m (3,281 ft) from the accident is shown for comparison with the concentration limit for ERPG-2. The distance to the site boundary and the concentration at the site boundary are also shown for comparison with the ERPG-2 concentration limits and for determining if the limits are exceeded offsite.

C.7.2.1 Los Alamos Site Alternative

This section describes the impacts associated with the MPF LANL Alternative.

Table C.7.2.1–1. MPF Alternative Chemical Accident Frequency and Consequences at LANL for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 1.75 km (ppm)	
Nitric acid[b]	10,500	6	0.68	3.16	1.28	10^{-4}
Hydrofluoric acid[b]	550	20	0.61	6.98	2.43	10^{-4}
Formic acid[b]	1,500	10	0.19	0.51	0.202	10^{-4}
Hydrochloric Acid[c]	600	20	2	69.2	24.8	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.1–2. MPF Alternative Chemical Accident Frequency and Consequences at LANL for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	Site Boundary at 1.75 km (ppm)	
Nitric acid[b]	21,000	6	1.4	11.4	3.31	10^{-4}
Hydrofluoric acid[b]	1,100	20	0.83	13.4	4.02	10^{-4}
Formic acid[b]	3,000	10	0.26	0.975	0.34	10^{-4}
Hydrochloric acid[c]	1,200	20	2.7	124	46.4	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.1–3. MPF Alternative Chemical Accident Frequency and Consequences at LANL for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 1.75 km (ppm)	
Nitric acid[b]	40,000	6	1.9	20.3	7.29	10^{-4}
Hydrofluoric acid[b]	2,000	20	1.1	23.7	8.42	10^{-4}
Formic acid[b]	5,500	10	0.36	1.73	0.694	10^{-4}
Hydrochloric acid[c]	2,200	20	3.5	188	77.7	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

C.7.2.2 Nevada Test Site Alternative

This section describes the impacts associated with the MPF NTS Alternative.

Table C.7.2.2–1. MPF Alternative Chemical Accident Frequency and Consequences at NTS for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 7.6 km (ppm)	
Nitric acid[b]	10,500	6	0.28	0.5	0.01	10^{-4}
Hydrofluoric acid[b]	550	20	0.35	2.0	0.016	10^{-4}
Formic acid[b]	1,500	10	0.08	0.07	0	10^{-4}
Hydrochloric acid[c]	600	20	1.1	26.3	0.35	10^{-4}

[a] Site boundary is at a distance of 7.6 km (4.7 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.2–2. MPF Alternative Chemical Accident Frequency and Consequences at NTS for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 7.6 km (ppm)	
Nitric acid[b]	21,000	6	0.4	0.98	0.02	10^{-4}
Hydrofluoric acid[b]	1,100	20	0.48	3.9	0.03	10^{-4}
Formic acid[b]	3,000	10	0.12	0.14	0	10^{-4}
Hydrochloric acid[c]	1,200	20	1.6	50.9	0.68	10^{-4}

[a] Site boundary is at a distance of 7.6 km (4.7 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.2–3. MPF Alternative Chemical Accident Frequency and Consequences at NTS for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 7.6 km (ppm)	
Nitric acid[b]	40,000	6	0.54	1.8	0.038	10^{-4}
Hydrofluoric acid[b]	2,000	20	0.64	6.93	0.056	10^{-4}
Formic acid[b]	5,500	10	0.15	0.25	0.0054	10^{-4}
Hydrochloric acid[c]	2,200	20	2.1	90.7	1.22	10^{-4}

[a] Site boundary is at a distance of 7.6 km (4.7 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

C.7.2.3 Pantex Site Alternative

This section describes the impacts associated with the MPF Pantex Alternative.

Table C.7.2.3–1. MPF Alternative Chemical Accident Frequency and Consequences at Pantex for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.5 km (ppm)	
Nitric acid[b]	10,500	6	0.59	2.49	0.58	10^{-4}
Hydrofluoric acid[b]	550	20	0.59	5.25	0.99	10^{-4}
Formic acid[b]	1,500	10	0.16	0.37	0.87	10^{-4}
Hydrochloric acid[c]	600	20	1.8	60.8	10.4	10^{-4}

[a] Site boundary is at a distance of 2.5 km (1.5 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.3–2. MPF Alternative Chemical Accident Frequency and Consequences at Pantex for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.5 km (ppm)	
Nitric acid[b]	21,000	6	0.88	4.82	1.14	10^{-4}
Hydrofluoric acid[b]	1,100	20	0.83	10.2	1.94	10^{-4}
Formic acid[b]	3,000	10	0.22	0.72	0.17	10^{-4}
Hydrochloric acid[c]	1,200	20	2.5	117	20	10^{-4}

[a] Site boundary is at a distance of 2.5 km (1.5 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.3–3. MPF Alternative Chemical Accident Frequency and Consequences at Pantex for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.5 km (ppm)	
Nitric acid[b]	40,000	6	1.3	8.89	2.11	10^{-4}
Hydrofluoric acid[b]	2,000	20	1.1	18.2	3.46	10^{-4}
Formic acid[b]	5,500	10	0.3	1.28	0.3	10^{-4}
Hydrochloric acid[c]	2,200	20	3.3	202	35.1	10^{-4}

[a] Site boundary is at a distance of 2.5 km (1.5 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

C.7.2.4 Savannah River Site Alternative

This section describes the impacts associated with the MPF SRS Alternative.

Table C.7.2.4–1. MPF Alternative Chemical Accident Frequency and Consequences at SRS for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 8.7 km (ppm)	
Nitric acid[b]	10,500	6	0.44	1.27	0.017	10^{-4}
Hydrofluoric acid[b]	550	20	0.49	3.35	0.03	10^{-4}
Formic acid[b]	1,500	10	0.13	0.19	0	10^{-4}
Hydrochloric acid[c]	600	20	1.5	42.2	0.361	10^{-4}

[a] Site boundary is at a distance of 8.7 km (4.5 mi) west.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.4–2. MPF Alternative Chemical Accident Frequency and Consequences at SRS for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 8.7 km (ppm)	
Nitric acid[b]	21,000	6	0.62	2.45	0.032	10^{-4}
Hydrofluoric acid[b]	1,100	20	0.66	6.51	0.06	10^{-4}
Formic acid[b]	3,000	10	0.18	0.37	0	10^{-4}
Hydrochloric acid[c]	1,200	20	2.1	81	0.71	10^{-4}

[a] Site boundary is at a distance of 8.7 km (4.5 mi) west.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.4–3. MPF Alternative Chemical Accident Frequency and Consequences at SRS for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 8.7 km (ppm)	
Nitric acid[b]	40,000	6	0.86	4.52	0.06	10^{-4}
Hydrofluoric acid[b]	2,000	20	0.83	11.5	0.11	10^{-4}
Formic acid[b]	5,500	10	0.24	0.66	0.0084	10^{-4}
Hydrochloric acid[c]	2,200	20	2.8	144	1.28	10^{-4}

[a] Site boundary is at a distance of 8.7 km (4.5 mi) west.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

C.7.2.5 Carlsbad Site Alternative

This section describes the impacts associated with the MPF Carlsbad Site Alternative.

Table C.7.2.5–1. MPF Alternative Chemical Accident Frequency and Consequences at the Carlsbad Site for 125 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.3 km (ppm)	
Nitric acid[b]	10,500	6	1.0	6.18	1.57	10^{-4}
Hydrofluoric acid[b]	550	20	0.81	12.7	2.49	10^{-4}
Formic acid[b]	1,500	10	0.28	0.97	0.24	10^{-4}
Hydrochloric acid[c]	600	20	2.4	97.6	20.6	10^{-4}

[a] Site boundary is at a distance of 2.3 km (1.4 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.5–2. MPF Alternative Chemical Accident Frequency and Consequences at the Carlsbad Site for 250 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.3 km (ppm)	
Nitric acid[b]	21,000	6	1.5	11.9	3.04	10^{-4}
Hydrofluoric acid[b]	1,100	20	1.1	24.6	4.86	10^{-4}
Formic acid[b]	3,000	10	0.39	1.88	0.47	10^{-4}
Hydrochloric acid[c]	1,200	20	3.3	174	38.7	10^{-4}

[a] Site boundary is at a distance of 2.3 km (1.4 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

Table C.7.2.5–3. MPF Alternative Chemical Accident Frequency and Consequences at the Carlsbad Site for 450 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 2.3 km (ppm)	
Nitric acid[b]	40,000	6	2.3	21.9	5.64	10^{-4}
Hydrofluoric acid[b]	2,000	20	1.5	43.7	8.71	10^{-4}
Formic acid[b]	5,500	10	0.54	3.36	0.85	10^{-4}
Hydrochloric acid[c]	2,200	20	4.3	262	66.2	10^{-4}

[a] Site boundary is at a distance of 2.3 km (1.4 mi) east.
[b] Chemicals used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

C.7.3 Radiological Accident Frequency and Consequences for the TA-55 Upgrade Alternative

This section describes the radiological accident impacts associated with the TA-55 Upgrade Alternative at LANL.

Table C.7.3–1. Upgrade Alternative Radiological Accident Frequency and Consequences at LANL for 80 ppy

Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population[a]		Non-involved Worker	
	Dose (rem)	LCFs[b]	Dose (person-rem)	LCFs[c]	Dose (rem)	LCFs[b]
Beyond Evaluation Basis Earthquake with Fire	26.4	0.026	23,200	11.6	156	0.13
1.0×10^{-5}						
Fire in a Single Building	20.9	0.021	13,700	6.85	193	0.15
1.0×10^{-4}						
Explosion in a Feed Casting Furnace	38.3	0.038	25,100	12.5	353	0.28
1.0×10^{-2}						
Nuclear Criticality	0.00012	5.8×10^{-8}	0.11	5.3×10^{-5}	0.0012	4.7×10^{-7}
1.0×10^{-2}						
Fire-induced Release in the CRT Storage Room	1.6	0.0008	1,070	0.54	151	0.006
1.0×10^{-2}						
Radioactive Material Spill	0.77	0.00036	502	0.25	7.05	0.0028
1×10^{-2}						

[a] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.
[b] Increased likelihood of a LCF.
[c] Increased likelihood of LCFs.

Table C.7.3–2. Annual Cancer Risks for the Upgrade Alternative at LANL for 80 ppy

Accident	Maximally Exposed Offsite Individual[a]	Offsite Population[b,c]	Non-involved Worker[a]
Beyond Evaluation Basis Earthquake with Fire	2.6×10^{-7}	0.00012	1.3×10^{-6}
Fire in a Single Building	2.1×10^{-7}	0.00069	1.5×10^{-5}
Explosion in a Feed Casting Furnace	0.00038	0.13	0.0028
Nuclear Criticality	5.6×10^{-10}	5.3×10^{-7}	4.7×10^{-9}
Fire-induced Release in the CRT Storage Room	8.0×10^{-6}	0.0054	6.0×10^{-5}
Radioactive Material Spill	3.6×10^{-6}	0.0025	2.8×10^{-5}

[a] Increased likelihood of a LCF.
[b] Increased likelihood of LCFs
[c] Based on a year-2043 population of 586,335 persons residing within 80 km (50 mi) of LANL.

C.7.4 Chemical Accident Frequency and Consequences for the TA-55 Upgrade Alternative

This section describes the chemical accident impacts for the TA-55 Upgrade Alternative at LANL for the single production case of 80 ppy.

Table C.7.4–1. Upgrade Alternative Chemical Accident Frequency and Consequences for 80 ppy

Chemical Released	Quantity Released (kg)	ERPG-2 [a]		Concentration [a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 m (ppm)	At Site Boundary 1.75 km (ppm)	
Nitric acid[b]	3,420	6	0.37	1.08	0.44	10^{-4}
Hydrofluoric acid[b]	340	20	0.5	4.44	1.54	10^{-4}
Hydrochloric acid[c]	384	20	1.6	47.1	16.6	10^{-4}

[a] Site boundary is at a distance of 1.75 km (1.1 mi) north.
[b] Chemical used in the aqueous processing method.
[c] Chemical used in the pyrochemical processing method.

C.7.5 Chemical Dispersion Plumes

The chemical accident scenario postulates a release of the chemical and the formation of a chemical pool of one-inch depth in the area surrounding the release. The release could be a result of a pipe or tank rupture. Based on the chemical's properties, evaporation will take place producing an airborne plume that travels in the direction of the wind at the time of the accident. This section provides a graphic representation of the plume with respect to on site and offsite locations.

The plumes for two chemicals have been evaluated, nitric acid for the aqueous plutonium process and hydrochloric acid for the pyrochemical plutonium process. These two chemicals are considered the most hazardous for the indicated process. They are also based on the maximum pit production case of 450 pits per year.

The plume (Figures C.7.5-1 through C.7.5-10) is shown as emanating from the point of release in a direction towards where the maximum exposed individual for radiological accidents would be located. The farthest end of the plume is the point where the ERPG-2 concentration level is no longer exceeded. Concentrations closer to the point of release will be higher then ERPG-2 and at some point exceed the higher concentration limit defined by ERPG-3.

Although the direction of the plume is graphically positioned towards the site boundary where the maximum exposed individual for radiological accidents would be located, in reality the plume will travel in a direction determined by the wind direction at the time of the accident. Thus, the plume could be positioned in a direction anywhere in the circle surrounding the point of release. In the event of an accident, all individuals in the plume as determined by the wind direction at the time will be exposed to harmful chemical concentrations in excess of ERPG-2 and in some cases, in excess of ERPG-3.

Plumes for the TA-55 upgrade case are not shown because the plume concentrations are smaller than the TA-55 MPF Alternative at LANL.

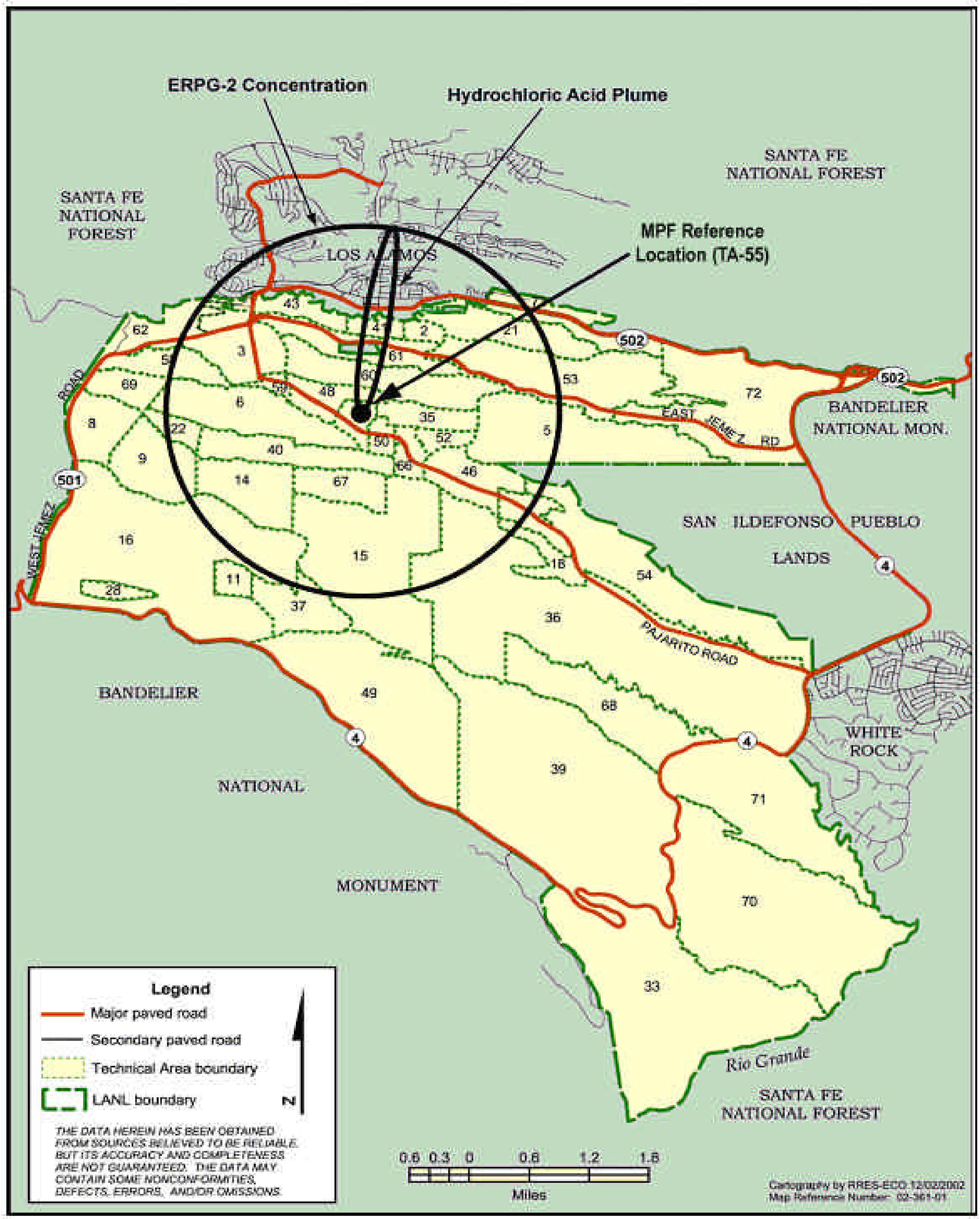
C.8 ANALYSIS CONSERVATISM AND UNCERTAINTY

The analysis of accidents is based on calculations relevant to hypothetical sequences of events and models of their potential impacts. The models provide estimates of the frequencies, source terms, pathways for dispersion, exposures, and the effects on human health and the environment as realistic as possible within the scope of the analysis. In many cases, the scarcity of experience with the postulated accidents leads to uncertainty in the calculation of the consequences and frequencies. This fact has promoted the use of models or input values that yield conservative estimates of consequences and frequency. Additionally, since no credit is taken for safety systems that may function during this event, these events do not represent expected conditions within the facility at any point in its lifetime.

Due to the layers of conservatism built into the accident analysis for the spectrum of postulated accidents, the estimated consequences and risks to the public represent the upper limit for the individual classes of accidents. The uncertainties associated with the accident frequency estimates are enveloped by the analysis conservatism.

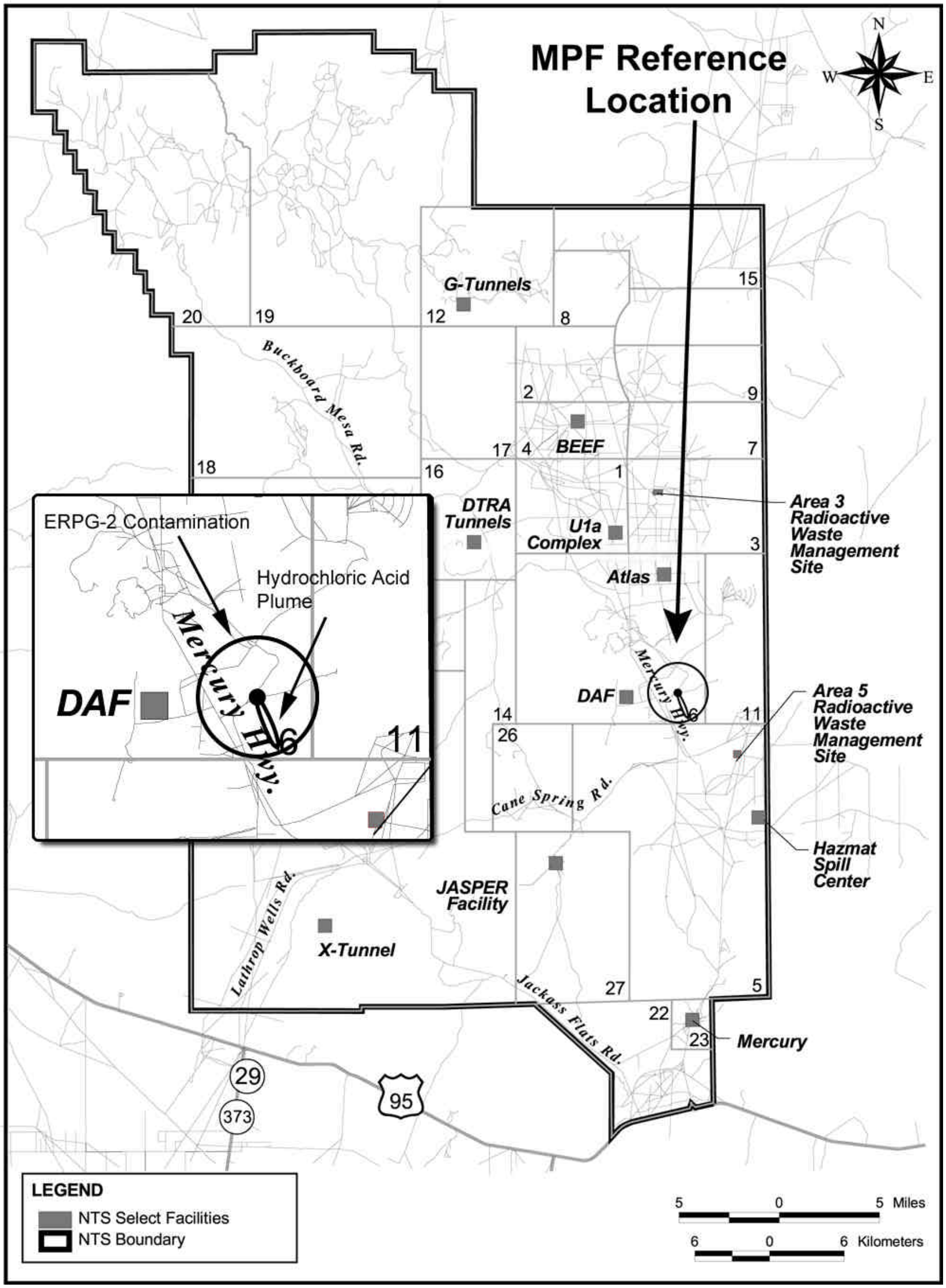
Of particular interest are the uncertainties in the estimates of cancer fatalities from exposure to radioactive materials. The numerical values of the health risk estimators used in this EIS were obtained by linear extrapolation from the nominal risk estimate for lifetime total cancer mortality resulting from exposures of 10 rad, because the health risk estimators are multiplied by conservatively calculated radiological doses to predict fatal cancer risks. The fatal cancer values presented in this EIS are expected to be overestimates.

For the purposes of this EIS, the impacts calculated from the linear model are treated as an upper-bound case, consistent with the widely used methodologies for quantifying radiogenic health impacts. This does not imply that health effects are expected. Moreover, in cases where the upper-bound estimators predict a number of LCFs greater than 1, this does not imply that the LCF risk can be determined for a specific individual.



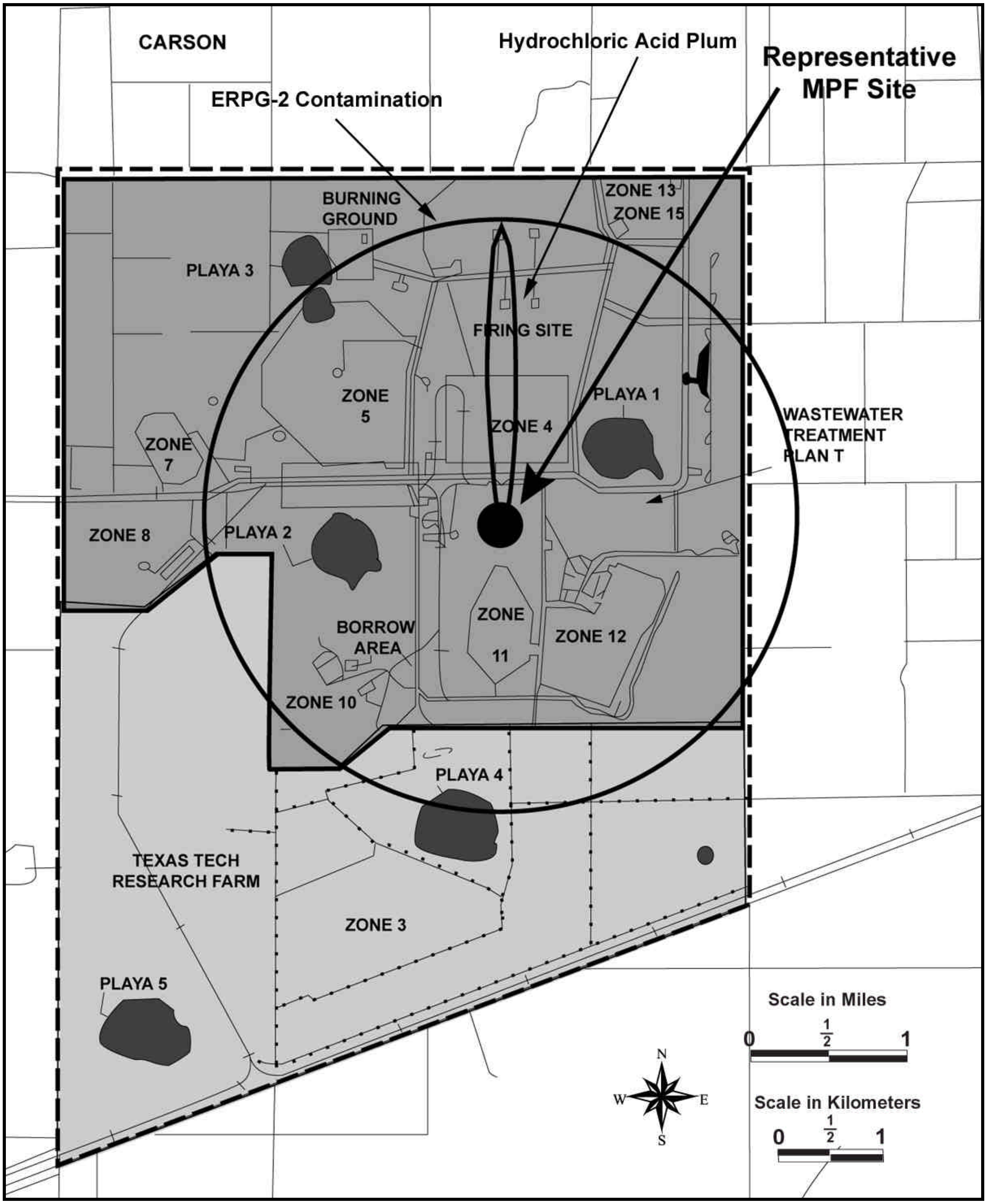
An accidental release of hydrochloric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 3.5 km (2.2 mi) from the source.

Figure C.7.5–1. Accidental Release of Hydrochloric Acid at the MPF at LANL



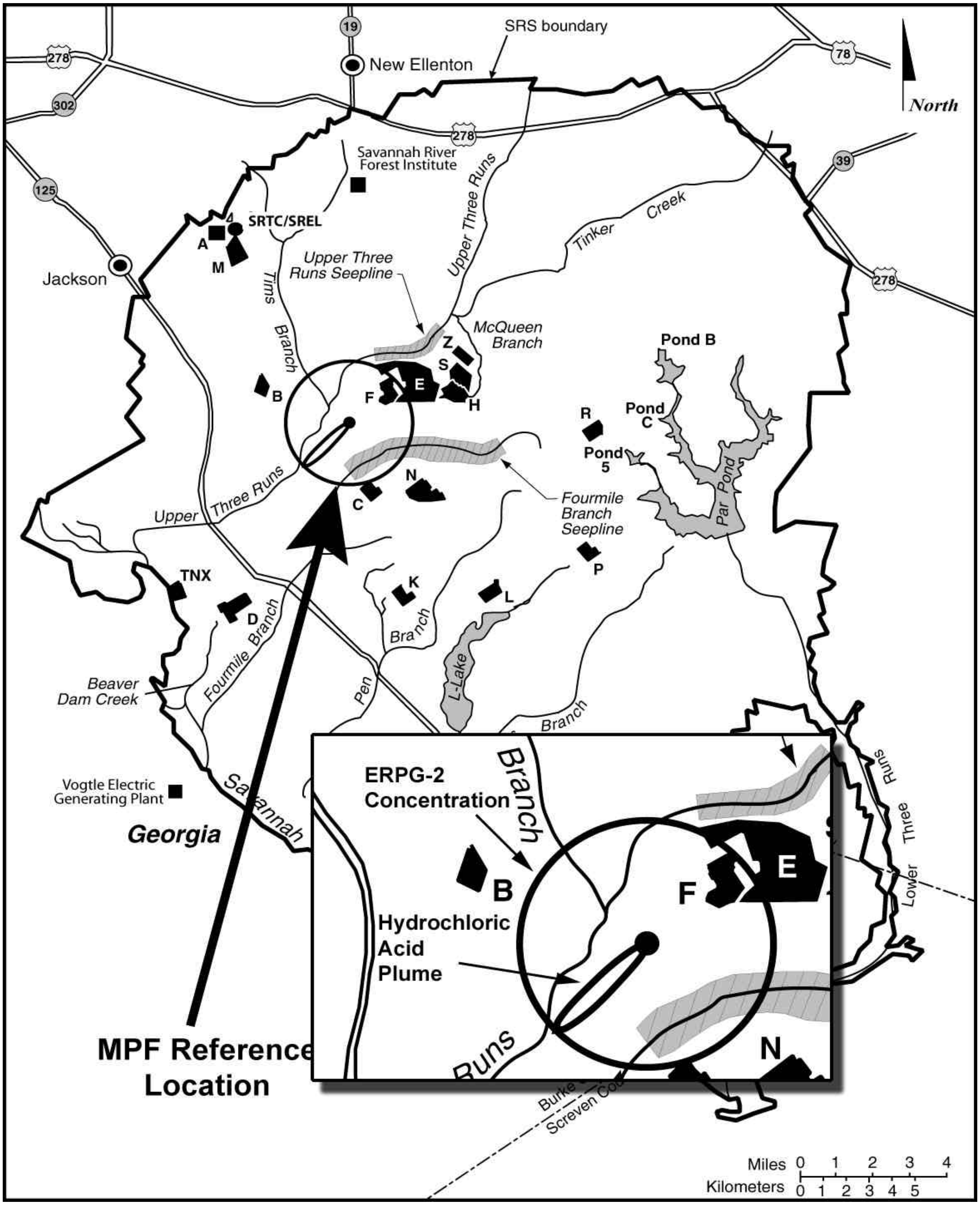
An accidental release of hydrochloric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 2.1 km (1.3 mi) from the source.

Figure C.7.5–2. Accidental Release of Hydrochloric Acid at the MPF at NTS



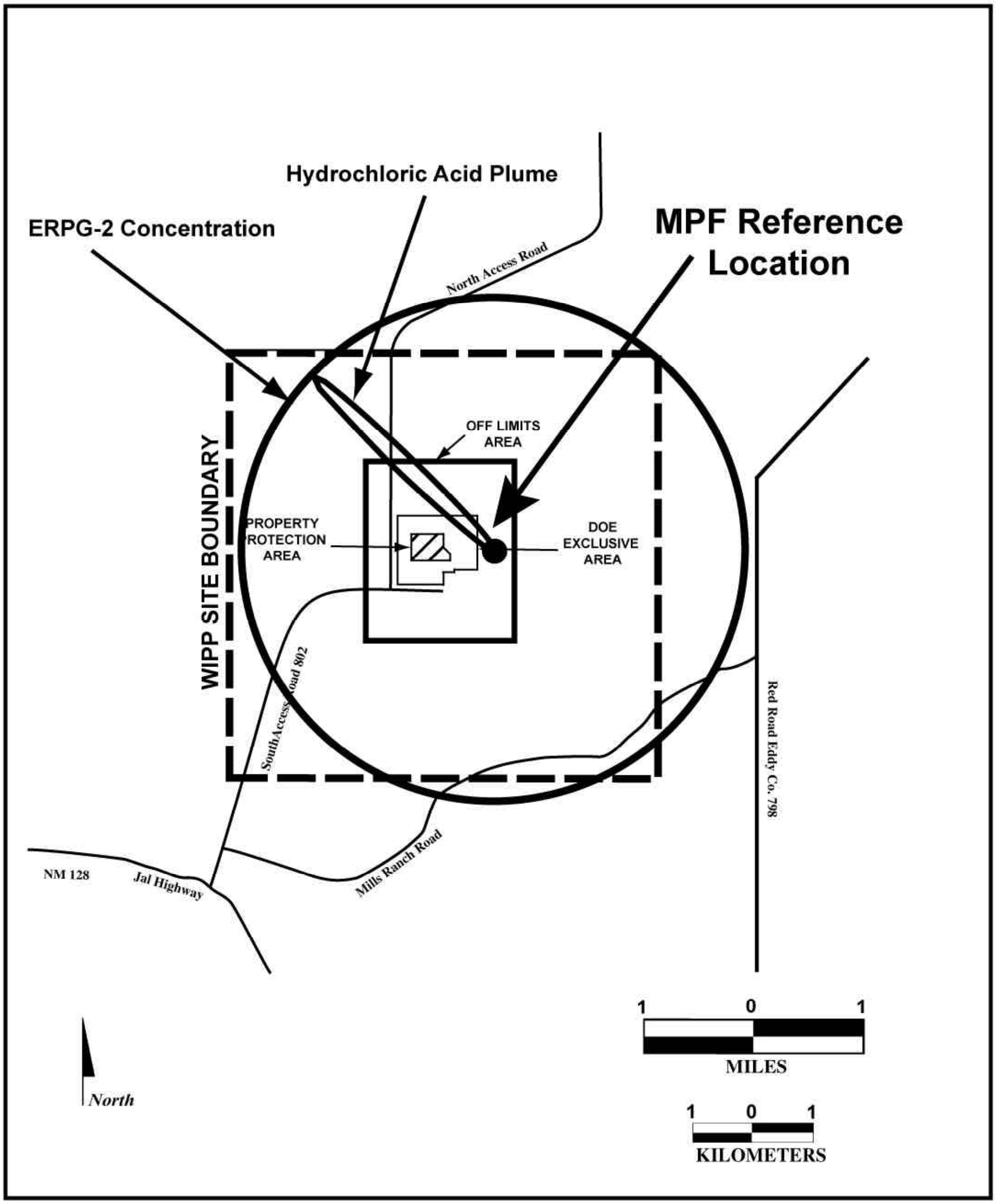
An accidental release of hydrochloric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 3.3 km (2.05 mi) from the source.

Figure C.7.5–3. Accidental Release of Hydrochloric Acid at the MPF at Pantex



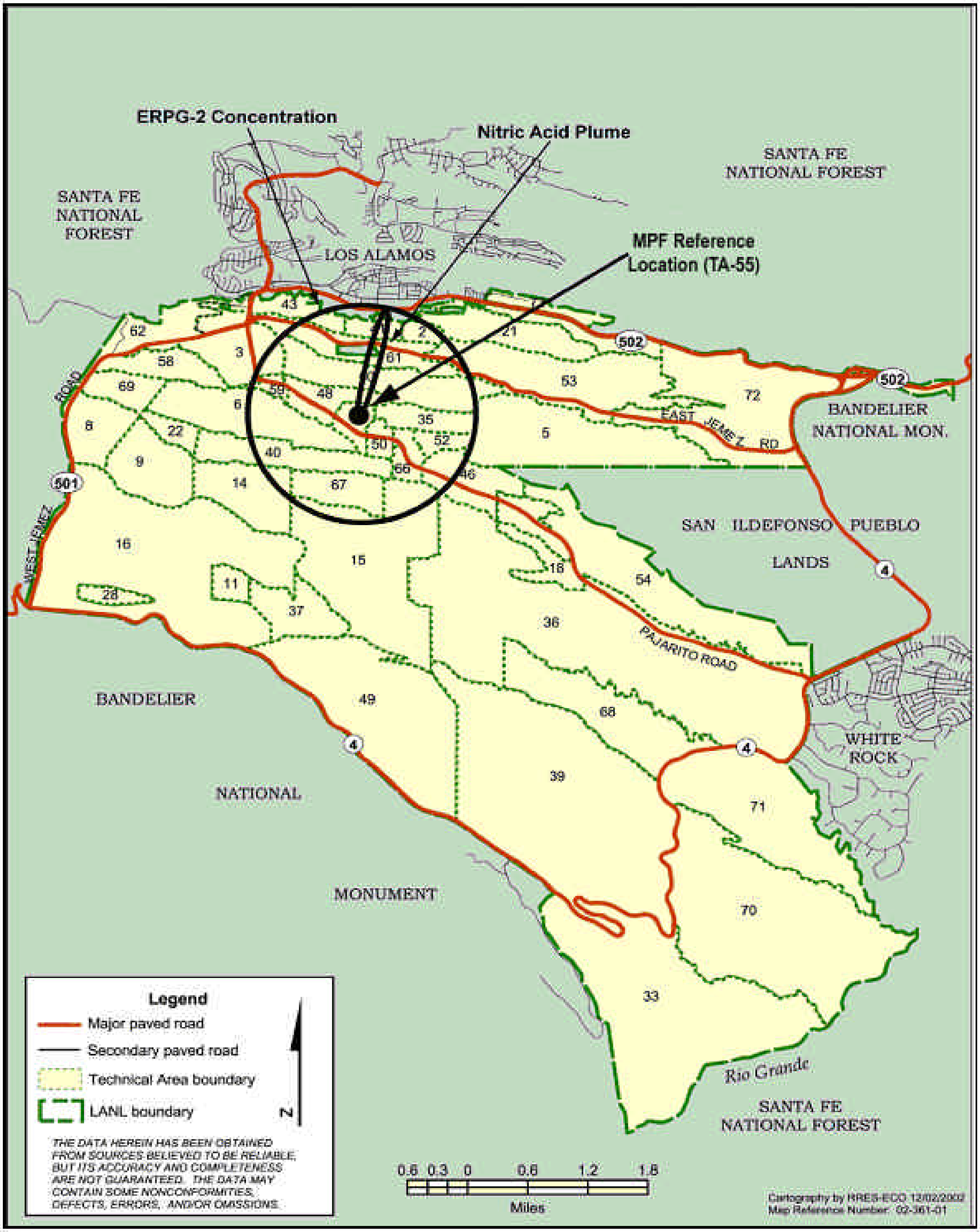
An accidental release of hydrochloric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 2.8 km (1.7 mi) from the source.

Figure C.7.5–4. Accidental Release of Hydrochloric Acid at the MPF at SRS



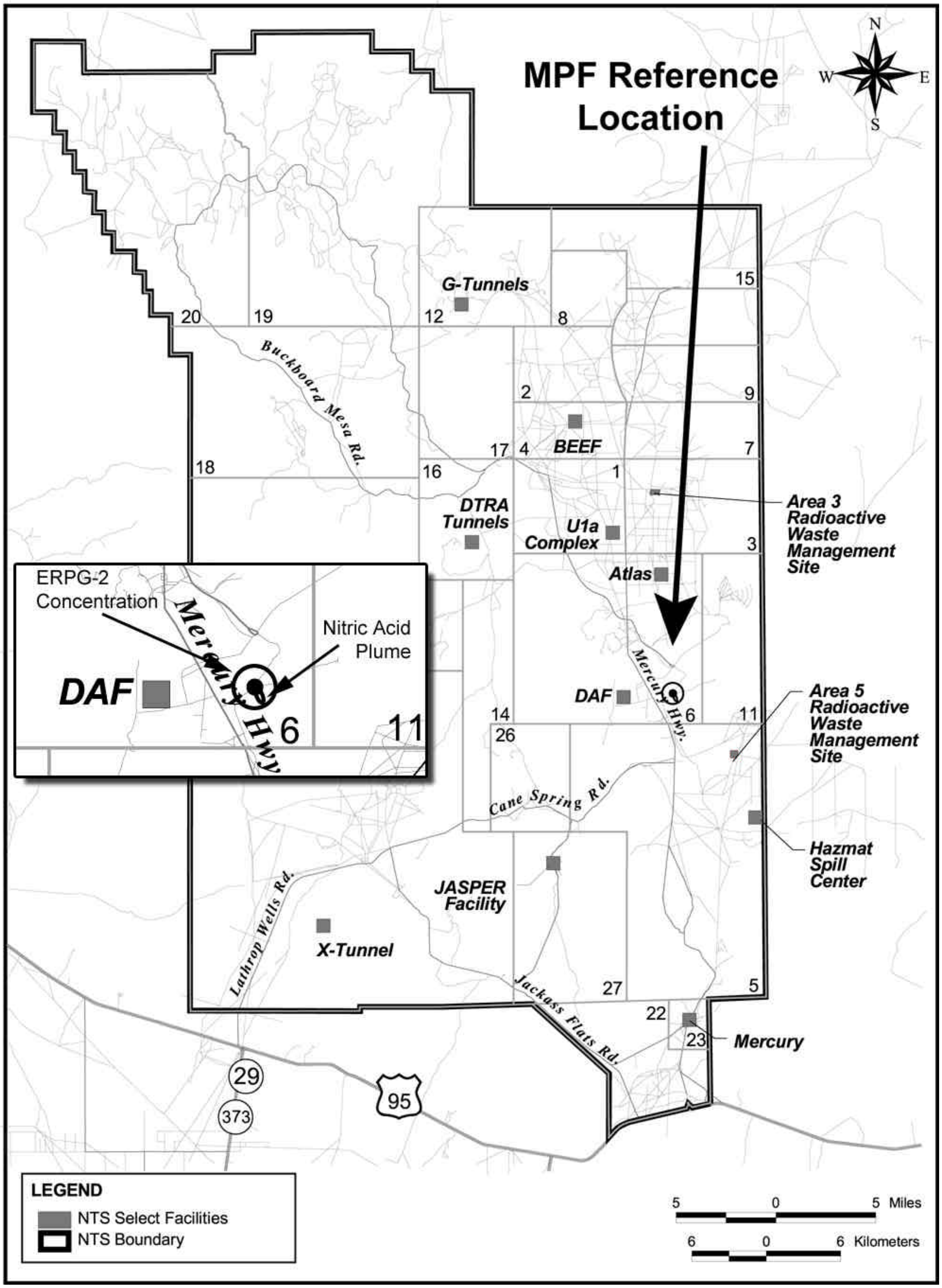
An accidental release of hydrochloric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 4.3 km (2.7 mi) from the source.

Figure C.7.5–5. Accidental Release of Hydrochloric Acid at the MPF at Carlsbad Site



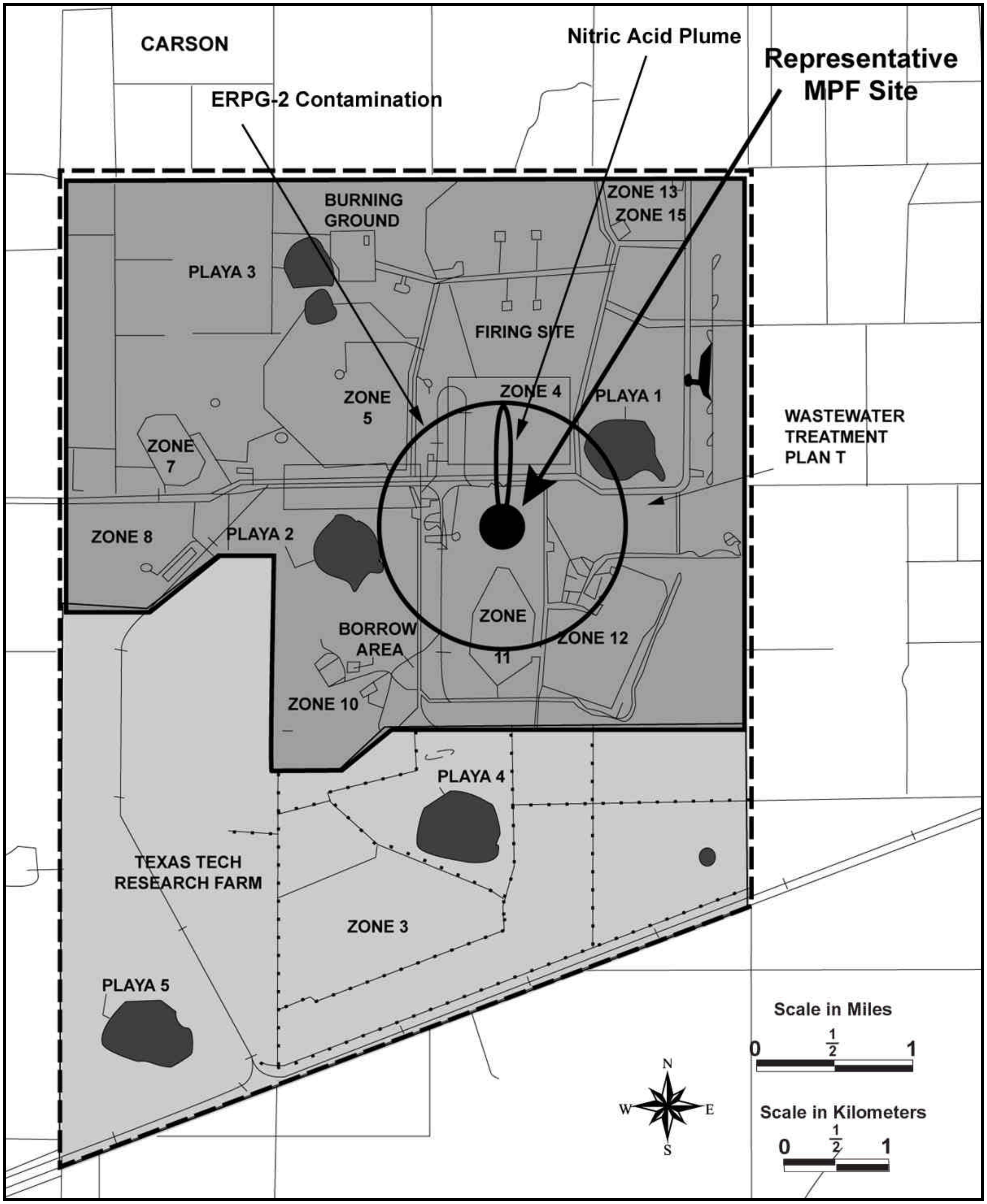
An accidental release of nitric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 1.9 km (1.2 mi) from the source.

Figure C.7.5–6. Accidental Release of Nitric Acid at the MPF at LANL



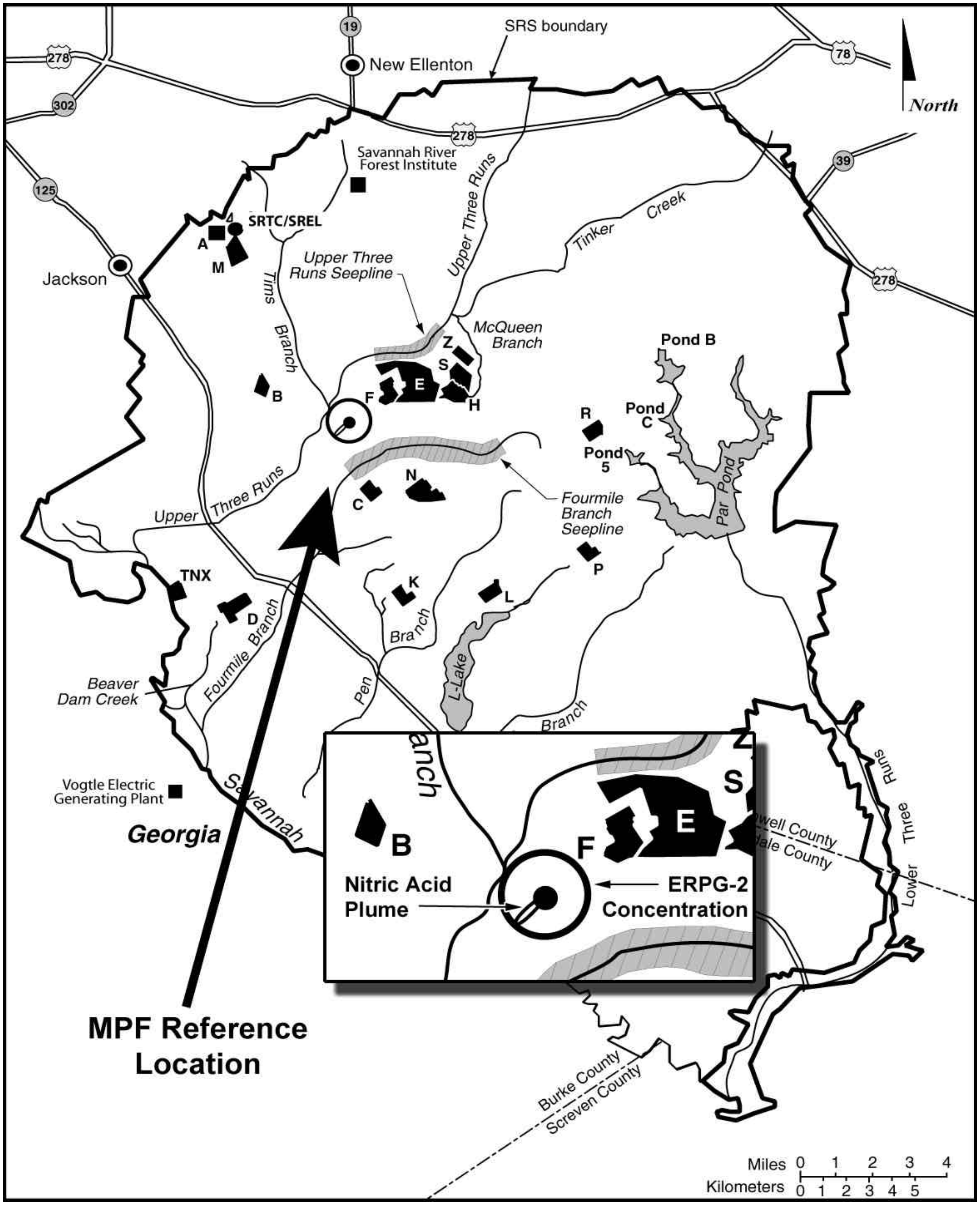
An accidental release of nitric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 0.54 km (0.34 mi) from the source.

Figure C.7.5–7. Accidental Release of Nitric Acid at the MPF at NTS



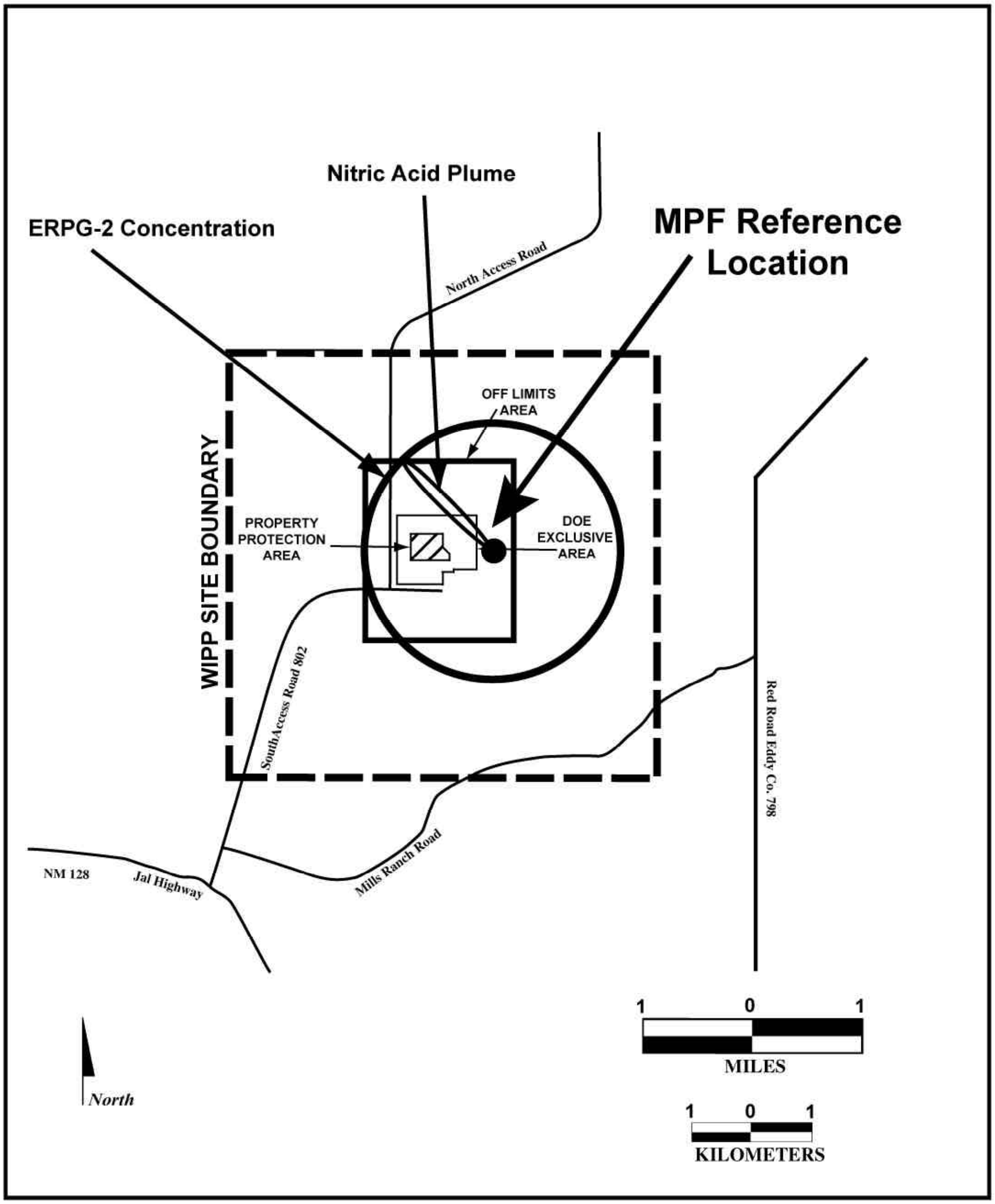
An accidental release of nitric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 1.3 km (0.8 mi) from the source.

Figure C.7.5–8. Accidental Release of Nitric Acid at the MPF at Pantex



An accidental release of nitric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 0.86 km (0.53 mi) from the source.

Figure C.7.5–9. Accidental Release of Nitric Acid at the MPF at SRS



An accidental release of nitric acid from the MPF could affect an area with ERPG-2 levels of exposure extending as far as 2.3 km (1.4 mi) from the source.

Figure C.7.5–10. Accidental Release of Nitric Acid at the MPF at Carlsbad Site

APPENDIX D
RADIOLOGICAL TRANSPORTATION ANALYSIS METHODOLOGY

D.1 SHIPMENT SCENARIOS

D.1.1 Proposed Action for Transportation

The Modern Pit Facility (MPF) Alternative, as described in Chapter 3, includes transportation as a major component. Aged plutonium pit assemblies would be shipped from Department of Energy (DOE) Pantex Plant in Amarillo, Texas to the MPF site under consideration. Enriched uranium (EU) parts would be disassembled from the pit assemblies and shipped to the Y-12 National Security Complex (Y-12) near Oak Ridge, Tennessee. The reworked EU parts would then be shipped back to MPF. The pit assemblies would be returned to Pantex. During startup, and potentially at other infrequent times, plutonium metal would be shipped from either the Savannah River Site (SRS) or Los Alamos National Laboratory (LANL) to the MPF site.

Both transuranic (TRU) waste and low-level waste (LLW) would be generated at the MPF site. It would have to be disposed at another location if facilities at the MPF site were not available. DOE's Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico would be the destination for TRU waste from all potential MPF sites. Three potential MPF sites, LANL, Nevada Test Site (NTS), and SRS, have LLW disposal facilities. Neither WIPP nor Pantex have such disposal capacity and would have to ship LLW to NTS.

A matrix depicting the origins, destinations, and materials shipped is provided in Table D.1.1–1. The matrix also includes shipments under the No Action and TA-55 Upgrade Alternatives, which are subsets of those for the MPF Alternative.

Table D.1.1–1. Origins, Destinations, and Material Shipped Under the MPF Alternative

Shipment Type	SRS	Pantex	LANL	NTS	Carlsbad Site
SRS Plutonium in	SRS ⇒ SRS	SRS ⇒ Pantex	SRS ⇒ LANL	SRS ⇒ NTS	SRS ⇒ Carlsbad Site
LANL Plutonium in	LANL ⇒ SRS	LANL ⇒ Pantex	LANL ⇒ LANL	LANL ⇒ NTS	LANL ⇒ Carlsbad Site
Pits in	Pantex ⇒ SRS	Pantex ⇒ Pantex	Pantex ⇒ LANL	Pantex ⇒ NTS	Pantex ⇒ Carlsbad Site
EU in	Y-12 ⇒ SRS	Y-12 ⇒ Pantex	Y-12 ⇒ LANL	Y-12 ⇒ NTS	Y-12 ⇒ Carlsbad Site
EU out	SRS ⇒ Y-12	Pantex ⇒ Y-12	LANL ⇒ Y-12	NTS ⇒ Y-12	Carlsbad Site ⇒ Y-12
Pits out	SRS ⇒ Pantex	Pantex ⇒ Pantex	LANL ⇒ Pantex	NTS ⇒ Pantex	Carlsbad Site ⇒ Pantex
TRU waste out	SRS ⇒ WIPP	Pantex ⇒ WIPP	LANL ⇒ WIPP	NTS ⇒ WIPP	Carlsbad Site ⇒ WIPP
LLW out	SRS ⇒ SRS	Pantex ⇒ NTS	LANL ⇒ LANL	NTS ⇒ NTS	Carlsbad Site ⇒ NTS

D.1.2 Materials Shipped

The materials shipped are described as follows.

SRS plutonium/LANL plutonium: Whether from SRS or LANL, this material is plutonium metal that is primarily plutonium-239, but contains other plutonium isotopes in small amounts. It is used for start-up testing and will be infrequently shipped in currently undefined quantities. Because of the relatively small volume of material and lack of specific data on the shipments, analysis of this material is limited to a determination of person-miles for a single shipment, as described in Section D.2.

pits: Pits are the feed and product stream of the MPF. A pit is actually an assembly of plutonium metal with EU parts. The plutonium is primarily plutonium-239, and the uranium is primarily uranium-235. A single shipment of pits contains approximately 110 kilograms (kg) (243 pounds [lb]) of plutonium and 450 kg (992 lb) of uranium. Under each of the MPF capacity options of 125, 250, and 450 pits per year (ppy), there will be 7, 14, and 25 roundtrip shipments per year, respectively.

EU: The EU parts from disassembled pits are shipped to the Y-12 National Security Complex (Y-12) for processing and returned to the MPF. A single shipment of EU contains approximately 630 kg (1,389 lb) of uranium.

TRU waste: Processing of plutonium pits produces contact-handled TRU waste, primarily americium-241. Under the MPF capacity options of 125, 250, and 450 ppy, there will be 74, 93, and 142 shipments per year of TRU waste, respectively.

LLW: This waste would consist of job control waste and decontamination wastes. The radioisotopes would primarily be transuranics, but their concentrations would be sufficiently low to classify the waste as LLW. Under the MPF capacity options of 125, 250, and 450 ppy, there will be 136, 217, and 331 shipments per year of LLW, respectively.

D.1.3 Packaging

For purposes of this analysis, the National Nuclear Security Administration (NNSA) used two general package types: Type A and Type B. A Type A package is designed to protect and retain their contents under normal transport conditions and must maintain sufficient shielding to limit radiation exposure to handling personnel. These packages are used to transport LLW. A Type B package is used to transport material with the highest radioactivity levels and to protect and retain their contents under transportation accident conditions.

DOE adopts Nuclear Regulatory Commission standards for Type B packages, which include certification of packages against stringent testing standards (10 CFR 71). The testing or other analysis must certify that the contents of the package will not be released under the following tests:

Free Drop: The cask drops 9 meters (m) (30 feet [ft]) onto a flat, horizontal, unyielding surface so that it strikes at its weakest point.

Puncture: The cask drops 102 centimeters (cm) (40 inches [in]) onto a 15-cm (6-in) diameter steel bar at least 20 cm (8 in) long. The bar strikes the cask at its most vulnerable spot.

Fire: After the impact tests, the cask is totally engulfed in an 808 ^{o}C (1,475 ^{o}F) thermal environment for 30 minutes. The cask is then completely submerged under at least 102 cm (40 in) of water for 8 hours. Undamaged packages must withstand more severe immersion tests.

There are numerous designs of Type B packages that the NNSA uses for transporting radioactive materials. The NNSA would select packages that are appropriate for the purpose and contents for which it would be used. Most likely, plutonium pits would use one kind of Type B package and EU parts would use another. The NNSA would use the Transuranic Package Transporter (TRUPACT-II) for contact-handled TRU waste shipments. The TRUPACT-II is a large casks that can contain 14 208-L (55-gal) drums. It includes armor, impact limiters, and thermal insulation and is shipped up to three to a truck.

Type B packages for pits and EU are shipped in specially designed Safe Secure Trailers/Safeguards Transports (SST/SGT). The SST/SGT contains enhanced structural and security features that are classified. They operate under operational security procedures and emergency plans that include armed escort, satellite tracking, and advanced communications.

D.2 ROUTING AND DEMOGRAPHICS

NNSA used the computer code TRAGIS (Transportation Routing Analysis Geographic Information System) (Johnson and Michelhaugh 2000) to determine representative routes for the transportation indicated in Table D.1.1–1. Designed by Oak Ridge National Laboratory, TRAGIS gives routes from an origin to destination based on user-selected criteria. The NNSA selected criteria consistent with transport of radioactive material by preferred routes as described in 49 CFR 397, Subpart D, i.e., highway route-controlled quantities.

TRAGIS provides route information such as nodes, segments, miles per segment, miles per state, miles per highway type, miles per population density category, population within 800 m (0.5 mi) of the route, and other parameters of interest. Some of the output is specifically designed for direct input into the RADTRAN computer code (see Section D.3).

TRAGIS runs were performed for the unique origin-destination pairs indicated in Table D.1.1–1. Pairs with origin the same as the destination were eliminated. Duplicates and pairs already represented by a reverse-direction pair were also eliminated. Unique TRAGIS runs reduced to those in Table D.2–1.

Table D.2–1. Unique TRAGIS Runs

ID No.	Origin-Destination Pair	Material Shipped
1	LANL ⇔ SRS	Plutonium metal
2	Pantex ⇔ SRS	Pits; plutonium metal
3	Y-12 ⇔ SRS	EU
4	LANL ⇔ Pantex	Pits; plutonium metal
5	Y-12 ⇔ Pantex	EU
6	Y-12 ⇔ LANL	EU
7	SRS ⇔ NTS	Plutonium metal
8	LANL ⇔ NTS	Plutonium metal
9	Pantex ⇔ NTS	Pits; LLW
10	Y-12 ⇔ NTS	EU
11	SRS ⇔ Carlsbad Site/WIPP	Plutonium metal; TRU
12	LANL ⇔ Carlsbad Site/WIPP	Plutonium metal; TRU
13	Pantex ⇔ Carlsbad Site/WIPP	Pits; TRU
14	Y-12 ⇔ Carlsbad Site	EU
15	NTS ⇔ WIPP	TRU; LLW

Note: WIPP and Carlsbad Site were modeled as the same location.

The following tabulations provide the resulting RADTRAN input data for each unique TRAGIS run.

LANL Û SRS

RADTRAN Input Data	Rural		Suburban	Urban	Totals
Weighted Population					
People/mi^2	29.7		860.5	5,902.2	
People/km^2	11.5		332.2	2,278.8	
Distance					
Miles	1,241.2		430.6	64.5	1,736.1
Kilometers	1,997.5		692.9	103.8	2,794.0
Percentages	71.5		24.8	3.7	
Basis (people/mi^2)	<139		139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AR	77,168			
	GA	226,097			
	NM	84,915			
	OK	80,578			
	SC	4,642			
	TN	185,926			
	TX	39,756			
Total Population within 800-m (0.5-mi)Buffer Zone:					**699,082**

Pantex Û SRS

RADTRAN Input Data	Rural		Suburban	Urban	Totals
Weighted Population					
People/mi^2	34.96		861.0	5,882.0	
People/km^2	13.4		332.4	2,271.0	
Distance					
Miles	918.2		385.9	50.1	1,354.1
Kilometers	1,477.6		621.1	80.5	2,179.1
Percentages	67.8		28.5	3.7	
Basis (people/mi^2)	<139		139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AR	77,168			
	GA	226,097			
	OK	80,578			
	SC	4,642			
	TN	185,926			
	TX	2,186			
Total Population within 800-m (0.5-mi) Buffer Zone:					**576,597**

Y-12 Û SRS

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	48.8	920.9	5,917.6	
People/km^2	18.9	355.6	2,284.8	
Distance				
Miles	188.4	170.8	22.8	382.0
Kilometers	303.3	274.8	36.7	614.7
Percentages	49.3	44.7	6.0	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	GA 226,097 SC 4,642 TN 34,368			
Total Population within 800-m (0.5-mi) Buffer Zone:				**264,408**

LANL Û Pantex

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	16.2	835.5	5,972.2	
People/km^2	6.2	322.6	2,305.9	
Distance				
Miles	342.1	46.6	14.4	403.0
Kilometers	550.5	74.9	23.2	648.6
Percentages	84.9	11.6	3.6	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	NM 84,915 TX 38,420			
Total Population within 800-m (0.5-mi) Buffer Zone:				**123,335**

Y-12 Û Pantex

RADTRAN Input Data	Rural		Suburban	Urban	Totals
Weighted Population					
People/mi^2	33.5		776.2	5,788.5	
People/km^2	13.0		299.7	2,235.0	
Distance					
Miles	811.7		252.3	26.1	1,090.1
Kilometers	1,306.3		406.0	42.1	1,754.2
Percentages	74.5		23.1	2.4	
Basis (people/mi^2)	<139		139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AR	77,168			
	OK	80,578			
	TN	168,225			
	TX	2,186			
Total Population within 800-m (0.5-mi) Buffer Zone:					**328,157**

Y-12 Û LANL

RADTRAN Input Data	Rural		Suburban	Urban	Totals
Weighted Population					
People/mi^2	28.5		788.2	5,853.9	
People/km^2	11.0		304.3	2,260.2	
Distance					
Miles	1,134.7		296.9	40.6	1,472.1
Kilometers	1,826.1		477.8	65.3	2,369.1
Percentages	77.1		20.2	2.8	
Basis (people/mi^2)	<139		139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AR	77,168			
	NM	84,915			
	OK	80,578			
	TN	168,225			
	TX	39,756			
Total Population within 800-m (0.5-mi) Buffer Zone:					**450,642**

SRS Û NTS

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	28.9	864.4	6,105.2	
People/km^2	11.2	333.7	2,357.2	
Distance				
Miles	1,987.3	554.8	82.7	2,624.8
Kilometers	3,198.1	892.9	133.1	4,224.1
Percentages	75.7	21.1	3.2	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AR 287			
	GA 226,097			
	IL 37,937			
	IA 9,881			
	KY 13,961			
	MO 185,917			
	NE 59,486			
	NV 74,850			
	SC 4,642			
	TN 99,201			
	UT 159,595			
	WY 32,573			
Total Population within 800-m (0.5-mi) Buffer Zone:				**904,426**

LANL Û NTS

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	17.9	861.3	6,261.4	
People/km^2	6.9	332.6	2,417.5	
Distance				
Miles	860.7	98.7	17.6	977.1
Kilometers	1,385.2	158.8	28.4	1,572.5
Percentages	88.1	10.1	1.8	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AZ 36,032			
	CA 15,433			
	NV 61,906			
	NM 76,780			
Total Population within 800-m (0.5-mi) Buffer Zone:				**190,151**

Pantex Û NTS

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	16.9	897.6	6,153.3	
People/km^2	6.5	346.6	2,375.8	
Distance				
Miles	1,063.2	104.0	23.0	1,190.3
Kilometers	1,711.1	167.4	37.0	1,915.5
Percentages	89.3	8.7	1.9	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AZ 36,032			
	CA 15,433			
	NV 61,906			
	NM 83,907			
	TX 38,420			
Total Population within 800-m (0.5-mi) Buffer Zone:				**235,698**

Y-12 Û NTS

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	24.0	814.2	5,959.3	
People/km^2	9.3	314.3	2,300.9	
Distance				
Miles	1,861.6	354.3	49.2	2,265.0
Kilometers	2,995.8	570.3	79.1	3,645.1
Percentages	82.2	15.6	2.2	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AR 77,168			
	AZ 36,032			
	CA 15,433			
	NM 83,907			
	NV 61,906			
	OK 80,578			
	TN 168,225			
	TX 39,756			
Total Population within 800-m (0.5-mi) Buffer Zone:				**563,005**

SRS Û WIPP

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	34.0	815.1	5,632.2	
People/km^2	13.1	314.7	2,174.6	
Distance				
Miles	1,072.5	401.1	39.4	1,512.8
Kilometers	1,726.0	645.5	63.4	2,434.6
Percentages	70.9	26.5	2.6	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AL 67,186			
	GA 155,168			
	LA 53,453			
	MS 47,944			
	NM 1,150			
	SC 4,642			
	TX 186,722			
Total Population within 800-m (0.5-mi) Buffer Zone:				**516,265**

LANL Û WIPP

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	15.2	727.5	4,948.3	
People/km^2	5.9	280.9	1,910.5	
Distance				
Miles	347.2	23.1	3.1	373.5
Kilometers	558.8	37.2	5.0	601.0
Percentages	93.0	6.2	0.8	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	NM 29,512			
Total Population within 800-m (0.5-mi) Buffer Zone:				**29,512**

Pantex Û WIPP

RADTRAN Input Data	Rural		Suburban	Urban	Totals
Weighted Population					
People/mi^2	12.1		961.7	5,317.1	
People/km^2	4.7		371.3	2,052.9	
Distance					
Miles	419.8		20.3	6.9	447.0
Kilometers	675.6		32.7	11.1	719.4
Percentages	93.9		4.5	1.5	
Basis (people/mi^2)	<139		139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	NM TX	19,291 38,420			
Total Population within 800-m (0.5-mi) Buffer Zone:					**57,711**

Y-12 Û WIPP

RADTRAN Input Data	Rural		Suburban	Urban	Totals
Weighted Population					
People/mi^2	32.4		851.1	5,879.8	
People/km^2	12.5		328.6	2,270.2	
Distance					
Miles	1,018.4		319.3	41.3	1,379.0
Kilometers	1,638.9		513.9	66.4	2,219.3
Percentages	73.8		23.2	3.0	
Basis (people/mi^2)	<139		139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AR NM TN TX	63,457 1,150 168,225 248,611			
Total Population within 800-m (0.5-mi) Buffer Zone:					**481,443**

NTS Û WIPP

RADTRAN Input Data	Rural	Suburban	Urban	Totals
Weighted Population				
People/mi^2	16.6	879.1	6,148.9	
People/km^2	6.4	339.4	2,374.1	
Distance				
Miles	1,084.0	100.6	20.8	1,205.3
Kilometers	1,744.4	161.9	33.4	1,939.8
Percentages	89.9	8.3	1.7	
Basis (people/mi^2)	<139	139-3,326	>3,326	
Population within 800-m (0.5-mi) Buffer Zone by state:	AZ 36,032 CA 15,433 NV 61,906 NM 97,394			
Total Population within 800-m (0.5-mi) Buffer Zone:				**210,765**

Based on these data, it is possible to construct a ranking of relative impacts for the various sites with respect to the infrequent plutonium shipments that were not analyzed. The results are presented in Table D.2–2. SRS and LANL logically tied for least impact because they are suppliers of the plutonium metal. Rankings are listed by total person-miles and then re-ranked by selecting only the nearest plutonium supplier.

Table D.2–2. Ranking of Relative Impacts for Plutonium Metal Shipments

Ranking By Total Person Miles			
MPF site	**Person-miles from SRS**	**Person-miles from LANL**	**Total person-miles**
1. LANL	788,000	0	788,000
1. SRS	0	788,000	788,000
2. Pantex	659,000	130,000	789,000
3. Carlsbad Site	585,000	214,000	800,000
4. NTS	1,040,000	211,000	1,250,000
Ranking by Person-Miles to Nearest Supplier			
MPF site	**Nearest supplier**	**Person-miles from nearest supplier**	
1. LANL	LANL	0	
1. SRS	SRS	0	
2. Pantex	LANL	130,000	
3. NTS	LANL	211,000	
4. Carlsbad Site	LANL	214,000	

D.3 INCIDENT-FREE ANALYSIS

NNSA used RADTRAN 5 (Neuhauser and Kanipe 2000) to calculate collective dose from incident-free transportation of radioactive materials by truck. RADTRAN was developed and is maintained by Sandia National Laboratories. It is capable of analyzing both incident-free and accident impacts for highway, rail, ship and barge, and air transport. For incident-free analysis, the code calculates collective doses to persons along the route (e.g., residents), persons sharing the route, persons at stops, and drivers. Important inputs to RADTRAN are the demographic and route data described in Section D.2, the dose rate from the truck, and other parameters.

For incident-free analysis, a principal RADTRAN input is the radiation dose rate one meter from the truck. To determine dose rates from the truck, the NNSA made assumptions about the packages and the truck loading configuration and then used the computer code Microshield (Grove Engineering 1996) to determine doses. For pits, the NNSA selected the gross characteristics of the FL package, a Type B package certified for transport of pits. For EU shipments, the NNSA selected the gross characteristics of the 6M package, also a Type B package certified for the purpose. Contact-handled TRU waste was assumed to be packaged in the TRUPACT-II cask, three to a truck. LLW was assumed to be placed in a Type A 208 L (55-gal) drum, loaded 80 to a truck. For all four materials, actual shipments might involve different but similar packaging.

Microshield calculations of arrays of pit and EU packages placed into SST/SGTs yielded very low dose rates. For conservatism, the NNSA selected a larger dose rate to model, 1 mrem/hr. Years of experience shipping weapons-related fissile materials have demonstrated that the 1 mrem/hr dose rate is not likely to be exceeded. Dose rates for TRU waste were not calculated but taken from the WIPP SEIS (DOE 1997b). LLW was assumed to be 1 mrem/hr based on information in the Waste Management Programmatic EIS (PEIS) (DOE 1997a). The shielding analyses made many simplifying, but conservative, assumptions to arrive at dose rates for analysis that would be higher than those actually encountered.

Individual RADTRAN runs needed for the analysis are indicated in Table D.3–1. (Except for the dose rate, Table D.3–1 also applies to accident analyses.) Results of the shielding analysis are also provided. The index numbers correspond to the TRAGIS runs for the relevant origin-destination pair. The plutonium metal analyses were not performed because of their small contribution to the overall analysis.

Results of the incident-free analysis for a single, one-way shipment are provided in Table D.3–2. They are keyed to the run numbers provided in Table D.2–1. These results can be aggregated into values for the three alternatives, three capacity options, and for the five sites as described in Section D.5 and reported in Sections 5.2.12, 5.3.12, 5.4.12, 5.5.12, and 5.6.12.

Table D.3–1. RADTRAN Runs and Dose Rates for Incident-Free Analysis

No.	Origin-Destination	Material	Dose Rate
1	LANL ⇔ SRS	Plutonium metal	No Run
2a	Pantex ⇔ SRS	Pits	1
2b	SRS ⇒ Pantex	Plutonium metal	No Run
3	Y-12 ⇔ SRS	EU	1
4a	LANL ⇔ Pantex	Pits	1
4b	LANL ⇒ Pantex	Plutonium metal	No Run
5	Y-12 ⇔ Pantex	EU	1
6	Y-12 ⇔ LANL	EU	1
7	SRS ⇒ NTS	Plutonium metal	No Run
8	LANL ⇒ NTS	Plutonium metal	No Run
9a	Pantex ⇔ NTS	Pits	1
9b	Pantex ⇒ NTS	LLW	1
10	Y-12 ⇔ NTS	EU	1
11a	SRS ⇒ Carlsbad Site	Plutonium metal	No Run
11b	SRS ⇒ WIPP	TRU waste	4
12a	LANL ⇒ Carlsbad Site	Plutonium metal	No Run
12b	LANL ⇒ WIPP	TRU waste	4
13a	Pantex ⇔ Carlsbad Site	Pits	1
13b	Pantex ⇒ WIPP	TRU waste	4
14	Y-12 ⇒ Carlsbad Site	EU	1
15a	NTS ⇒ WIPP	TRU waste	4
15b	Carlsbad Site ⇒ NTS	LLW	1

Table D.3–2. Results of Incident-Free RADTRAN Runs (Person-Rem) for a Single Shipment

RADTRAN Run No.	Public Collective Dose				Worker Collective Dose	Total Dose
	Stops	Sharing Route	Along Route	Total Public	Drivers	
1	-	-	-	-	-	-
2a	6.7×10^{-3}	1.6×10^{-2}	2.2×10^{-3}	2.5×10^{-2}	1.6×10^{-2}	4.1×10^{-2}
2b	-	-	-	-	-	-
3	1.4×10^{-3}	6.7×10^{-3}	1.0×10^{-3}	9.1×10^{-3}	5.4×10^{-3}	1.4×10^{-2}
4a	1.4×10^{-3}	3.7×10^{-3}	2.7×10^{-4}	5.3×10^{-3}	4.1×10^{-3}	9.5×10^{-3}
4b	-	-	-	-	-	-
5	5.4×10^{-3}	9.9×10^{-3}	1.3×10^{-3}	1.7×10^{-2}	1.2×10^{-2}	2.9×10^{-2}
6	6.7×10^{-3}	1.4×10^{-2}	1.6×10^{-3}	2.2×10^{-2}	1.6×10^{-2}	3.8×10^{-2}
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9a	5.4×10^{-3}	7.6×10^{-3}	6.5×10^{-4}	1.4×10^{-2}	1.2×10^{-2}	2.5×10^{-2}
9b	6.3×10^{-3}	8.9×10^{-3}	7.6×10^{-4}	1.6×10^{-2}	2.5×10^{-2}	4.1×10^{-2}
10	1.2×10^{-2}	1.8×10^{-2}	1.9×10^{-3}	3.2×10^{-2}	2.4×10^{-2}	5.5×10^{-2}
11a	-	-	-	-	-	-
11b	2.3×10^{-2}	4.3×10^{-2}	6.1×10^{-3}	7.2×10^{-2}	3.8×10^{-2}	1.1×10^{-1}
12a	-	-	-	-	-	-
12b	7.7×10^{-3}	4.6×10^{-3}	3.5×10^{-4}	1.3×10^{-2}	7.3×10^{-3}	2.0×10^{-2}
13a	2.7×10^{-3}	2.3×10^{-3}	1.4×10^{-4}	5.2×10^{-3}	4.1×10^{-3}	9.2×10^{-3}
13b	7.7×10^{-3}	6.6×10^{-3}	4.0×10^{-4}	1.5×10^{-2}	8.8×10^{-3}	2.3×10^{-2}
14	8.1×10^{-3}	1.4×10^{-2}	1.8×10^{-3}	2.4×10^{-2}	1.6×10^{-2}	3.9×10^{-2}
15a	1.9×10^{-2}	2.1×10^{-2}	1.8×10^{-3}	4.2×10^{-2}	2.5×10^{-2}	6.6×10^{-2}
15b	7.9×10^{-3}	8.5×10^{-3}	7.2×10^{-4}	1.7×10^{-2}	2.6×10^{-2}	4.3×10^{-2}

"-" = no RADTRAN run needed.

D.4 ACCIDENT ANALYSIS

The NNSA used RADTRAN 5 for the accident analysis and employed the conservative methodology of NUREG 0170, *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes* (NRC 1977). The method considers eight categories of potential accidents with severity levels based on increasing levels of impact, crush, fire, and puncture. As done for many other RADTRAN analyses of radioactive materials transport, the NNSA has selected parameters for the eight categories consistent with NUREG 0170 and the RADTRAN 5 User Guide. This simple approach with standard inputs based on the materials, packaging, and mode of transport, is appropriate for this programmatic evaluation to distinguish between the five sites.

The results of a RADTRAN accident analysis are based on a sum of the risks over various segments of the transportation route, taking into account differing accident frequencies and severity categories in urban, suburban, and rural population zones. Demographic information is taken from TRAGIS. Accident rates are taken from Saricks and Tompkins (1999) for standard truck transport. Analyses involving SST/SGT transport used actual accident rates that are lower. The final risk output is a product of the collective dose and the probability of the accident occurring, summed over all accident severity categories and population zones. Therefore, although the units of the results are in person-rem, the unitless probability is also a factor in the results.

Results of the RADTRAN runs are provided in Table D.4–1. The results of the RADTRAN runs must be multiplied by the number of shipments per year to give an annual risk value.

Table D.4–1. Results of RADTRAN Accident Runs for a Single Shipment

RADTRAN Run No.	Dose Risk (person-rem)	RADTRAN Run No.	Dose Risk (person-rem)
1	-	9b	4.8×10^{-6}
2a	3.5×10^{-8}	10	2.9×10^{-11}
2b	-	11a	-
3	9.3×10^{-12}	11b	1.5×10^{-4}
4a	6.2×10^{-9}	12a	-
4b	-	12b	2.3×10^{-6}
5	1.8×10^{-11}	13a	4.4×10^{-9}
6	2.2×10^{-11}	13b	6.3×10^{-6}
7	-	14	2.3×10^{-11}
8	-	15a	1.2×10^{-5}
9a	1.6×10^{-8}	15b	3.2×10^{-6}

"-" = no RADTRAN run needed.

NNSA also calculated the traffic accident fatality rate for all radiological transportation associated with the Proposed Action and alternatives. The state-specific miles for each shipment campaign (route mileage time number of trips) was multiplied by state-specific truck accident and fatality rates from Saricks and Tomkins (1999) and the summed for all states. Although the national average accident rate for SST/SGT shipments are much less than that for SST/SGTs, state-specific rates for SST/SGTs are not available. Accordingly, NNSA used commercial truck accident rates for all shipment campaigns. Results are reported in Chapter 5.

D.5 CONSTRUCTION OF ALTERNATIVES

The RADTRAN results presented in Sections D.3 and D.4 must be combined into alternatives, impacts for a given site, and capacity options.

D.5.1 No Action Alternative

Radiological transportation under the No Action Alternative for LANL would include transport of pits from Pantex to LANL, recycle of EU parts to and from the Y-12 in Oak Ridge, return of re-assembled pits to Pantex, and shipment of TRU waste to WIPP. LLW would be disposed of at LANL. For purposes of transportation analysis, these pits are assumed to arrive in two shipments. Recycle shipments of EU would also be sent and received in two shipments.

Therefore, the No Action Alternative includes:

- 2 roundtrip shipments of pits under RADTRAN run 4a
- 2 roundtrip shipments of EU under RADTRAN run 6
- 20 one-way shipments of TRU waste under RADTRAN run 12b

D.5.2 Modern Pit Facility Alternative

D.5.2.1 Los Alamos Site Modern Pit Facility Alternative

Radiological transportation under the MPF Alternative for LANL would include transport of pits from Pantex to LANL, recycle of EU parts to and from the Y-12 in Oak Ridge, return of re-assembled pits to Pantex, and shipment of TRU waste to WIPP. LLW would be disposed of at LANL. NNSA's analysis includes options for 125, 250, and 450 ppy. For purposes of transportation analysis, these pits are assumed to arrive in 7, 14, and 25 shipments, respectively. Recycle shipments of EU would be sent and received in 5, 10, and 18 shipments, respectively.

Therefore, for the MPF Alternative at LANL, the following RADTRAN runs would be selected:

- 7, 14, 25 roundtrip shipments of pits under RADTRAN run 4a
- 5, 10, 18 roundtrip shipments of EU under RADTRAN run 6
- 74, 93, 142 one-way shipments of TRU waste under RADTRAN run 12b

D.5.2.2 Nevada Test Site Modern Pit Facility Alternative

Radiological transportation under the MPF Alternative for NTS would include transport of pits from Pantex to NTS, recycle of EU parts to and from the Y-12 in Oak Ridge, return of re-assembled pits to Pantex, and shipment of TRU waste to WIPP. LLW would be disposed of at NTS. NNSA's analysis includes options for 125, 250, and 450 ppy. For purposes of transportation analysis, these pits are assumed to arrive in 7, 14, and 25 shipments, respectively. Recycle shipments of EU would be sent and received in 5, 10, and 18 shipments, respectively.

Therefore, for the MPF Alternative at NTS, the following RADTRAN runs would be selected:

- 7, 14, 25 roundtrip shipments of pits under RADTRAN run 9a
- 5, 10, 18 roundtrip shipments of EU under RADTRAN run 10
- 74, 93, 142 one-way shipments of TRU waste under RADTRAN run 15a

D.5.2.3 Pantex Site Modern Pit Facility Alternative

Radiological transportation under the MPF Alternative for Pantex would include recycle of EU parts to and from the Y-12 in Oak Ridge, shipment of TRU waste to WIPP, and shipment of LLW to NTS. The pits would already reside at Pantex. NNSA's analysis includes options for processing 125, 250, and 450 ppy. For purposes of transportation analysis, these pits are assumed to result in EU recycle shipments that would be sent and received in 5, 10, and 18 shipments, respectively.

Therefore, for the MPF Alternative at NTS, the following RADTRAN runs would be selected:

- 5, 10, 18 roundtrip shipments of EU under RADTRAN run 5
- 74, 93, 142 one-way shipments of TRU waste under RADTRAN run 13b
- 136, 217, 331 one-way shipments of LLW under RADTRAN run 9b

D.5.2.4 Savannah River Site Modern Pit Facility Alternative

Radiological transportation under the MPF Alternative for SRS would include transport of pits from Pantex to SRS, recycle of EU parts to and from the Y-12 in Oak Ridge, return of re-assembled pits to Pantex, and shipment of TRU waste to WIPP. LLW would be disposed of at SRS. NNSA's analysis includes options for 125, 250, and 450 ppy for purposes of transportation analysis, these pits are assumed to arrive in 7, 14, and 25 shipments, respectively. Recycle shipments of EU would be sent and received in 5, 10, and 18 shipments, respectively.

Therefore, for the MPF Alternative at SRS, the following RADTRAN runs would be selected:

- 7, 14, 25 roundtrip shipments of pits under RADTRAN run 2a
- 5, 10, 18 roundtrip shipments of EU under RADTRAN run 3
- 74, 93, 142 one-way shipments of TRU waste under RADTRAN run 11b

D.5.2.5 Carlsbad Site Modern Pit Facility Alternative

Radiological transportation under the MPF Alternative for the Carlsbad Site would include transport of pits from Pantex to the Carlsbad Site, recycle of EU parts to and from the Y-12 in Oak Ridge, return of re-assembled pits to Pantex, and shipment of LLW to NTS. TRU waste would be disposed of at WIPP. The NNSA's analysis includes options for processing 125, 250, and 450 ppy for purposes of transportation analysis, these pits are assumed to arrive in 7, 14, and 25 shipments, respectively, each with 18 packages. Recycle shipments of EU would be sent and received in 5, 10, and 18 shipments, respectively, each with 25 packages.

Therefore, for the MPF Alternative at the Carlsbad Site, the following RADTRAN runs would be selected:

- 7, 14, 25 roundtrip shipments of pits under RADTRAN run 13a
- 5, 10, 18 roundtrip shipments of EU under RADTRAN run 14
- 136, 217, 331 one-way shipments of LLW under RADTRAN run 15b

D.5.3 TA-55 Upgrade Alternative

Radiological transportation under the TA-55 Upgrade Alternative for LANL would include transport of pits from Pantex to LANL, recycle of EU parts to and from the Y-12 in Oak Ridge, return of re-assembled pits to Pantex, and shipment of TRU waste to WIPP. LLW would be disposed of at LANL. For purposes of transportation analysis, these pits are assumed to arrive in five shipments. Recycle shipments of EU would be sent and received in four shipments.

Therefore, for the TA-55 Upgrade Alternative, the following RADTRAN run would be selected:

- 5 roundtrip shipments of pits under RADTRAN run 4a
- 3 roundtrip shipments of EU under RADTRAN run 6
- 55 one-way shipments of TRU waste under RADTRAN run 12b

D.6 Calculation of Latent Cancer Fatalities

In Chapter 5 of this EIS, DOE reports human health effects from transportation of radioactive materials in terms of latent cancer fatalities (LCFs). Consistent with recommendations of the International Commission on Radiological Protection (ICRP 1991), DOE uses factors to convert collective dose in person-rem to numbers of latent cancer fatalities. For workers, the value is 4×10^{-4} LCFs per person-rem and for the general population the value is 5×10^{-4} LCFs per person-rem.

APPENDIX E
SUMMARY OF PUBLIC SCOPING COMMENTS

E.1 PUBLIC SCOPING PROCESS

As a preliminary step in the development of an environmental impact statement (EIS), regulations established by the Council on Environmental Quality (40 CFR 1501.7) and the U.S. Department of Energy (DOE) require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." The purpose of this scoping process is: (1) to inform the public about a proposed action and the alternatives being considered, and (2) to identify and/or clarify issues that are relevant to the EIS by soliciting public comments.

On September 23, 2002, the National Nuclear Security Administration (NNSA), a separately organized agency within DOE, published a Notice of Intent (NOI) in the *Federal Register* announcing its intent to prepare a *Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility* (67 FR 59577). During the *National Environmental Policy Act* (NEPA) process, there are opportunities for public involvement (see Figure E.1–1). The NOI listed the issues initially identified by DOE for evaluation in the EIS. Public citizens, civic leaders, and other interested parties were invited to comment on these issues and to suggest additional issues that should be considered in the EIS. The NOI informed the public that comments on the proposed action could be communicated via U.S. mail, via electronic mail, a fax line, or in person at public meetings to be held near the alternative location sites.

Public meetings were held near each of the five alternative location sites and DOE Headquarters: (1) Pantex Site on October 8, 2002, in Amarillo, Texas; (2) Carlsbad Site on October 10, 2002 in Carlsbad, New Mexico; (3) U.S. Department of Energy, on October 15, 2002 in Washington, DC; (4) Nevada Test Site (NTS) on October 17, 2002 in Las Vegas, Nevada; (5) Los Alamos Site on October 24, 2002 in Los Alamos, New Mexico; and (6) Savannah River Site (SRS) on October 29, 2002 in North Augusta, South Carolina (see Figure E.1–2).

Figure E.1–1. NEPA Process

As a result of previous experience and positive responses from attendees of other DOE NEPA public meetings and hearings, DOE chose an interactive format for the scoping meetings. Each meeting began with a presentation by a DOE representative who explained the background, purpose and need for the proposed Modern Pit Facility (MPF), the alternatives and NEPA and EIS process. Afterwards, the floor was opened to questions, comments, and concerns from the

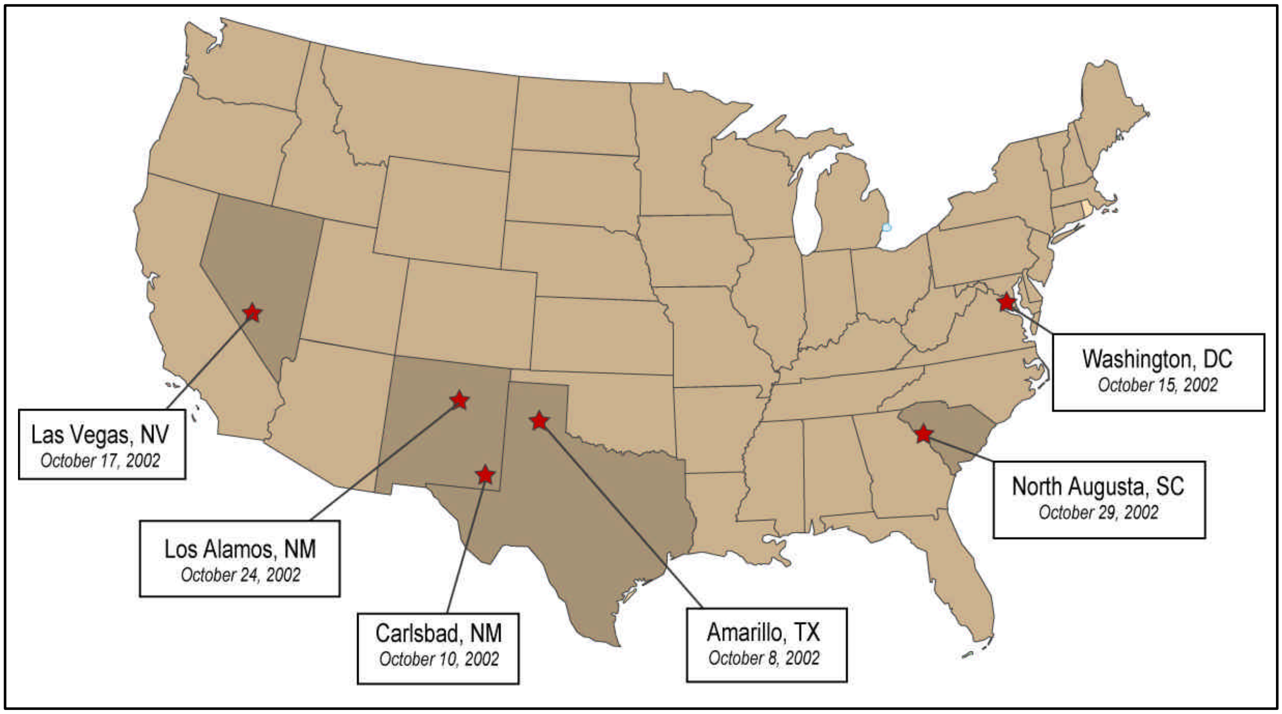


Figure E.1–2. Public Scoping Meeting Locations and Dates

audience. DOE representatives were available to respond to questions and comments as needed. The proceedings and formal comments raised at each meeting were recorded verbatim, and a transcript for each meeting was produced. The public was also encouraged to submit written or verbal comments during the meetings or to submit comments via letters (U.S. mail or electronic mail), or fax line, until the end of the scoping period.

It should be noted that, for EIS public scoping purposes, a comment is defined as a single opinion concerning a specific issue. An individual commentor's public statement may contain several such comments. Most of the verbal and written public statements submitted during the EIS scoping period contained multiple comments on various specific issues. These issues are summarized in the following section.

E.2 SCOPING PROCESS RESULTS

Nearly 1,600 comments were received from individuals, interested groups, and Federal, state, and local officials during the public scoping period, including approximately 480 oral comments made during the public meetings. The remainder of the comments (1,106) was submitted at the public meetings in written form, or submitted via U.S. mail, e-mail, or fax over the entire scoping period. Some commentors who spoke at the public meetings also prepared written statements that were later submitted during or after the meetings. Where this occurred, each comment provided by an individual commentor in both oral and written form was counted as a single comment.

Many of the oral and written comments questioned the need for the MPF. In particular, commentors questioned why the facility was needed since the NOI stated that no problems that would require pit replacements had been found to date. Commentors also quoted several previous DOE documents and DOE and other government officials who stated that both the nuclear and nonnuclear parts of pits in the stockpile were stable and reliable into the foreseeable future.

Other commentors cited a number of studies done by both DOE and independent researchers that demonstrated the stability of plutonium, a main component of a pit, over time; thus commentors felt that until conclusive evidence on pit aging is established, a MPF is not necessary.

Several commentors dismissed the need for the proposed action by stating that the Plutonium Facility, Building 4 (PF-4), the current interim production plutonium machining facility at the Los Alamos Site, analyzed in the 1996 *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996c) for production of up to 80 pits per year, already met the needs of pit refurbishment for the nuclear stockpile. Many commentors also felt that the NOI statement that "…DOE has been without the capability to produce plutonium pits…" is alarmist and false, considering PF-4.

Many commentors raised the issue of international treaties and decisions, particularly the Nuclear Nonproliferation Treaty, the Strategic Offensive Nuclear Reduction Treaty (Moscow Treaty), the Comprehensive Test Ban Treaty, and International Court of Justice Decision, July 1996 opinion, questioning whether a MPF would break international law. Commentors specifically stated that since the United States had agreed, under the Moscow Treaty, to reduce its number of nuclear weapons to approximately 1,700-2,200, the PF-4 was more than sufficient to meet pit refurbishment needs, thus a MPF would not be necessary. Furthermore, commentors wanted clarity on why "agility," defined in the NOI as the ability to change and expand pit production types and plutonium pit designs simultaneously, was necessary at all considering the United States had committed, under the Moscow Treaty, to reduce its number of weapons.

Other issues raised regarding need included questions on why the several thousand pits in reserve at the Pantex Plant could not be used to replace any potentially deteriorating pits in the active nuclear stockpile. Others questioned why a MPF was necessary at all since DOE had created the Stockpile Stewardship Program to monitor the nuclear stockpile. They went on to question that if the MPF was built, why would it be necessary to have both the Stockpile Stewardship Program and a MPF.

A significant number of commentors also expressed concern about the costs associated with building the MPF. Commentors wanted to see the full costs associated with each phase of the MPF: design, construction, operation, transportation of materials, waste handling and final disposition of waste, security, decommissioning, destruction and return of land to its original condition.

Several commentors expressed concern about environmental, health and safety risks associated with the MPF, particularly the transportation of pit materials and waste across the Nation's highways. DOE representatives were urged to thoroughly evaluate the potential consequences of the Proposed Action on local wildlife, water resources, air quality, the potential for accidents and their consequences, and the health and safety of residents near a prospective site and along transportation routes. Commentors suggested that the EIS quantify all radionuclide and chemical emissions associated with the MPF Alternative. Many were concerned that a MPF would not avoid the waste and contamination problems of the old pit facility at the Rocky Flats Plant, which ceased operations in 1989.

Many commentors also expressed concern about the safety and security of the MPF from terrorist actions both from on the ground and from the sky and wanted to know what measures DOE would implement to prevent such actions.

Many commentors expressed support for the No Action Alternative. More than seventy of the comments received were part of a write-in postcard campaign objecting to nuclear weapons. A number of commentors expressed support for the MPF. Other commentors also expressed favor or opposition to the MPF Alternative, reasons for which included security, cost, and workforce advantage.

The transcripts of the six public scoping meetings and all other public comments and materials submitted during the public scoping period were logged, categorized, analyzed, put up on the MPF EIS website (http://www.mpfeis.com), and placed in the Administrative Record.

E.3 COMMENT DISPOSITION AND ISSUE IDENTIFICATION

Comments received during the scoping period were systematically reviewed by DOE. Where possible, comments on similar or related topics were grouped under comment issue categories as a means of summarizing the comments. The comment issue categories were used to identify specific issues of public concern. After the issues were identified, they were evaluated to determine whether they fell within or outside the scope of the EIS. Some issues were found to be already "in scope," among the EIS issues initially identified by DOE for inclusion in the EIS. Table E.3-1 lists these issues along with where the issues are addressed in the EIS.

During the scoping process, DOE received many comments that were judged to be beyond the scope of the MPF EIS. The purpose and scope of the MPF EIS are only to evaluate the potential environmental impacts associated with the proposed siting of a MPF at one of five potential DOE sites, the TA-55 Upgrade Alternative at Los Alamos Site to expand pit production capacity, or the No Action Alternative. Comments judged to be beyond the scope of the EIS included: (1) new weapons development activities; (2) concerns regarding current U.S. foreign policy and national security matters; (3) concerns about the handling of waste and spread of contamination at DOE facilities in the past; and (4) concerns about cost and schedule overruns. Detailed design safety questions not covered in this MPF EIS would be covered in the site-specific tiered-EIS.

Table E.3-1. Issues Included in the EIS (In Scope)

Issues	EIS References
Address the possibility that the MPF would put the U.S. in violation of international laws and treaties.	Chapter 2
Address/review the possibility of having pits made for the U.S. in other nations (e.g., England).	Chapter 3
Address if LANL has the necessary acreage for the MPF.	Chapter 5
Include the long term disposition impacts on land use.	Chapter 5
Address the direction of the prevailing winds at all the alternative sites, specifying if the winds are in the direction of population centers.	Chapter 5
Address the potential for radioactive and non-radioactive air emissions from the MPF.	Chapter 5
Address the potential hurricanes and tornadoes pose to the MPF at each of the five alternative sites.	Chapter 4
Address each site's susceptibility to earthquakes and damage potential.	Chapter 4
Address the potential for the MPF to contaminate the high-yield agricultural lands in the Texas Panhandle and farmland in South Carolina and Georgia.	Chapter 5
Address the potential for the MPF to contaminate both surface and groundwater at all five alternative sites, particularly the movement of plutonium through groundwater.	Chapter 5
Address the potential for the MPF, if sited at the Pantex Site, to contaminate the Ogalla Aquifer (which extends from South Dakota to Texas).	Chapter 5
Address the water needs of the MPF, highlighting whether the current water supply, with the addition of the MPF, would be sufficient to meet both DOE's and the local communities' water needs.	Chapter 5
Address the potential of contamination in groundwater to leak to the rivers and Atlantic Ocean at SRS.	Chapter 4
Address the potential for contaminates in wastewater released from the LANL site to reach the ravines in the valleys below the site where organic farms are located.	Chapter 4
Address the affect of construction and operation of the MPF on Federal and state-listed endangered species and the actions taken to prevent harm as required under the *Endangered Species Act.*	Chapter 5
Due to its isolation from agricultural, urban or industrial activities for the last 50 years, SRS has one of the most biologically diverse suites of regional habitats in the Atlantic and Gulf Coastal Plain. Address how these habitats would be protected if the MPF were to be sited at SRS.	Chapter 5
Discuss all actions DOE would take to protect migratory birds, nests and eggs under the *Migratory Bird Treaty Act.*	Chapter 5
Discuss all actions DOE would take to protect wetlands and floodplains under Executive Orders 11988, 11990 and section 404 of the *Clean Water Act.*	Chapter 5

Table E.3-1. Issues Included in the EIS (In Scope) *(continued)*

Issues	EIS References
Include the epidemiological distribution of cancer, birth defects, infant mortality and other health related effects on the employees and local population at the five alternative sites and project any change with the siting of the MPF at those sites.	Chapter 5, all Human Health and Safety sections; Appendix B
Include a review of occupational and public safety measures to avoid potential criticality incidents; discuss all safety and oversight measures to be taken to avoid a nuclear criticality incident.	Chapter 5; Appendix C
Discuss the potential use of the aqueous process for the MPF.	Chapter 3; Appendix A
Discuss/address the health effects on workers and the local population if an accident or other incident were to occur either during the transportation of materials or at the MPF.	Chapter 5; Appendices C and D
Address the potential impacts on the MPF and its safety from the possible loss of electric power.	Chapter 5; Appendix c
Discuss the potential for airplanes to crash into the MPF.	Classified Appendix
Discuss how as low as reasonably achievable procedures would be implemented at the MPF.	Chapter 5,
Discuss the potential and consequences of a pit explosion.	Chapter 5; Appendix C
Include Rio Arriba County, New Mexico (near Los Alamos Site) in the analysis on environmental justice.	Chapter 5
Include a discussion on number of minorities living near SRS.	Chapter 5
Address/discuss all materials (radioactive, nonradioactive, and waste) to be the transported and the potential accidents that could occur during transportation.	Chapter 5; Appendices C and D
Discuss the potential of an avalanche or rock slide on materials transported on narrow, mountainous, two-lane highways within the State of Nevada (because the state does not have a north-south interstate highway or a interstate highway connecting the state's two largest cities).	Chapter 5; Appendix D
Considering the high number of Driving While Intoxicated offenses in the State of New Mexico, and past traffic accidents involving DOE transported materials, discuss the measures DOE would take to avoid such accidents in the future.	Chapter 5; Appendix D
Address/discuss all safety and security measures that would be put in place for transporting plutonium pits and related pit parts between DOE sites.	Chapter 5; Appendix D
Address the safety of the TRUPACT shipment containers, which DOE has confirmed, emits radiation within a 5-mile radius (without accidents) as the shipments pass through towns.	Chapter 5; Appendix D
Discuss the routes of the transported materials (so citizens along those routes can be fully informed).	Chapter 5; Appendix D
Address/discuss the lifecycle of all waste streams, including storage and ultimate disposition.	Chapter 5
Address/discuss all permits that would be required for waste disposition	Chapter 5; Chapter 6
Address/discuss the accelerated closure of the WIPP facility, which would be closed either before or soon after the MPF, begins operation and where the waste WIPP is currently taking would then be disposed.	Chapter 6

Table E.3-1. Issues Included in the EIS (In Scope) *(continued)*

Issues	EIS References
Discuss the cumulative impacts on human health and the environment from waste streams and contamination already at each of the sites and with the addition of the MPF.	Section 5.8
Discuss all aspects of decommissioning and deconstructing the MPF once its useful life is finished; discuss how the land to be used for the MPF would be returned to its original condition.	Section 5.7
Discuss whether the amount of waste that would be generated at the MPF is similar to the amount that was generated at Rocky Flats.	Chapter 3; Chapter 5
Address safeguard and security measures to be put in place to protect the MPF and shipments of materials to and from the MPF from different types of terrorist attacks (e.g., from the air, from the ground).	Classified Appendix
Address/discuss the potential consequences of a terrorist attack on the MPF to the communities downwind and downstream from the site and the measures DOE would put in place to mitigate those consequences.	Classified Appendix
Address/discuss all applicable Federal and state laws and regulations that DOE would have to follow to build the MPF.	Chapter 6
Address the limitations on land use under *WIPP Land Withdrawal Act* and the U.S. Environmental Protection Agency's role and responsibilities under the Act.	Chapter 6
Address/discuss the role of all other governmental agencies involved with the MPF project.	Chapters 5 and 6
Discuss a number of studies done by both DOE and independent researchers on the stability of plutonium over time.	Chapter 2
Address MPF's potential need for a waste solidification facility; the NRC has stated that the Mixed Oxide Fuel Fabrication Facility (MOX), using similar materials to MPF, would need such a facility.	Chapter 3
Address what would happen to pits if they are shipped to the selected site, but the MPF project is halted. Discuss the long-term storage plans for pits.	Chapter 3
MPF at the Los Alamos Site: Address in the EIS any integration of the CMRR and PF-4 with MPF.	Chapter 3
MPF at SRS - MOX Facility: Address/Review restrictions on use of the MOX plant at SRS for a pit mission, including constraints of the U.S.-Russian plutonium disposition agreement and international agreements on control of "dual-use" civilian military equipment. Address availability of MOX plant for MPF use after MOX mission has ended and NRC licensing terminated. Address any correlations between the failure of the MOX missions and pit production plans. Address dual-use controls and safeguards established by International Atomic Energy Agency, Nuclear Suppliers Group and Zangger Committee when discussing all possible overlaps between MOX and pit programs.	Chapter 3
MPF at SRS - Other Facilities: Address/review the viability of using other facilities at SRS in support of or in conjunction with the MPF: Pit Disassembly and Conversion Facility (PDCF), K Area Materials Storage.	Chapter 3

Table E.3-1. Issues Included in the EIS (In Scope) *(continued)*

Issues	EIS References
Address/review the ability of the Kansas City Plant and Oak Ridge to make nonnuclear parts for pit production.	Chapter 3; Appendix A
Include the site screening report in the EIS so the public can review the how DOE has already evaluated and eliminated potential sites for the MPF.	Appendix G
Address/discuss the reasons for eliminating the Y-12 National Security Complex (Y-12) as the MPF site. A 1997 DOE Report, "Rapid Reconstruction of Pit Production Capacity: Systems Studies and Recommendations" stated that "a combined SRS/Y-12 site is the technically superior multi-site option for the MPF." Address/discuss how Y-12's traditional mission of fabricating highly enriched uranium components may intersect with pit production.	Chapter 3; Appendix G
Discuss the additional energy use needed for the MPF and the additional environmental impacts due to increased power generation.	Chapter 5
Address the reliability of HEPA filters in preventing plutonium transport: specifically their reliability in case of a fire, during a nuclear criticality event, the potential of alpha recoil of plutonium through HEPA filters, and vaporized plutonium.	Chapter 5
Discuss how DOE would prevent at the MPF the types of accidents that occurred at the pit production facility at Rocky Flats, including new technology to be used to prevent accidents and contamination.	Chapter 3
Discuss the exposure pathways that would occur if a rain storm occurred during the release of contaminates via air (radiological and non-radiological) and the potential health affects on the population exposed.	Chapter 5
Discuss recent studies that have shown that continuous low levels of radiation exposure over a specific area are much more damaging than previously believed (see studies by Dr. Bertell); address/discuss radiation's cumulative effect, commonly called the Petcau effect.	Chapter 5; Appendix B
Address the potential risk of exposure to contamination and the exposure pathways to individuals and communities that would be downwind and downstream from the MPF, particularly children, pregnant women and senior citizens who are especially susceptible.	Chapter 5; Appendix B

APPENDIX F
ENVIRONMENTAL IMPACT METHODOLOGY

This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the alternatives in the *Modern Pit Facility Environmental Impact Statement* (MPF EIS). Included are impact assessment methods for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, waste management, and cumulative impacts. Each section includes descriptions of the affected resources, region of influence (ROI), and impact assessment methods.

F.1 LAND USE/VISUAL RESOURCES

F.1.1 Land Use

F.1.1.1 Description of Affected Resources and Region of Influence

The analysis of impacts to land use will consider land use plans and policies, zoning regulations, and existing land use as appropriate for each site analyzed. The potential impacts associated with changes to land use as a result of the alternatives will be discussed.

F.1.1.2 Description of Impact Assessment

Land use changes associated with construction and operation of the MPF could potentially affect both developed and undeveloped land. The analysis of land use will consider impacts that could result from the construction and operation of the MPF on each site. Potential changes in land use, if any, would likely occur within the existing boundaries of the alternative sites. However, the use of lands adjacent to or in the vicinity of U.S. Department of Energy (DOE) sites (i.e., non-DOE land) could be affected by these changes, including new or expanded safety zones.

The degree to which the MPF could affect future use or development of land at each DOE site will be considered. Land use impacts will be assessed based on the extent (relative to the immediate surroundings and the plant site, as a whole) and type of land that would be affected. The land use analysis will also consider potential direct impacts resulting from the conversion of land and/or the incompatibility of land use changes with special status lands such as national parks or monuments, and other protected lands such as Federal- and state-controlled lands (e.g., public land administered by the Bureau of Land Management [BLM] or other government agencies).

F.1.2 Visual Resources

F.1.2.1 Description of Affected Resources and Region of Influence

Visual resources include natural and man-made physical features that give a particular landscape its character and value. The feature categories that form the overall impression a viewer receives of an area include landform, vegetation, water, color, adjacent scenery, rarity, and man-made (cultural) modifications.

F.1.2.2 Description of Impact Assessment

Criteria used in the visual resources analysis will include scenic quality, visual sensitivity, distance, and/or visibility zones from key public viewpoints. The analysis will be comparative in nature and consist of a qualitative examination of potential changes in visual resources, scenic values (attractiveness), and view corridors (visibility). Aspects of visual modification to be examined will include site development or modification activities that could alter the visibility of structures at each of the alternative sites or obscure views of the surrounding landscape, and changes in land cover that could make structures more visible.

F.2 SITE INFRASTRUCTURE

F.2.1 Description of Affected Resources and Region of Influence

This section describes the impact on Los Alamos National Laboratory (LANL) site infrastructure for the No Action Alternative and the modifications that would be needed for the construction and operation of the MPF Alternative and the TA-55 Upgrade Alternative. These impacts are evaluated by comparing current site infrastructure to key facility resource needs for the No Action, MPF, and TA-55 Upgrade Alternatives.

F.2.2 Description of Impact Assessment

The assessment of potential impacts to site infrastructure, which includes electrical power, fuels, and process gases, addresses whether there is sufficient available and peak capacity to support the MPF Alternative and pit production capacities. Projections of electricity availability, site development plans, and other DOE mid- and long-range planning documents are used to project site infrastructure conditions. Tables are presented that depict the additional infrastructure requirements resulting from the alternatives. Mitigation considerations that could reduce impacts due to changes in infrastructure are identified on a site-by-site basis.

F.3 AIR QUALITY AND NOISE

F.3.1 Nonradiological Air Resources

F.3.1.1 Description of Affected Resources and Region of Influence

The air quality assessment evaluates the consequences of criteria and hazardous/toxic air pollutants associated with each alternative at each candidate site. The criteria pollutants are specified in 40 CFR 50, the U.S. Environmental Protection Agency (EPA) Regulations on National Primary and Secondary Ambient Air Quality Standards. The hazardous/toxic air pollutants are listed in Title III of the 1990 *Clean Air Act* (CAA) Amendments, the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61), and standards or guidelines proposed or adopted by the respective states.

Current information on emissions from existing operations and ambient air concentrations will be obtained from each alternative site's information (e.g., site Annual Reports, recent EISs).

F.3.1.2 Description of Impact Assessment

Atmospheric dispersion of pollutant emissions from construction activities (e.g., engine exhaust and fugitive dust emissions), operations, and maintenance activities will be estimated with conventional modeling techniques, such as those included in the EPA's SCREEN3 and Industrial Source Complex Short Term (ISCST) models. The estimated concentrations of these pollutants at facility boundaries will be compared with existing air quality standards for criteria pollutants or with guidelines for pollutants that do not have corresponding standards.

EPA guidelines are conservatively applied in the air quality assessment. The "highest-high" will be selected for comparison to applicable standards and guidelines for all averaging times, instead of the EPA-recommended "highest-high" and "highest second highest" concentration for long-term and short-term averaging times, respectively. The concentrations to be evaluated are the maximum occurring at or beyond the site boundary or public access roads. Chemical release rates and modes (e.g., pounds per year, stack height and velocity) will be defined fro the project alternatives. It will also be assumed that the toxic/hazardous emissions for the alternative sites with incomplete source characteristics originate from a single point source. This assumption generally results in higher concentrations than would actually occur since emission sources are commonly geographically separated from one another.

A more detailed and quantitative assessment will be performed in site-specific *National Environmental Policy Act* (NEPA) documents designed to support a construction-level siting decision. This EIS assessment of impacts from the No Action Alternative and the other alternatives will use a screening level analysis based on conservative assumptions for modeling of potential impacts. The screening level modeling analysis to be presented in the EIS is a programmatic approach intended to provide a comparison of the air quality among each of the alternative sites. Modeled concentrations of air pollutants to be presented in the EIS that exceed the Federal or state air quality standards provide an indication of a potential problem. Detailed modeling and/or monitoring at each site would be required in order to obtain more accurate estimates of pollutant concentrations. The assessment in followon site-specific NEPA documents would be more refined with detailed design, source characteristics, and exact source locations.

Health risks from hazardous chemical releases during normal operation at the respective sites will be assessed. A model such as ISCST or SCREEN3 will be used to assess concentrations to the population, to maximum exposed individuals (MEIs), and to non-involved workers. Hazard Index (HI) values will be used to screen for additional analysis. Site boundary concentrations will be used to develop hazard quotients (HQs) for noncancer risks for comparison to reference concentration values, such as the EPA Integrated Risk Information System. The cancer risk to the maximally exposed individual is calculated from the doses derived from modeling exposure levels, using slope factors or unit risks for individual chemicals published in the Integrated Risk Information System or the health effects summary tables. The health effects summary tables are the yearly summary of EPA's regulatory toxicity data.

The HIs and cancer risks are used to identify potential health concerns that may require further analysis. If the HI and/or cancer risk exceed acceptable limits, then these sites or activities become candidates for further analysis. The in-depth analysis should identify the individual chemicals that contribute to substantial adverse HI and/or cancer risk impacts, starting with those chemicals showing the highest HQs and/or cancer risk and grouping them according to their specific health effects. These chemicals may then be identified for inclusion in more specific site analyses. HIs and/or the cancer risk default values exceeding Occupational Health and Safety Administration (OSHA) standards do not necessarily indicate that a health concern exists. The calculated HIs and cancer risk only establish a baseline for comparison of alternatives among different sites. The baseline is then used to determine the extent to which each alternative adds or subtracts from the No Action Alternative HI and cancer risk to the public at each site.

F.3.2 Radiological Air Resources

F.3.2.1 Description of Affected Resources and Region of Influence

It is expected that radiological impacts from the MPF to workers and surrounding populations will be predominantly via the air pathway. Current information on dose to non-involved workers, MEI, and collective dose to surrounding population due to radiological releases from existing operations will be obtained from each alternative site's information (e.g., site Annual Reports, recent EISs). Impacts from operation of the MPF at each site will be calculated using a model such as GENII or CAP-88.

F.3.2.2 Description of Impact Assessment

The impacts from operation of the MPF at each site are based on a combination of site-specific and technology-specific data. Site-specific data required for modeling include meteorology (e.g., wind speed, wind direction, precipitation), population distribution (for impacts on population), agricultural production (distribution about the release, types and quantity produced), and distances and directions to the fenceline (or other locations at which the public could be exposed; for MEI calculations). All distances and directions (population and agricultural distribution, fenceline) are relative to the assumed location of the MPF at each alternative site.

Operations data required for the calculations include release rates (i.e., curies per year by nuclide) and modes of release (e.g., stack height, stack velocity, diffuse release area). Doses will be calculated for the general population and for non-involved workers (i.e., onsite workers not directly involved in the pit manufacturing operations). The latter will be assumed to be 1,000 meters (m) (3,281 feet [ft]) from the release.

F.3.3 Noise

F.3.3.1 Description of Affected Resources and Region of Influence

Current information on noise from existing operations will be obtained from each alternative site's information (e.g., site Annual Reports, recent EISs).

F.3.3.2 Description of Impact Assessment

The methodology used to determine environmental impacts of the MPF at each of the alternative sites with respect to noise will involve a two-step analysis. The first step will be to identify noise levels associated with construction and operation of the MPF and determine if they are likely to exceed noise levels defining ambient background conditions. If these noise levels could exceed ambient conditions, the analysis will determine whether the impacts are significant, using a qualitative assessment of the increase or decrease in noise level experienced by receptors near the source.

A subjective response to changes in sound levels based upon judgments of sound presented within a short time span indicate that a change of ±5 A-weighted decibels (dBA) may be quite noticeable, although changes that take place over a long period of time of this magnitude or greater may be "barely perceptible." Changes in sound levels of ±10 dBA within a short time span may be perceived as "dramatic" and changes in sound levels of ±20 dBA within a short time span may be perceived as "striking." Dramatic or striking changes in sound level could be considered significant impacts.

F.4 WATER RESOURCES

F.4.1 Surface Water

F.4.1.1 Description of Affected Resources and Region of Influence

Surface waters include rivers, streams, lakes, ponds, playas, and reservoirs. An inventory of surface water resources in the project ROI, a description of areas in the ROI currently using surface water, general flow characteristics, reservoirs, and an identification of classifications applicable to the surface water will be used to determine the affected environment at each alternative site. Emphasis will be placed on those waterbodies that have the potential to be impacted during the facility's operations over the timeframe analyzed. Current wastewater treatment facilities and discharges also will be described as a baseline.

The affected environment descriptions for water quality of potentially affected receiving waters for each site will be developed by reviewing current monitoring data to identify parameters that exceed water quality criteria. Monitoring reports for discharges permitted under the National Pollutant Discharge Elimination System (NPDES) program and state regulations will be examined for exceeding permit limits or requirements. In addition, surface water quality will be evaluated in terms of whether the water body supports the designated use assigned by the individual states under the *Clean Water Act* (CWA).

F.4.1.2 Description of Impact Assessment

The assessment of potential water quality impacts will include evaluation of the type (wastewater effluent), rate, and potential discharge constituents. Environmental consequences may result if: (1) the surface water flow rate is decreased to the point where the capacity of the receiving waterbody to assimilate discharges is noticeably diminished; (2) the proposed increases in discharge cannot comply with NPDES permit limits on flow rates; (3) the proposed increases in discharges contribute to receiving waters already identified as exceeding applicable surface water quality criteria; or (4) the proposed increases in effluent cannot comply with pre-treatment limits on flow rates or specific constituent contributions without additional treatment. In addition, any expected increases in surface water runoff will be discussed along with the potential impact to surface water features at each site.

F.4.2 Groundwater

F.4.2.1 Description of Affected Resources and Region of Influence

As part of the affected environment section of the EIS, groundwater will be described in terms of the local aquifers' extent and yield, thickness, EPA classification, and recharge and discharge areas for each site. Areas in the ROI currently experiencing groundwater overdraft and related problems, and areas that have experienced large water table declines, will be described if applicable. Current potable and process water supplies and systems, water rights agreements, and water allocation of the site areas also will be described. The latest environmental data, including maps, reports, and other literature, will be used to the maximum extent possible to evaluate these conditions.

The affected environment groundwater quality at the site will be evaluated by reviewing current monitoring data and identifying any parameters that exceed state water quality standards, drinking water standards, and DOE-derived concentration guides for radionuclides in water. Parameters that exceed water quality criteria will be further described and contaminant plumes delineated, where possible.

F.4.2.2 Description of Impact Assessment

An assessment of potential groundwater quality environmental consequences will be associated with pollutant discharges during facility modification and operation phases (e.g., process wastes and sanitary wastes) and will be examined for each site to determine if a direct input to groundwater could occur. The results of the groundwater quality projections will then be discussed relative to Federal and state groundwater quality standards, effluent limitations, and safe drinking water standards to assess the acceptability of each alternative. Operation parameters from the alternatives with the potential to further degrade existing groundwater quality will be identified.

The potential effects to groundwater availability will be assessed for each alternative at each candidate site by evaluating whether the proposed project: (1) increases groundwater withdrawals in areas already experiencing overdraft and other related problems (e.g., land subsidence); (2) potentially decreases groundwater levels causing a substantial depletion of the resource; (3) water requirements exceed the allotment, water rights, or available supply limits, if present; or (4) reduces or ceases the flow of one or more major springs. Suitable mitigation measures to reduce impacts will be identified and discussed.

F.4.3 Floodplains

Floodplains include any lowlands that border a stream and encompass areas that may be covered by the stream's overflow during flood stages. As part of the affected environment discussion at each site, floodplains will be identified from maps and environmental documents. Any potential facility location within a 100-year floodplain or a critical action in a 500-year floodplain would be assessed for environmental consequence. The 500-year floodplain evaluation is of concern for activities determined to be critical actions for which even a slight chance of flooding would be intolerable. Appropriate mitigation measures would be identified to minimize potential floodplain impacts.

F.5 GEOLOGY AND SOILS

F.5.1 Description of Affected Resources and Region of Influence

The analysis of geology and soils examines the ROI, or lands occupied by and immediately surrounding each alternative site. Information on the regional structural geology, stratigraphy, and soils will be collated and summarized.

In addition, the seismicity of the region surround each site will be evaluated to provide a perspective on the probability of earthquakes in the area and their likely severity. This information will used to provide input to the evaluation of accidents due to natural phenomena.

F.5.2 Description of Impact Assessment

The proposed project areas being evaluated at each site will be evaluated for the amount of disturbance that may affect the geology and/or soils of the areas under study. These impacts may include, among others, potential erosion impacts and impacts to potential geologic economic resources. Impacts, if any, will be evaluated and a determination made as to severity. Possible mitigation will also be identified for adverse impacts.

F.6 BIOLOGICAL RESOURCES

F.6.1 Description of Affected Resources and Region of Influence

Biological resources will be described within the ROI, which is defined by the lands occupied by and immediately surrounding each alternative site. In the case of threatened and endangered species and other special interest species, biotic information will include species distribution within the county of each alternative site location. Information on biological resources will be complied, collated and summarized from existing documentation. No site-specific biological surveys will be conducted. Site-specific quantitative analyses would be performed in support of follow-on site- and project-specific NEPA analysis. Descriptions will be at a summary level and focus within four categories: Terrestrial Resources, Wetlands, Aquatic Resources, and Threatened and Endangered Species.

F.6.2 Description of Impact Assessment

During construction, impacts to biotic resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species, may result from land-clearing activities, erosion and sedimentation, and human disturbance and noise. Operations may affect biotic resources as a result of changes in land use, emission of radionuclides, water withdrawal, wastewater discharge, and human disturbance and noise. In general, potential impacts will be assessed based on the degree to which various habitats or species could be effected by an alternative. Where appropriate, impacts will be evaluated with respect to Federal and state protection regulations and standards.

The analysis of impacts of MPF project alternatives to biological resources will be addressed at a level that is appropriate to the specificity of available information. In general, the analysis of impacts to biological resources presented in the MPF EIS will be qualitative rather than quantitative. Quantitative analyses would be performed in follow-on site- and project-specific NEPA documentation.

Terrestrial Resources

Impacts of the MPF proposed alternatives on terrestrial plant communities will be evaluated by comparing data on site vegetation communities to proposed land requirements for construction and operation. The analysis of impacts to wildlife is based to a large extent on plant community loss or modification, which directly affects animal habitat. The loss of important or sensitive habitats and species is considered more important than the loss of regionally abundant habitats or species. Impacts on biotic resources from the release of radionuclides will not be evaluated. Radiological releases associated with the various alternatives would generally be at or below natural background levels and would be within limits established to protect workers and the public. Since humans have generally been shown to be the most sensitive organism to radiation release, radiological levels should also be protective of biota.

Wetlands

The potential direct loss of wetlands resulting from construction and operation of the proposed MPF will be addressed in a way similar to the evaluation of impacts on terrestrial plant communities; that is, by comparing data on site or area wetlands to proposed land requirements. Sedimentation impacts will be evaluated based on the proximity of wetlands to the MPF project area. Impacts resulting from wastewater discharge into a wetland system will be evaluated, recognizing that effluents would be required to meet applicable Federal and state standards.

Aquatic Resources

Impacts to aquatic resources resulting from sedimentation and wastewater discharge will be evaluated as described for wetlands. Potential impacts from radionuclides will not be addressed for the same reasons described for terrestrial resources.

Threatened and Endangered Species

Impacts on threatened and endangered species and other special interest species will be determined in a manner similar to that used to describe terrestrial and aquatic resources since the sources of potential impacts are similar. A list of species potentially present on each candidate site or in proximity to the candidate site or area will be developed using information obtained from the U.S. Fish and Wildlife Service (USFWS) and appropriate state agencies databases. This list, along with consideration of site environmental and engineering data, and provisions of the *Endangered Species Act*, will be used to evaluate whether the various MPF siting alternatives could impact any threatened or endangered plant or animal (or its habitat).

F.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

F.7.1 Description of Affected Resources and Region of Influence

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. For this EIS, cultural resources are divided into three general categories: prehistoric resources, historic resources, and Native American resources. A cultural resource can fall into more than one of these categories due to use through a long period of time or multiple functions.

Prehistoric resources are material remains, structures, and items used or modified by people before the establishment of a European presence in the area. By definition, these resources pre-date written records. Historic resources include the material remains and landscape alterations that have occurred since the arrival of Europeans to the area. Due to the focus of this EIS on DOE facilities, historic resources often include resources associated with the Manhattan Project, World War II, and the Cold War. Native American resources are material remains, locations, and natural materials important to Native Americans for traditional religious or heritage reasons. These resources are rooted in the community's history or are important in maintaining cultural identity.

Paleontological resources are the physical remains, impressions, or traces of plant or animal species that date to former geological epochs or the early Holocene. These resources may be sources of information on ancient environments and the evolutionary development of plants and animals.

The ROI for the cultural and paleontological resource analyses encompass the entire DOE site, since analyses include the possibility of locating the MPF anywhere within each DOE site.

F.7.2 Description of Impact Assessment

The analyses of potential impacts to cultural and paleontological resources are very similar because the two types of resources can be affected by the alternatives in much the same manner. The analyses address potential direct and indirect impacts at each candidate site from construction activities and operation of the facility. Most potential impacts are those resulting from groundbreaking activities; however, other types of impacts are considered, such as reduced access by practitioners to resources, introduction of visual, audible, or atmospheric elements out of character with the resources, and increased visitation to sensitive areas. Analyses of impacts take into consideration the location of the reference site, the acreage required for the proposed facility, and the likelihood of resources being located in that area.

F.8 SOCIOECONOMICS

The analysis of socioeconomics will describe impacts on local and regional socioeconomic conditions and factors including employment, economy, population, housing and community services at each alternative site considered in the MPF EIS. The potential for socioeconomic impacts is greatest in those local jurisdictions immediately adjacent to each site and those that are potential residential locations for future DOE site employees at a new or expanded MPF.

Therefore, potential socioeconomic impacts are assessed using a geographic ROI. ROIs are used to assess potential effects on the economy as well as effects that are more localized in political jurisdiction surrounding the sites.

Region of Influence

The ROI for each site encompasses an area that involves trade among and between regional industrial and service sectors. It is characterized by strong economic linkages between the communities located in the region. These linkages determine the nature and magnitude of multiplier effects on economic activity (i.e., purchases, earnings, and employment) at each candidate site.

The U.S. Bureau of Economic Analysis measures multiplier effects of inter-industry linkages with the Regional Input-Output Modeling System (RIMS II). RIMS II is based on an accounting framework called an input-output table. An input-output table shows, for each industry, industrial distributions of input purchased and outputs sold. RIMS II Total Direct-Effect Multipliers will be used in the MPF EIS to estimate additional regional employment and income generated by employment and income directly associated with the Proposed Action.

Additional potential demographic impacts will be assessed on the area where the housing market and community services would be most affected. The ROI is defined as those counties where approximately 90 percent of the current DOE and contractor employees reside. This residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at each site, and is used to estimate the future distribution of direct workers with the Proposed Action. The evaluation of impacts is based on the degree to which changes in employment and population affect the regional economy, housing market, and community services. It is assumed that most new jobs would occur within the ROI where the majority of DOE and contractor employees live.

F.9 HUMAN HEALTH AND SAFETY

F.9.1 Occupational Radiation Health

F.9.1.1 Description of Affected Resources and Region of Influence

Potential impacts to human health and safety posed by the MPF include radiological and nonradiological exposure pathways and occupational injuries, illnesses, and fatalities resulting from construction activities and normal (accident-free) operations of the completed facility. Exposures pathways include inhalation, immersion, ingestion, and exposure to external sources. Occupational regions of influence include involved and uninvolved workers. Non-occupational ROIs for the public include the MEI and the general population surrounding the candidate sites.

F.9.1.2 Description of Impact Assessment

Occupational Radiation Health

Radiological impacts will be assessed for workers (both involved and non-involved in MPF operations) and for the public (MEI and population). Health impacts to involved workers from

MPF operations will be based on either information from MPF specific technology data reports or from similar (radiation) workers at the alternative sites. It is expected that the same dose will be applied to involved workers at each alternative site and, therefore, that this will not be a discriminator among sites (although it may be compared to the No Action Alternative).

Health impacts to non-involved workers will be based on doses calculated by the radiological air analyses. Doses will be converted to health effects (fatal cancer risk) using the multiplier of 400 fatal cancers per 10^6 person-rem. A 40-hour, 50-week worker exposure will be assumed.

Similarly, health impacts to the MEI and population will be based on doses calculated by the radiological air analyses. In this case, 500 fatal cancers per 10^6 person-rem will be used in order to reflect the more diverse population with respect to age and health (as opposed to workers). Continuous exposure over the year will be assumed. Furthermore, while inhalation and immersion will be the pathways of interest for workers, the general population may also be exposed through food pathways. Radiological impacts to drinking water, as assessed by hydrological analyses, will be included.

Occupational Safety

Occupational injury, illness, and fatality estimates will be evaluated using occupational incidence rates of major industry groups, DOE, and DOE contractors. When site-specific evaluations are performed, DOE Computerized Accident/Incident Reporting System (CAIRS) data will be used. Since activities similar to MPF operations or facility construction are not being performed at all of the potential MPF sites, U.S. Department of Labor, Bureau of Labor Statistics injury, illness and fatality information for similar activities will be used to determine bounding rates. These rates will be compared to person-hour estimates for the project. Occupational injury, illness, and fatality categories used in this analysis will be in accordance with OSHA definitions. Incident rates will be developed for facility construction and facility operations.

Health risks from hazardous chemical releases during normal operation at the respective DOE sites will be assessed by evaluating facility chemical source term inventories and engineered facility safety features used to mitigate personnel exposures during normal (accident-free) operations. HI values will be used to screen for additional analysis. If required, site boundary concentrations, derived through modeling (i.e., ISCST or equivalent) will be used to develop HQs for noncancer risks for comparison to reference concentration values, such as the EPA Integrated Risk Information System. The cancer risk to the MEI will be calculated from the doses derived from modeling exposure levels, using slope factors or unit risks for individual chemicals published in the Integrated Risk Information System or the health effects summary tables. The health effects summary tables are the yearly summary of EPA’s regulatory toxicity data.

The HIs and cancer risks are used to identify potential health concerns that may require further analysis. If the HI and/or cancer risk exceed acceptable limits, then these sites or activities become candidates for further analysis. An in-depth analysis would identify the individual chemicals that contribute to substantial adverse HI and/or cancer risk impacts, starting with those chemicals showing the highest HQs and/or cancer risk and grouping them according to their specific health effects. These chemicals then may be identified for inclusion in more specific site analyses. HIs and/or the cancer risk default values exceeding OSHA standards do not necessarily indicate that a health concern exists. The calculated HIs and cancer risk only establish a baseline for comparison of alternatives among different sites. The baseline is then used to determine the extent to which each alternative adds or subtracts from the No Action Alternative HI and cancer risk to the public at each site.

F.10 ACCIDENT ANALYSIS

F.10.1 Description of Affected Resources and Region of Influence

Potential impacts to human health and safety from postulated MPF accidents include radiological and nonradiological exposures. For both radiological and chemical accidents associated with the MPF, the affected resources are the facility and site workers and the offsite population. Specifically, for radiological accidents, the impact is incremental adverse health effects (i.e., latent cancer fatalities [LCFs]) for a non-involved worker, the maximally exposed offsite individual, and the offsite population within 80 kilometers (km) (50 miles [mi]) of each alternative site. In addition, a qualitative assessment will be made of the potential adverse health effects to workers in the MPF. For nonradiological accidents, airborne concentrations and potential health effects will be calculated for the non-involved worker and the maximally exposed offsite individual.

F.10.2 Description of Impact Assessment

Postulated accidents can be initiated by internal operations (e.g., fire, spill, criticality), external events (e.g., airplane crash), or natural phenomena (e.g., earthquake, flood). The MPF EIS will address a spectrum of unmitigated accident scenarios chosen to reflect the range and kinds of accidents that are postulated. The range of accidents is from low frequency-high consequence to high frequency-low consequence events in order to envelop potential risks. Accidents with estimated initiating event frequencies less than 10^{-7} per year will not be considered, unless their exclusion would affect decisionmaking. The spectrum of accidents and their calculated impacts should provide a baseline for each site that can be used to judge the environmental implications at alternative sites. The accident analysis will be performed in accordance with the *Recommendations for Analyzing Accidents Under the National Environmental Policy Act* (July 2002).

For radiological accidents, point estimates of radiation dose and, for the offsite population, corresponding incremental LCFs will be calculated for a hypothetical non-involved worker (located 1,000 m [3,281 ft] from the MPF release point), the maximally exposed offsite individual, and the offsite population within 80 km (50 mi) of each alternative site. For nonradiological accidents, estimates of airborne concentrations of chemical substances will be calculated for a hypothetical non-involved worker and the maximally exposed offsite individual.

It should be noted that the purpose of this EIS is to assist the decisionmaker in making site selection decisions. Since the activities at the MPF would be the same regardless of location, the risk to involved workers would be independent of site location and would not be a discriminating factor for programmatic siting decisions. Risks to involved workers may be addressed in greater detail in site-specific tiered NEPA documents if more detailed information is available.

For radiological and chemical accidents, the following general analytical steps will be followed:

1. Screen operations within the MPF to identify those with the potential to contribute to offsite risk.
2. Identify and screen postulated accident scenarios associated with those operations.
3. Calculate source terms (release rates and frequencies) for these unmitigated scenarios.
4. Calculate the onsite and offsite consequences (impacts to the health and safety of site workers and the general public) of these scenarios as follows.

The unmitigated consequences of accidental releases of radioactivity will be calculated using the MELCOR Accident Consequence Code System Version 2 (MACCS2) with the radiological source term values described above. In addition to the source term data, the following input data for the MACCS2 code will be obtained:

- Estimated location of specific MPF facilities and their distance from the site boundary
- Release heights (i.e., stack release, building release, or ground level release)
- Local meteorological conditions
- Offsite population distribution (using the 2000 census data)
- Offsite agricultural and economic data

The consequences of accidental releases of hazardous chemicals will be calculated using the Aerial Location of Hazardous Atmospheres (ALOHA) code with the chemical source term values described above. In addition to the source term data, input data for the ALOHA code is similar to that required for the radiological accident analysis, with the exception that offsite agricultural and economic data are not required.

For accident scenarios involving multiple operations within the MPF, such as those that might be caused by natural phenomena, estimates of radiation dose and corresponding incremental LCFs and estimates of airborne concentrations of chemical substances will be calculated for the same receptors as described previously.

F.11 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 rulemaking. 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 siting the MPF at any of the proposed alternative sites will be analyzed. The minority population and low-income population composition of the area surrounding the proposed alternative sites will be compared to that of a larger geographic area to determine whether the possible impacts of siting the MPF at a particular site will have a disproportionately high and adverse impact on minority or low-income populations.

F.12 TRAFFIC AND TRANSPORTATION

F.12.1 Description of Affected Resources and Region of Influence

Transportation routes in the vicinity of the proposed MPF location will be identified, in text and on a map, to indicate which highways would be impacted by MPF traffic, including commuters and shipments. Where available, traffic data, such as annual average daily traffic, will be presented as a baseline for a subsequent qualitative analysis of increased traffic congestion. Traffic data will be derived from recent DOE environmental documentation or from state agencies.

F.12.2 Description of Impact Assessment

The MPF EIS is programmatic in scope and will be used to support site selection and operation capacity. A tiered EIS on construction and operation will examine impacts at the selected site. Accordingly, the range of potential analytical endpoints for this siting EIS will be been reduced to those necessary to provide discrimination among the sites and operation alternatives. The full range of analytical endpoints will be reconsidered in the tiered EIS for construction and operation. The shipments under consideration would be limited to product inputs/outputs and waste associated with pit processing.

Incident-Free Transportation Impacts

Using the TRAGIS code, routes and routing characteristics will be determined for the origin-destination pairs associated with each of the alternative sites. Worker and population collective dose and latent cancer fatalities will be calculated using the RADTRAN 5 code. Results will be presented on an annual basis.

Transportation Accident Impacts

Using the RADTRAN 5 code, the total annual risk for each of the shipment campaigns (product and waste) will be calculated and analyzed for incident-free impacts.

Traffic Impacts

Traffic flow will be analyzed to determine whether or not the flow would be adversely impacted by the addition of new commuters for the MPF at each of the potential sites for both construction and operations phases. The number of new commuters will be determined based on construction and operations employment. If the data support a level of service (LOS) calculation, then changes in LOS will be calculated for each site. If LOS cannot be determined for all the sites, then semi-quantitative or qualitative arguments will be used with an attempt to rank the sites by the result. Depending upon availability of data, a fraction of an increase in traffic at peak times could be an important indicator in lieu of LOS changes.

F.13 WASTE MANAGEMENT

F.13.1 Description of Affected Resources and Region of Influence

A key goal of the MPF project is to develop a safe, secure, environmentally compliant facility based on modern manufacturing procedures. Waste minimization will also be a goal of the MPF. The production of waste requiring offsite disposal will be reduced to as low as reasonably achievable (ALARA) consistent with cost-benefit analyses. The MPF siting alternatives would incorporate waste minimization and pollution prevention practices to the maximum extent practicable. Waste minimization efforts and the management of MPF-related wastes will be analyzed for each alternative site. The impact assessment will address the projected waste types and volumes from the MPF at each site compared to the No Action Alternative.

MPF construction wastes are similar to those generated by any construction project of comparable scale. Wastes generated during MPF operations would consist of five primary types: transuranic (TRU) waste, low-level waste (LLW), mixed LLW, hazardous waste, and nonhazardous waste. Waste management facilities supporting the MPF would treat and package the waste into forms that would enable long-term storage or disposal. The MPF would include the capability to process liquid TRU waste to a form suitable for disposal at Waste Isolation Pilot Plant (WIPP). Other waste types generated by the MPF would be transferred to existing facilities and managed in accordance with current practices at the DOE site.

F.13.2 Description of Impact Assessment

To provide a framework for addressing the impacts of waste management for the MPF, descriptive information will be presented on each site's waste management capabilities. The volumes of each waste type generated will be estimated. These estimates, obtained from the MPF data call, will include consideration of concepts for waste minimization. Impacts will be assessed in the context of existing site practices for treatment, storage, and disposal including the applicable regulatory requirements. Permits, compliance agreements, and other site-specific practices will be reviewed and analyzed to assess the ability to conduct the MPF-related waste management activities.

DOE generates both "routine" waste (e.g., job control, maintenance) and waste associated with environmental restoration (ER) and decontamination and decommissioning (D&D) activities. The ER/D&D waste volumes can vary greatly from year to year and often exceed the routine waste volumes. ER/D&D waste is fundamentally different (more volume, less contamination) from routine wastes and is frequently managed at separate facilities. The estimated waste volumes for MPF construction and operations will be compared to the routine waste generation at each site to identify potential impacts to the site's waste management infrastructure.

For all sites except WIPP, the number of additional shipments required to transport TRU waste to the WIPP will be estimated. The risks associated with additional TRU waste shipments will be addressed as part of the transportation impacts assessment.

For sites under consideration for the MPF that do not have existing or planned onsite LLW disposal, the number of additional shipments required to transport LLW from the site to a DOE LLW disposal facility will be estimated. For example, for purposes of this analysis, it will be assumed that the Pantex Plant would ship its LLW to the Nevada Test Site as per current practice. The risks associated with additional LLW shipments will be addressed as part of the transportation impacts assessment.

F.14 CUMULATIVE IMPACTS

The Council on Environmental Quality (CEQ) regulations implementing the NEPA define cumulative effects as "the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). The regulations further explain "cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." Other DOE programs and other Federal, state, and local development programs all have the potential to contribute to cumulative effects on DOE sites.

The methodology for the analysis of cumulative effects for the MPF EIS was developed from the guidelines and methodology in the CEQ's *Considering Cumulative Effects Under the National Environmental Policy Act*. The major components of the CEQ methodology include:

- Scoping, including identifying the significant potential cumulative effects issues associated with the proposed action, identifying the ROI and timeframe for the analysis, and identifying other actions affecting the resources
- Describing the affected environment
- Determining the environmental consequences, including the impacts from the proposed action and other activities in the ROI, and the magnitude and significance of the cumulative effects

The cumulative effects of the MPF EIS alternatives will be analyzed for each alternative site by reviewing and analyzing data from existing NEPA documents and other DOE documents. To update the data and to supplement this information, Internet searches, literature reviews of environmental documents for the regions surrounding the proposed sites, and personal contacts with local government planning departments will be undertaken, as needed, to obtain information on the potential cumulative effects for each resource area. For some resource areas, the analysis will include the cumulative regional impacts. For example, the air analysis must examine air quality in the region for each potential site in order to access the impacts of the proposed action.

Environmental impacts for other DOE programs and other Federal, state, and local development programs for each potential site will be reviewed and the cumulative impacts analyzed. The analysis will include impacts from previous actions at each of the sites and the region of influence, current actions, and actions planned for the future. These impacts, combined with the impacts from the MPF EIS, form the basis of the analysis of cumulative effects. Where possible, quantifiable data will be used. The level of analysis for each resource area will be commensurate to the importance of the potential cumulative impacts on that resource. The data and analysis is then summarized and potential cumulative impacts for each site identified.

APPENDIX G
PROJECT NOTICES AND STUDIES

This appendix includes project notices and some of the studies that were either performed in relation to, or used as reference materials, in the preparation of the Modern Pit Facility Environmental Impact Statement (MPF EIS). These notices and studies are not intended to be an all-inclusive list. Chapter 8 of this EIS provides an all-inclusive list of the references used to prepare this EIS.

The following are included as part of this appendix:

- *Notice of Intent to Prepare a Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility*

- *Modern Pit Facility Site Screening Report*

- *Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as no Longer Required for Defense Purposes and Related Cooperation*

- *Summary of TA-55/PF-4 Upgrade Evaluation for Long-term Pit Manufacturing Capacity*

- *Plutonium Aging: Implications for Pit Lifetimes* temporary items). Extra copies of fire reports and related documentation as well as electronic copies of documents created using electronic mail and word processing. Recordkeeping copies of these files are proposed for permanent retention.

2. Department of Defense, National Imagery and Mapping Agency (N1–537–02–2, 2 items, 2 temporary items). Individual procurement appointment files relating to participants in purchase card programs. Also included are electronic copies of records created using word processing and electronic mail.

3. Department of Justice, Federal Bureau of Investigation (N1–65–02–5, 1 item, 1 temporary item). Hard copy fingerprint cards generated in connection with background investigations of military enlistees.

4. Department of Justice, National Drug Intelligence Center (N1–523–02–1, 8 items, 6 temporary items). Staff meeting files, firearms training records, and training materials that do not pertain to law enforcement. Also included are electronic copies of records created using electronic mail and word processing. Proposed for permanent retention are recordkeeping copies of executive level meeting files and training materials for law enforcement training.

5. Department of Justice, National Drug Intelligence Center (N1–523–02–2, 6 items, 3 temporary items). Policy files that do not pertain to the agency's mission, including electronic copies of records created using electronic mail and word processing. Proposed for permanent retention are recordkeeping copies of mission-related policy files and records that pertain to agreements.

6. Department of the Navy, Agency-wide (N1-NU–02–03, 5 items, 4 temporary items). Records relating to international agreements accumulated by the International Programs Office. The records include Navy annexes to data exchange agreements, newsletters, and charts. Also included are electronic copies of records created using electronic mail and word processing. Recordkeeping copies of case files pertaining to agreements are proposed for permanent retention.

7. Department of the Navy, Agency-wide (N1–NU–02–04, 13 items, 13 temporary items). Records relating to security assistance policy accumulated by the International Programs Office. Included are budgetary documents, case files relating to such matters as foreign military sales and other assistance programs, and inter-service agreements for administrative services. Also included are electronic copies of records created using electronic mail and word processing.

8. Department of State, Bureau of Human Resources (N1–59–00–8, 23 items, 21 temporary items). Records accumulated by the Office of the Executive Director relating to administrative oversight and support. Included are such records as subject files, the personnel action handbook master, performance files, and several databases containing personnel data for employees, including Foreign Service Nationals. Also included are electronic copies of documents created using electronic mail and word processing. Proposed for permanent retention is the master file of the main personnel system and microfilm copies of employee service record cards from 1940 to 1975.

9. Department of State, Assistant Secretary for Intelligence and Research (N1–59–02–7, 2 items, 1 temporary item). Electronic copies of documents created using electronic mail and word processing that are associated with the office's subject files. Proposed for permanent retention are the recordkeeping copies of these files.

10. Department of State, Office of the Secretary of State (N1–59–02–8, 2 items, 1 temporary item). Electronic copies of documents created using electronic mail and word processing that pertain to memorandums of conversations. Recordkeeping copies of these files are proposed for permanent retention.

11. Department of State, Office of Information Technology Operations and Management for the Bureau of Educational and Cultural Affairs and the Coordinator of International Information Programs (N1–59–02–9, 26 items, 26 temporary items). Records relating to information technology operations and management, including such matters as the management of computer equipment and software, tape libraries, system backups, data security, and user support. Also included are electronic copies of records created using electronic mail and word processing.

12. Department of the Treasury, Financial Management Service (N1–425–02–2, 4 items, 4 temporary items). Electronic copies of documents created using electronic mail and word processing relating to foreign claim files and to closed court cases concerning forgery and alteration of government checks. This schedule also increases retention period for recordkeeping copies of these files, which were previously approved for disposal.

13. Court Service and Offender Supervision Agency, Community Supervision Services Division (N1–562–02–1, 3 items, 3 temporary items). Case files for offenders in the District of Columbia Superior Court system who are under parole, supervised release, and/or probation supervision. Included are electronic copies of documents created using electronic mail and word processing.

14. Peace Corps, Management Division (N1–490–02–1, 1 item, 1 temporary item). Electronic records accumulated by the Office of Information Resources Management that are used for tracking staff access to and use of agency automated systems.

Dated: September 12, 2002.

Michael J. Kurtz,

Assistant Archivist for Record Services, Washington, DC.

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DEPARTMENT OF ENERGY

National Nuclear Security Administration

Notice of Intent to Prepare a Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

AGENCY: Department of Energy, National Nuclear Security Administration.

ACTION: Notice of intent.

SUMMARY: The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including protection of production readiness to maintain that stockpile. Since 1989, the DOE has been without the capability to produce plutonium pits (the portion of a nuclear weapon which generates the fission energy to drive modern thermonuclear weapons). The NNSA, the Department of Defense (DOD), and Congress have highlighted the lack of long-term pit production capability as a national security issue requiring timely resolution. While an interim capability is currently being established at the Los Alamos National Laboratory (LANL), classified analyses indicate that this capability will not suffice to maintain, long-term, the nuclear deterrent that is a cornerstone of U.S. national security policy. Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*), and the DOE Regulations Implementing NEPA (10 CFR Part 1021), the NNSA is announcing its intent to prepare a Supplement to the Programmatic Environmental Impact Statement (EIS) on Stockpile Stewardship and Management (SSM) for

a Modern Pit Facility (MPF) in order to decide: (1) whether to proceed with the MPF; and (2) if so, where to locate the MPF. This NOI also sets forth the dates, times, and locations for public scoping meetings on the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility.

DATES: NNSA is inviting comments related to its intention to prepare a Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Comments should be submitted within November 22, 2002. Comments submitted during the 60-day comment period following publication of this NOI will assist the NNSA in developing the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Public scoping meetings to discuss issues and receive comments on the scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will be held in the vicinity of sites that may be affected by the proposed action, as well as in Washington, DC. The public scoping meetings will provide the public with an opportunity to present comments, ask questions, and discuss concerns with NNSA officials regarding the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. The locations, dates, and times for these public scoping meetings are as follows:

Pantex—October 8, 2002 , 7 p.m.–10 p.m., College Union Building, Oak Room, Amarillo College, Washington Street Campus, 24th and Jackson Streets, Amarillo, TX 79178, (806) 371–5100

Carlsbad, NM—October 10, 2002, 7 p.m.–10 p.m., U.S. Department of Energy, Carlsbad Area Office, 4021 National Parks Highway, Carlsbad, NM 88220, (505) 234–7227

Washington, DC—October 15, 2002, 2 p.m.–5 p.m., U.S. Department of Energy, 1000 Independence Avenue, SW., Room 1E–245, Washington, DC 20585, (202) 586–0821

Nevada Test Site—October 17, 2002, 7 p.m.–10 p.m., U.S. Department of Energy, Nevada Operations Office, Auditorium, 232 Energy Way, Las Vegas, NV 89030, (702) 295–3521

Los Alamos National Laboratory—October 24, 2002, 7 p.m.–10 p.m., Duane W. Smith Auditorium, 1400 Diamond Drive, Los Alamos, NM 87544, (505) 663–2510

Savannah River Site—October 29, 2002, 7 p.m.–10 p.m., North Augusta Community Center, 495 Brookside Avenue, North Augusta, SC 29841, (803) 441–4290

The NNSA will publish additional notices on the dates, times, and locations of the scoping meetings in local newspapers in advance of the scheduled meetings. Any necessary changes will be announced in the local media. Any agency, state, pueblo, tribe, or unit of local government that desires to be designated a cooperating agency should contact Mr. Jay Rose at the address listed below by October 15, 2002.

ADDRESSES: General questions concerning this Notice of Intent for the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility can be asked by calling 1–800–832–0885, ext. 65484, or by writing to: Mr. Jay Rose, Supplement to the Programmatic EIS on SSM for a Modern Pit Facility Document Manager, NA–53, Forrestal Building, U.S. Department of Energy/NNSA, 1000 Independence Avenue, SW., Washington, D.C. 20585. Comments can be submitted to Mr. Rose at the address above; or faxed to: 1–202–586–5324; or e-mailed to *James.Rose@nnsa.doe.gov.* Please mark envelopes, faxes, and E-mail: ''Supplement to the Programmatic EIS on SSM for a Modern Pit Facility Comments.''

FOR FURTHER INFORMATION CONTACT: For general information on the NNSA NEPA process, please contact: Mr. James J. Mangeno, NNSA NEPA Compliance Officer, NA–3.6, Forrestal Building, U.S. Department of Energy/NNSA, 1000 Independence Avenue, SW., Washington, D.C. 20585; or telephone 1–800–832–0885, ext. 6–8395. For general information on the DOE NEPA process, please contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance, EH–42, Forrestal Building, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, telephone 202–586–4600, or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION: Plutonium pits are essential components of nuclear weapons. Prior to the shutdown of its production activities in 1989, plutonium pits for the nuclear weapons stockpile were manufactured at the DOE Rocky Flats Plant in Colorado. No stockpile-certified pits have been produced by this country since that shutdown. During the mid-1990s, the DOE conducted a comprehensive analysis of the capability and capacity needs for the entire Nuclear Weapons Complex and evaluated alternatives for maintaining the Nation's nuclear stockpile in the Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS, DOE/EIS–0236). Issued in September 1996, the SSM PEIS looked extensively at pit manufacturing capability and capacity needs, and evaluated reasonable alternatives for re-establishing interim pit production capability on a small scale. A large pit production capacity—in line with the capacity planned for other manufacturing functions—was not evaluated in the PEIS ''because of the small current demand for the fabrication of replacement pits, and the significant, but currently undefined, time period before additional capacity may be needed.'' In the SSM PEIS Record of Decision (ROD) (61 FR 68014, December 26, 1996), the Secretary of Energy decided to re-establish an interim pit fabrication capability, with a small capacity, at LANL. That decision limited pit fabrication to a facility ''sized to meet programmatic requirements over the next ten or more years.'' In the ROD, DOE committed to ''performing development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity.''

Subsequent to the SSM PEIS ROD, a number of citizen groups filed suit challenging the adequacy of the SSM PEIS. In August 1998, the SSM PEIS litigation was resolved. As a result of that litigation, DOE agreed to entry of a court order that required, ''[p]rior to taking any action that would commit DOE resources to detailed engineering design, testing, procurement, or installment of pit production capability for a capacity in excess of the level that has been analyzed in the SSM PEIS [50 pits per year under routine conditions, 80 pits per year under multiple-shift operations], DOE shall prepare and circulate a Supplemental PEIS, in accordance with DOE NEPA Regulation 10 CFR 1021.314, analyzing the reasonably foreseeable environmental impacts of and alternatives to operating such an enhanced capacity, and shall issue a Record of Decision based thereon.'' This Supplement to the SSM PEIS is being prepared in part to satisfy that obligation.

Following the SSM PEIS, in January 1999, the Department prepared the LANL Site-Wide EIS (SWEIS) (DOE/EIS–0238), which evaluated site-specific alternatives for implementing pit production at LANL. Consistent with the SSM PEIS ROD, the LANL SWEIS evaluated alternatives that would implement pit production with a capacity up to 50 pits per year under single-shift operations and 80 pits per year using multiple shifts. In the ROD for the LANL SWEIS (64 FR 50797, September 20, 1999), DOE decided to produce up to 20 pits per year at LANL, and deferred any decision to expand pit manufacturing beyond that level.

Consistent with the 1996 SSM PEIS ROD and the 1999 LANL SWEIS ROD, NNSA has been re-establishing a small pit manufacturing capability at LANL. The establishment of the interim pit production capacity is expected to be completed in 2007. However, classified analyses indicate that the capability being established at LANL will not support either the projected capacity requirements (number of pits to be produced over a period of time), or the agility (ability to rapidly change from production of one pit type to another, ability to simultaneously produce multiple pit types, or the flexibility to produce pits of a new design in a timely manner) necessary for long-term support of the stockpile. In particular, any systemic problems that might be identified in an existing pit type or class of pits (particularly any aging phenomenon) could not be adequately addressed today, nor could it be with the capability being established at LANL. Although no such problems have been identified, the potential for such problems increases as pits age. NNSA's inability to respond to such issues is a matter of national security concern. NNSA is responsible for ensuring that appropriate pit production capacity and agility are available when needed, and this Supplement to the SSM PEIS is being undertaken to assist NNSA in discharging this responsibility.

NEPA Strategy and EIS Alternatives

Currently, the NNSA envisions the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility as a ''programmatic document'' that will support two decisions: (1) Whether to proceed with the MPF; and (2) if so, where to locate the MPF. A tiered, project-specific EIS is expected to be prepared after the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility if the Secretary decides to proceed with such a facility. That tiered EIS, which would utilize detailed design information to evaluate site-specific alternatives at any site selected as a potential location for a MPF, would ultimately support a decision for construction and operation of the MPF. As described below, the NNSA has developed preliminary alternatives for the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility.

Alternatives: The NNSA has prepared, and will continue to prepare mission, requirements, and planning documents required to support an NNSA decision on whether to proceed with the MPF, and has conducted a site screening analysis to assure that potential sites meet program requirements. Initially, all existing, major DOE sites were considered to serve as potential host location for the MPF. The site screening analysis considered the following criteria: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA presence at the site, and infrastructure. The first two criteria were deemed to be ''exclusionary'' criteria; that is, a site either passed or failed on each of these two criteria. The sites that passed the exclusionary criteria were then scored against all criteria. Based upon results from the site screening analysis, the following sites were determined to be reasonable alternatives for the MPF: (1) Los Alamos National Laboratory at Los Alamos, New Mexico; (2) Nevada Test Site near Las Vegas, Nevada ; (3) Pantex Plant at Amarillo, Texas; (4) Savannah River Site at Aiken, South Carolina; and (5) the Waste Isolation Pilot Plant at Carlsbad, NM. The Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will also evaluate the no-action alternative of maintaining the current plutonium pit capabilities at LANL, and the reasonableness of upgrading the existing facilities at LANL to increase pit production capacity. Additionally, the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will evaluate a range of pit production capacities consistent with national security requirements.

Identification of Environmental and Other Issues

The environmental impacts of constructing and operating the MPF, including the impacts that might occur at each potential site, will be addressed in the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. These impacts will be presented along with environmental baseline information to enable the reader to discern the differences between alternatives. The NNSA has identified the following issues for analysis in the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Additional issues may be identified as a result of the scoping process.

1. Public and Worker Safety, Health Risk Assessment: Radiological and non-radiological impacts, including projected effects on workers and the public from construction, normal operations and accident conditions, and decommissioning and decontamination activities associated with constructing and operating the MPF.

2. Impacts from releases to air, water, and soil associated with constructing and operating the MPF.

3. Impacts to plants, animals, and habitats, including threatened or endangered species and their habitats, associated with constructing and operating the MPF.

4. The consumption of natural resources and energy associated with constructing and operating the MPF.

5. Socioeconomic impacts to affected communities from construction and operation of the MPF.

6. Environmental justice: Disproportionately high and adverse human health or environmental effects on minority and low-income populations associated with constructing and operating the MPF.

7. Impacts to cultural resources such as historic, archaeological, scientific, or culturally important sites associated with constructing and operating the MPF.

8. Impacts associated with transportation and storage of nuclear materials.

9. Status of compliance with all applicable Federal, state, and local statutes and regulations; required Federal, state, and tribe environmental consultations and notifications; and DOE Orders on waste management, waste minimization, and environmental protection.

10. Cumulative impacts from the proposed action and other past, present, and reasonably foreseeable actions at the alternative sites.

11. Potential irreversible and irretrievable commitments of resources associated with constructing and operating the MPF.

12. Pollution prevention and waste management practices, including characterization, storage, treatment and disposal of wastes associated with constructing and operating the MPF. NNSA anticipates that certain classified information will be utilized in preparing the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility and considered by the NNSA in deciding whether to construct and operate MPF, and if so, where the facility would be located. Accordingly, the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will likely contain a classified appendix. To the extent allowable, the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will summarize this information in an unclassified manner.

Supplement to the Programmatic EIS on SSM for a Modern Pit Facility Schedule

The proposed Supplement to the Programmatic EIS on SSM for a Modern Pit Facility schedule is as follows:

Notice of Intent: September 2002.
Public Scoping Meetings: October 2002.
Publish Draft EIS: May 2003.
Draft EIS Public Hearings: June–July 2003.
Publish Final EIS: March 2004.
Record of Decision: April 2004.

Public Scoping Process

To assist in defining the appropriate scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility and to identify significant environmental issues to be addressed, NNSA representatives will conduct public scoping meetings at the dates, times, and locations described above under **DATES**. At these meetings, the NNSA will present a short summary of the project, indicate the alternatives to be considered, and present the proposed scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Following the initial presentation at each site, NNSA representatives will answer questions and accept comments, and the public will have a chance to offer their comments on the proposal, alternatives to be studied and the scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Copies of handouts from the meetings will be available to those unable to attend, by contacting the NNSA as described above under **ADDRESSES**.

Issued in Washington, DC, this 16th day of September 2002.

Spencer Abraham,

Secretary of Energy.

[FR Doc. 02–24076 Filed 9–20–02; 8:45 am]

BILLING CODE 6450–01–P

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50–237, 50–249, 50–254, and 50–265]

Exelon Generation Company, LLC; Dresden Nuclear Power Station, Units 2 and 3, Quad Cities Nuclear Power Station, Units 1 and 2; Environmental Assessment and Finding of No Significant Impact

The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of an exemption from certain requirements of 10 CFR 50.71(e)(4) for Facility Operating License Nos. DPR–19 and DPR–25, issued to Exelon Generation Company, LLC (the licensee), for operation of the Dresden Nuclear Power Station, Units 2 and 3, located in Grundy County, Illinois, and for Facility Operating License Nos. DPR–29 and DPR–30, issued to the licensee, for operation of the Quad Cities Nuclear Power Station, Units 1 and 2, located in Rock Island County, Illinois. Therefore, as required by 10 CFR 51.21, the NRC is issuing this environmental assessment and finding of no significant impact.

Environmental Assessment

Identification of the Proposed Action

The proposed action would grant a schedular extension for Dresden Nuclear Power Station (Dresden), Units 2 and 3, and for Quad Cities Nuclear Power Station (Quad Cities), Units 1 and 2, for submittal of revised Updated Final Safety Analysis Reports (UFSARs) from the regularly scheduled dates. 10 CFR 50.71(e)(4) requires that subsequent revisions to the UFSAR be submitted periodically to the NRC provided that the interval between successive updates does not exceed 24 months. The Dresden and Quad Cities UFSAR revisions are currently submitted on a 24-month cycle. The next scheduled date for submittal of the revised UFSAR for Dresden is June 30, 2003, and for Quad Cities is October 20, 2003. However, the licensee plans to submit revised UFSARs along with Operating License Renewal Applications (LRAs) for Dresden and Quad Cities in January 2003. The licensee plans to resume the established schedule for submittal of the UFSAR revisions in 2005 for both stations. The licensee requests a one-time exemption to postpone submittal of the revised Dresden and Quad Cities UFSARs until 2005.

The proposed action is in accordance with the licensee's application dated August 9, 2002.

The Need for the Proposed Action

The licensee proposes to submit revised UFSARs with LRAs in January 2003, and to resume the established schedule for submittal of UFSAR revisions for Dresden on June 30, 2005, and for Quad Cities on October 20, 2005. An exemption is required because 10 CFR 50.71(e)(4) requires that subsequent revisions to the UFSAR be submitted periodically to the NRC provided that the interval between successive updates does not exceed 24 months.

Environmental Impacts of the Proposed Action

The NRC has completed its evaluation of the proposed action and concludes that there are no significant adverse environmental impacts associated with the proposed action.

The proposed action will not significantly increase the probability or consequences of accidents, no changes are being made in the types of effluents that may be released off site, and there is no significant increase in occupational or public radiation exposure. Therefore, there are no significant radiological environmental impacts associated with the proposed action.

With regard to potential nonradiological impacts, the proposed action does not have a potential to affect any historic sites. It does not affect nonradiological plant effluents and has no other environmental impact. Therefore, there are no significant nonradiological environmental impacts associated with the proposed action.

Accordingly, the NRC concludes that there are no significant environmental impacts associated with the proposed action.

Environmental Impacts of the Alternatives to the Proposed Action

As an alternative to the proposed action, the staff considered denial of the proposed action (*i.e.*, the ''no-action'' alternative). Denial of the application would result in no change in current environmental impacts. The environmental impacts of the proposed action and the alternative action are similar.

Alternative Use of Resources

The action does not involve the use of any different resource than those previously considered in the Final Environmental Statement for the Dresden Nuclear Power Station, Units 2 and 3, dated November 1973, and for the Quad Cities Nuclear Power Station, Units 1 and 2, dated September 1972.

Agencies and Persons Consulted

On August 22, 2002, the staff consulted with the Illinois State official, Mr. F. Niziolek of the Department of Nuclear Safety, regarding the environmental impact of the proposed action. The State official had no comments.

Finding of No Significant Impact

On the basis of the environmental assessment, the NRC concludes that the proposed action will not have a significant effect on the quality of the human environment. Accordingly, the

Modern Pit Facility Site Screening Report

INTRODUCTION

Based on the May 24, 2002 approval of the critical decision on mission need (CD-0) by the Secretary of Energy, the National Nuclear Security Administration (NNSA) is planning to design, construct and operate a new modern pit facility (MPF) that will provide a significantly larger capacity than the interim production capacity being established at Los Alamos National Laboratory (LANL). As a key step in the planning, the NNSA will prepare a Supplemental Environmental Impact Statement (SEIS) to the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS) [hereafter, that SEIS will be referred to as the MPF EIS]. The MPF EIS will support the following decisions: (1) whether to proceed with the MPF; and (2) if so, where to locate the MPF. A tiered, project-specific EIS is expected to be prepared after the MPF EIS if the Secretary decides to proceed with such a facility. That tiered EIS, which would utilize detailed design information to evaluate site-specific alternatives at any site selected as a potential location for a MPF, would ultimately support a decision for construction and operation of the MPF. The purpose of this paper is to describe the results of the site screening process used to develop the reasonable site alternatives that will be evaluated in the MPF EIS.

OVERVIEW OF SITE SCREENING

The purpose of the site screening process was two-fold: (1) to identify reasonable site alternatives for the MPF EIS; and (2) to identify unsuitable site alternatives and document why these alternatives were not reasonable for the MPF EIS. A two-step screening process was employed: first, all potential sites were judged against Ago/no go@ criteria; and second, those sites satisfying the go/no go criteria were judged against desired, weighted criteria. The desired criteria and weights were developed by members of the MPF project office. Federal employees from the NNSA and other relevant DOE program offices then Ascored@ the potential sites using the desired criteria. Aggregate scores for the alternatives were then tallied, and the reasonable site alternatives were determined.

SITES UNDER CONSIDERATION

Existing, major Department of Energy (DOE) sites were considered to serve as the host location for the MPF. Non-DOE or new sites were not considered to avoid potential contamination issues at a new location that had not previously been associated with plutonium or plutonium-bearing waste operations. Many DOE sites did not satisfy the go/no-go criteria and were eliminated during the first step of the screening process. The seven sites that were evaluated through both steps of the screening process were: Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), Nevada Test Site (NTS), Pantex (PX), Savannah River Site (SRS), Waste Isolation Pilot Plant (WIPP) site at Carlsbad, and Y-12 on the Oak Ridge Reservation.

SITE SCREENING PROCESS

The first step in the site screening process was to develop go/no go criteria that any potential site had to satisfy to be judged further as a reasonable site alternative for the MPF. Sites not satisfying these go/no go criteria were not judged any further in the screening process. Members of the MPF project office determined that security and safety to workers and the public were the two most important factors. Accordingly, population encroachment and mission compatibility were deemed the appropriate go/no go criteria for siting the MPF, as explained below.

With respect to population encroachment, two types of data were factored into the criterion: density of surrounding population and nearness to a major city. Sites surrounded by populations greater than 1,000,000 people (based on a 50-mile radius population) were determined to be unsuitable. Sites contiguous to major cities were also determined to be unsuitable, due to the potential for future population encroachment and economic disruption and deleterious health impacts in the unlikely event of a major accident.

With respect to mission compatibility, it was decided that sites not currently conducting ADOE nuclear operations@ were unsuitable for the MPF. Sites that currently conduct ADOE nuclear operations@ have an established nuclear facility Environment, Safety, and Health (ES&H) and security infrastructure that were determined to be essential. Non-DOE nuclear sites were eliminated from consideration because of concerns regarding long-term mission compatibility and the absence of an existing DOE ES&H and security infrastructure. Sites predominantly engaged in Aclean-up@ missions were also determined to be unsuitable for the MPF because proposing a major new nuclear facility had the potential to distract from efforts related to site clean-up.

Sites that satisfied the go/no go criteria were then judged against desired, weighted criteria to determine the comparative reasonableness of each site alternative. The following weighted criteria were utilized: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA site, and infrastructure.

Technical judgments were utilized to establish criterion weighting. The most important criteria were assigned a relative weight of 5, the remaining criterion were assigned a weight of 3. Of the desired criteria, the NNSA determined that population encroachment, mission compatibility, margin for safety/security, and synergy with existing/future plutonium operations were of greatest importance and thus, were assigned the highest weighting of 5. Minimizing transportation of plutonium, current use as an NNSA site, and infrastructure were assigned a weighting of 3.

SITE SCREENING CRITERIA

Population Encroachment: Population encroachment considered the population density within a fifty-mile radius of the site. The population density near the site boundary and population centers within 10 miles of the site boundary were also considered. Because population encroachment has strong security implications, as well the potential to affect ES&H risks to the public, this criterion was rated one of the most important criterion and assigned a weighting of 5.

> Sites with the smallest population at the greatest distance from the MPF received the highest rating of 10.

Sites with the highest population closest to the MPF received the lowest rating of 0.

Sites in-between received a rating of 2.5, 5, or 7.5, depending upon the relative population encroachment

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Mission Compatibility: Mission compatibility referred to the capability of the MPF to be constructed and operated in harmony with a site=s existing missions. For example, a site conducting similar operations to those of the MPF, i.e., receipt and storage of Category I quantities of plutonium, large scale plutonium chemical processing operations, plutonium foundry, plutonium machining and joining, assembly, post assembly testing, extensive analytical and metallurgical laboratories, and waste handling of high level and TRU waste, was expected to be more suitable for constructing and operating the MPF compared to a site without such operations. Sites conducting similar missions were expected to have a higher likelihood of successfully accomplishing the MPF mission on schedule and on budget; thus, this criterion was rated one of the most important criterion and assigned a weighting of 5.

Sites with existing missions most similar to those of the MPF received the highest score of 10.

Sites with existing missions least similar to those of the MPF received the lowest score of 0.

Sites in-between received ratings of 2.5, 5, or 7.5, depending upon the relative similarity of their missions to those of the MPF.

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Synergy with Plutonium Operations: While similar to mission compatibility, this criterion took into account specific attributes associated with plutonium manufacturing and processing, including potential synergies with existing/future plutonium missions that have the potential to improve the efficiency/reduce the costs of constructing/operating the MPF. Factors such as the extent of existing/future plutonium manufacturing and processing, experience with plutonium manufacturing and processing, existing/future plutonium radiological labs and analytical capability, existence of emergency operation personnel and equipment are examples of factors that were considered. This criterion was rated one of the most important criterion and assigned a weighting of 5.

Sites which conduct the most plutonium manufacturing and processing, or which have the potential to conduct the most plutonium manufacturing and processing in the future, or which have or may have the greatest plutonium infrastructure received the highest score of 10.

Sites which conduct the least plutonium manufacturing and processing, or which have the potential to conduct the least plutonium manufacturing and processing in the future, or which have or may have the least plutonium infrastructure received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of plutonium manufacturing and processing/infrastructure afforded by the site.

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Margin for Safety/Security: Margin for safety and security referred to a site's inherent ability to provide a safe and secure operating environment against threats and to minimize potential effects of accidents. Factors such as remoteness, terrain, proximity to military bases, controlled air space, proximity to commercial flight paths, and visibility from public highways are examples of factors that were considered. Sites with greatest margins for safety/security provided a higher likelihood of successfully accomplishing the MPF mission; thus, this criterion was rated one of the most important criterion and assigned a weighting of 5.

Sites with the greatest margin for safety/security received the highest score of 10.

Sites with the lowest margin for safety/security received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative margin for safety/security afforded by the site.

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Minimization of Transportation: Candidate sites were scored, on a relative basis, according to their geographic location and the amount of hazardous material transportation that would be required to support the location of the MPF at that site. Reducing the total distance that plutonium feedstock, manufactured product, and radioactive waste are transported has potentially substantial operational, cost, safety, and security benefits. This criterion was assigned a weighting of 3.

Sites requiring the least plutonium transportation received the highest score of 10.

Sites requiring the most plutonium transportation received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of plutonium transportation associated with the site.

These scores were then multiplied by a factor of three to determine the final score for this criterion.

NNSA Sites: Existing NNSA sites (including non-NNSA sites that conduct a significant amount of NNSA work) with NNSA procedures, NNSA management, safety, security, and administrative procedures in place were deemed more desirable than sites that do not conduct a significant amount of NNSA work. This criterion was assigned a weighting of 3.

NNSA sites (including non-NNSA sites that conduct a significant amount of NNSA work) received the highest score of 10.

Non-NNSA sites that do not conduct a significant amount of NNSA work received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of NNSA work associated with the site.

These scores were then multiplied by a factor of three to determine the final score for this criterion.

<u>Existing Infrastructure:</u> Candidate sites were scored, on a relative basis, on the amount of existing relevant infrastructure. Factors such as existing security forces and structures, existing administrative facilities, existing safety equipment and personnel, available utilities, existence of on-site technical capability to provide applied R&D and manufacturing technical support, and existence of a waste handling infrastructure for both higher level and TRU waste are examples of factors that would make a site a more desirable location for the MPF. This criterion was assigned a weighting of 3.

Sites with the greatest existing infrastructure received the highest score of 10.

Sites with the least existing infrastructure received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of infrastructure at the site.

These scores were then multiplied by a factor of three to determine the final score for this criterion.

RESULTS OF SITE SCREENING PROCESS

All major DOE sites were initially considered. Many DOE sites did not satisfy the go/no-go criteria. For example, Hanford, although remote, did not satisfy the mission compatibility criteria. Hanford is clearly a remediation site which no longer has a weapons mission. Siting a new weapons production facility at Hanford would clearly conflict with the future plans for the site. Kansas City Plant did not satisfy either of the two go/no-go criteria as it is a non-nuclear facility located in the midst of a large urban setting. Both SNL and LLNL, due to their proximity to large, rapidly growing populations, did not satisfy the go/no-go criterion for population encroachment. Rocky Flats did not satisfy either of the go/no-go criterion. This facility is in close proximity to a large population, no longer has a weapons mission, and is considered to be a remediation site. Other major DOE sites, such as ANL-East or BNL, that do not have national security-related missions and/or are close to major urban centers were eliminated for similar reasons.

Seven DOE sites remained after initial go/no-go screening. These remaining DOE sites (Carlsbad, INEEL, LANL, Nevada Test Site, Oak Ridge Reservation (Y-12), Pantex and Savannah River site) were then ranked, on a relative basis, using each of the site screening criteria and the weighting factors described above. Each of the DOE reviewing officials independently scored these seven

sites using the criteria described above. Scores of each reviewer were then averaged for each criteria. Weighted scores for the sites were then tallied, yielding the results shown below:

Average Weighted Site Selection Scores

	LANL	SRS	NTS	Pantex	Carlsbad	INEEL	Y-12
Population Encroachment	23.5	14	50	23.5	47	40.5	0
Mission Compatibility	48.5	47	9.5	28	11	6.5	9.5
Margin for Safety/Security	20.5	29.5	50	17	33	31.5	8
Synergy With Pu Ops	48.5	47	12.5	19	11	6.5	0
Transportation Minimization	20.7	0.9	8.4	30	29.1	6.6	3.9
NNSA Site	28.8	28.2	28.2	28.2	3.9	3.9	25.2
Infrastructure	28.2	28.8	10.2	15.9	8.4	8.4	11.4
TOTAL WEIGHTED SCORE	**218.7**	**195.4**	**168.8**	**161.6**	**143.4**	**103.9**	**58**

CONCLUSION

Based on the weighted scores shown above, Y-12 and INEEL scored significantly less than the other five sites, thereby creating a significant break among the seven sites. Carlsbad, LANL, NTS, Pantex and SRS all received scores of at least 28% higher than INEEL, and at least 60% higher than Y-12. The average score for the five highest ranked sites was 178, and the five highest-scoring sites were within 20% of this average. INEEL and Y-12 were 42% and 67% below this average respectively.

In addition, the results of the site screening scoring process were reviewed to determine if one or more Avariant@ scores influenced the results. A sensitivity analysis was performed in which both the high and low scores were eliminated in an attempt to add more consistency to the average scores. The results determined that no single individual score influenced the final results of the process. Another sensitivity analysis was performed to examine the importance of the weighting factor for transportation that is a criterion that could have broad interest from citizens in several states. This criterion was assessed using a weighting factor of 5 instead of 3. The increased weighting yielded higher scores for Carlsbad and Pantex (which were already score the highest for this criterion based on a weighting factor of 3), while not changing the relative ranking of any of the sites. The net result was an even more significant break between the top 5 sites and the bottom 2 sites, thus, corroborating the original results.

The results of these sensitivity analyses confirmed both the relative rankings of the seven sites and the significant Abreak point@ between the top five sites and the bottom two sites. As a result of the site screening process, it was determined that Carlsbad, LANL, NTS, Pantex and SRS represented a reasonable range of alternatives sites that should be evaluated in detail in the MPF EIS.

AGREEMENT
BETWEEN
THE GOVERNMENT OF THE UNITED STATES OF AMERICA
AND
THE GOVERNMENT OF THE RUSSIAN FEDERATION
CONCERNING THE MANAGEMENT AND DISPOSITION
OF PLUTONIUM DESIGNATED AS NO LONGER REQUIRED
FOR DEFENSE PURPOSES AND RELATED COOPERATION

The Government of the United States of America and the Government of the Russian Federation, hereinafter referred to as the Parties,

Guided by:

The Joint Statement of Principles for Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes, signed by the President of the United States of America and the President of the Russian Federation on September 2, 1998, affirming the intention of each country to remove by stages approximately 50 metric tons of plutonium from their nuclear weapons programs and to convert this plutonium into forms unusable for nuclear weapons;

Taking into account:

The Agreement between the Government of the United States of America and the Government of the Russian Federation on Scientific and Technical Cooperation in the Management of Plutonium That Has Been Withdrawn from Nuclear Military Programs, signed on July 24, 1998 (hereinafter referred to as the Scientific and Technical Cooperation Agreement);

Continuation by the Parties of their cooperation within the framework of the Scientific and Technical Cooperation Agreement and the importance of that work for making decisions concerning technologies for plutonium conversion and mixed uranium-plutonium fuel fabrication, as well as for reactor modification for the use of such fuel;

The statement of the President of the United States of America on March 1, 1995, announcing that 200 tons of fissile material will be withdrawn from the U.S. nuclear stockpile and directing that these materials will never again be used to build a nuclear weapon;

The statement of the President of the Russian Federation to the 41st Session of the General Conference of the International Atomic Energy Agency, on September 26, 1997, on step-by-step removal from nuclear military programs of up to 500 tons of highly enriched uranium and up to 50 tons of plutonium released in the process of nuclear disarmament; and

The Joint Statement by the Parties concerning non-separation of weapon-grade plutonium in connection with the signing of this Agreement;

Have agreed as follows:

Article I

For the purposes of this Agreement, the terms specified below are defined as follows:

1. “Weapon-grade plutonium” means plutonium with an isotopic ratio of plutonium 240 to plutonium 239 of no more than 0.10.

2. “Disposition plutonium” means weapon-grade plutonium that has been

   a) withdrawn from nuclear weapon programs,

   b) designated as no longer required for defense purposes, and

   c) declared in the Annex on Quantities, Forms, Locations, and Methods of Disposition, which is an integral part of this Agreement.

3. “Blend stock” means any plutonium other than disposition plutonium that is received at a disposition facility for mixing with disposition plutonium.

4. “Spent plutonium fuel” means fuel that was manufactured with disposition plutonium and irradiated in nuclear reactors.

5. “Immobilized forms” means disposition plutonium that has been imbedded in a glass or ceramic matrix and encapsulated with high-level radioactive waste in a can-in-canister system suitable for geologic disposal, or any other immobilization system agreed in writing by the Parties.

6. “Disposition facility” means any facility that is constructed, modified or operated under this Agreement or that stores, processes, or otherwise uses disposition plutonium, spent plutonium fuel, or immobilized forms, including any such conversion or conversion/blending facility, fuel fabrication facility, immobilization facility, nuclear reactor, and storage facility (other than storage facilities specified in Section III of the Annex on Quantities, Forms, Locations, and Methods of Disposition).

Article II

1. Each Party shall, in accordance with the terms of this Agreement, dispose of no less than thirty-four (34) metric tons of disposition plutonium.

2. Each Party’s declaration on quantities, forms, locations, and methods of disposition for disposition plutonium is set forth in the Annex on Quantities, Forms, Locations, and Methods of Disposition.

3. The Parties shall cooperate in the management and disposition of disposition plutonium, implementing their respective disposition programs in parallel to the extent practicable.

4. The reciprocal obligations set forth in paragraph 1 of this Article shall not prejudice consideration by the Parties of what additional quantities of plutonium may be designated by each Party in the future as no longer required for defense purposes.

5. The Parties shall cooperate with a view to ensuring that additional quantities of weapon-grade plutonium that may be withdrawn from nuclear weapon programs and designated in the future by the Parties as no longer required for defense purposes are:

   a) brought under and disposed of in accordance with the terms of this Agreement; or

   b) subject to other measures as agreed by the Parties in writing that provide for comparable transparency and disposition.

6. Each Party shall have the right to mix blend stock with disposition plutonium provided that for nuclear reactor fuel containing disposition plutonium the mass of blend stock shall:

   a) be kept to a minimum, taking into account the protection of classified information, safety and economic considerations, and obligations of this Agreement; and

   b) in no case exceed twelve (12) percent of the mass of disposition plutonium with which it is mixed.

   The resulting mixture of disposition plutonium and blend stock shall be weapon-grade plutonium.

7. Each Party's disposition plutonium shall count toward meeting the thirty-four (34) metric ton obligation set forth in paragraph 1 of this Article once the other Party confirms in accordance with agreed procedures that the spent plutonium fuel or immobilized forms meet the criteria specified in the Annex on Technical Specifications, which is an integral part of this Agreement. Blend stock shall not count toward meeting that thirty-four (34) metric ton obligation.

Article III

1. Disposition shall be by one or more of the following methods:

   a) irradiation of disposition plutonium as fuel in nuclear reactors;

   b) immobilization of disposition plutonium into immobilized forms; or

   c) any other methods that may be agreed by the Parties in writing.

2. The following are the nuclear reactors that may be used for irradiation of disposition plutonium under this Agreement: light water reactors in the United States of America and in the Russian Federation; the BOR-60 at Dimitrovgrad and the BN-600 at Zarechnyy in the Russian Federation; and any other nuclear reactors agreed by the Parties in writing.

Article IV

1. Each Party shall take all reasonable steps, including completion of necessary technical and other preparatory activities and feasibility studies, to complete construction and modification and to begin operation of disposition facilities necessary to dispose of no less than two (2) metric tons per year of its disposition plutonium in accordance with

Article III of this Agreement, if the assistance specified in the multilateral agreement referred to in paragraph 8 of Article IX of this Agreement for this disposition rate is being provided for achievement of milestones in the Russian Federation specified in the Annex on Schedules and Milestones, which is an integral part of this Agreement.

2. Each Party shall seek to begin operation of facilities referenced in paragraph 1 of this Article not later than December 31, 2007.

3. Pending conclusion of the multilateral agreement referred to in paragraph 8 of Article IX of this Agreement for the disposition rate specified in paragraph 1 of this Article, the Parties shall proceed with research, development, demonstrations, design and licensing activities under this Agreement, on the condition that assistance for such activities is being provided pursuant to paragraph 1 of Article IX of this Agreement.

4. Each Party shall notify the other Party whenever it reaches a milestone set forth in the Annex on Schedules and Milestones or, if not reached at the specified time, the reasons for that delay. If a Party does not reach a milestone at the specified time, it shall make every effort to minimize the delay. In these circumstances, the Parties shall establish in writing a revised mutually-agreed schedule of work for achieving the milestone.

5. Once facilities specified in paragraph 1 of this Article are constructed or modified and begin operations, each Party shall proceed to dispose of disposition plutonium to achieve a disposition rate of no less than two (2) metric tons per year at the earliest possible date.

6. If, prior to December 31, 2007, a Party begins to dispose of disposition plutonium, such plutonium may count toward meeting the thirty-four (34) metric ton obligation set forth in paragraph 1 of Article II of this Agreement if:

   a) the criteria specified in the Annex on Technical Specifications are met; and

   b) monitoring and inspection measures agreed in writing by the Parties are applied to such disposition activities.

Article V

1. Promptly upon entry into force of this Agreement, the Parties shall undertake to develop a detailed action plan, including efforts with other countries as appropriate, to at least double the disposition rate specified in paragraphs 1 and 5 of Article IV of this Agreement at the earliest practicable date. The Parties shall seek to complete this detailed action plan within one year after entry into force of this Agreement. The development of the action plan and the development of arrangements provided for in paragraph 7 of Article IX of this Agreement will, for the Government of the United States of America and the Government of the Russian Federation, proceed in the channels that have negotiated this Agreement.

2. In developing the action plan pursuant to paragraph 1 of this Article, consideration may be given to:

   a) expanding the capability of existing nuclear reactors to utilize mixed uranium-plutonium fuel or using such fuel in additional nuclear reactors, including nuclear reactors outside the Russian Federation, and using such fuel or other plutonium fuel in advanced nuclear reactors within the Russian Federation, if they prove practical in light of available resources within the time frame of this Agreement;

b) consistent with the expansion of capabilities mentioned in subparagraph (a) of this paragraph, increasing the capacity of conversion or conversion/blending facilities, fuel fabrication facilities and/or immobilization facilities, or constructing additional facilities; and

c) any other approaches as the Parties may agree.

3. Each Party shall proceed at the earliest possible date to dispose of disposition plutonium at the disposition rate specified in the action plan referred to in paragraph1 of this Article if the assistance specified in the provisions supplementing the multilateral agreement referred to in paragraph 8 of Article IX of this Agreement for this rate in the Russian Federation is being provided.

Article VI

1. Disposition plutonium and blend stock, once received at any disposition facility, shall not be:

   a) used for the manufacture of nuclear weapons or any other nuclear explosive device, for research, development, design or testing related to such devices, or for any other military purpose; or

   b) exported to a third country, including for disposition, except by agreement in writing of the Parties to this Agreement and subject to international safeguards and other applicable international agreements or arrangements, including INFCIRC/274/Rev. 1, The Convention on the Physical Protection of Nuclear Material.

2. Neither Party shall separate plutonium contained in spent plutonium fuel until such time as that Party has fulfilled the obligation set forth in paragraph1 of Article II of this Agreement.

3. Neither Party shall separate disposition plutonium contained in immobilized forms.

4. Disposition facilities shall be utilized only in ways consistent with the terms and conditions of this Agreement.

5. Disposition plutonium and blend stock shall be the only plutonium received at or processed by disposition facilities that are conversion or conversion/blending facilities, or fuel fabrication facilities.

Article VII

1. Each Party shall have the right to conduct and the obligation to receive and facilitate monitoring and inspection activities in accordance with this Article and the Annex on Monitoring and Inspections, which is an integral part of this Agreement, in order to confirm that the terms and conditions of this Agreement with respect to disposition

plutonium, blend stock, spent plutonium fuel and immobilized forms, and disposition facilities are being met.

2. Disposition plutonium and blend stock shall become subject to monitoring and inspection under this Agreement, in accordance with the Annex on Monitoring and Inspections and procedures developed pursuant to that Annex, either (a) after receipt but before processing at a conversion or conversion/blending facility, or (b) upon receipt at a fuel fabrication or an immobilization facility, whichever (a) or (b) occurs first for any given disposition plutonium or blend stock.

3. Each Party shall begin consultations with the International Atomic Energy Agency (IAEA) at an early date and undertake all other necessary steps to conclude appropriate agreements with the IAEA to allow it to implement verification measures beginning not later in the disposition process than: (a) when disposition plutonium or disposition plutonium mixed with blend stock is placed into the post-processing storage location of a conversion or conversion/blending facility; or (b) when disposition plutonium is received at a fuel fabrication or an immobilization facility, whichever (a) or (b) occurs first for any given disposition plutonium.

4. If agreed in writing by the Parties, the exercise of each Party's right set forth in paragraph 1 of this Article may be suspended in whole or in part by the application of equivalent IAEA verification measures under the agreements referred to in paragraph 3 of this Article. The Parties shall, to the extent practicable, avoid duplication of effort of monitoring and inspection activities implemented under this Agreement and appropriate agreements with the IAEA.

Article VIII

1. Each Party shall be responsible within the territory of the United States of America and the Russian Federation, respectively, for:

   a) ensuring safety and ecological soundness of disposition plutonium activities under the terms of this Agreement; and

   b) effectively controlling and accounting for disposition plutonium, blend stock, spent plutonium fuel and immobilized forms, as well as providing effective physical protection of such material and facilities containing such material taking into account the recommendations published in the IAEA document INFCIRC/225/Rev. 4, The Physical Protection of Nuclear Material, or a subsequent revision accepted by the Parties.

Article IX

1. The Government of the United States of America shall make available up to two hundred (200) million United States dollars in assistance for the activities to be undertaken in the Russian Federation pursuant to this Agreement and such other amounts as may be agreed in writing by the Parties for these purposes in the future, subject to the availability of appropriated funds and the fulfillment of United States legal and administrative requirements. Assistance provided by the Government of the United States of America shall be for such activities as the research, design, development, licensing, construction

and/or modification of facilities (including modification of nuclear reactors), and technological processes, systems and associated infrastructure for such activities. This assistance will be in addition to any other assistance that may be provided by the Government of the United States of America under the Scientific and Technical Cooperation Agreement.

2. Assistance provided by the Government of the United States of America may include research and development, scientific and technical experimentation, design for facility construction or modification, general and specialized equipment, replacement and spare parts, installation services, licensing and certification costs, initial operations and testing, aspects of facility operations, and other assistance directly related to the management and disposition of plutonium in accordance with the provisions of this Agreement.

3. Equipment, supplies, materials, services, and other assistance provided or acquired by the Government of the United States of America, its contractors, subcontractors, and their personnel, for the implementation of this Agreement in the Russian Federation, are considered free technical assistance.

4. Assistance provided by the Government of the United States of America for activities to be undertaken in the Russian Federation pursuant to this Agreement shall be provided in accordance with the terms and conditions set forth in this Agreement, including the Annex on Assistance, which is an integral part of this Agreement.

5. The activities of each Party under this Agreement shall be subject to the availability of appropriated funds.

6. Activities to be undertaken in the Russian Federation pursuant to this Agreement may be supported by contributions by the Government of the Russian Federation and by assistance provided by the Government of the United States of America and, as may be specified in the multilateral agreement referred to in paragraph 8 of this Article, by other countries or groups of countries (including equipment, supplies, materials, services, and other assistance provided by them). Activities may also be supported from other sources, including non-government and private sector funds, under terms and conditions agreed in writing by the Parties.

7. The Parties shall seek to develop near-term and long-term international financial or other arrangements for the support of activities to be undertaken in the Russian Federation pursuant to this Agreement sufficient, in combination with contributions by the Government of the Russian Federation and assistance provided by the Government of the United States of America, to achieve and maintain:

   a) the two (2) metric ton per year disposition rate specified in paragraphs 1 and 5 of Article IV of this Agreement; and

   b) the disposition rate resulting from the action plan developed pursuant to paragraph 1 of Article V of this Agreement.

8. For the disposition rate referred to in paragraph 7(a) of this Article, the Parties shall cooperate with a view toward concluding within one (1) year after entry into force of this Agreement a multilateral agreement that documents the assistance arrangements necessary for that rate. For the disposition rate resulting from the action plan developed pursuant to paragraph 1 of Article V of this Agreement, the Parties shall cooperate with a view to

supplementing such multilateral agreement with provisions recording assistance arrangements necessary for that rate.

9. As part of the multilateral agreement referred to in paragraph 8 of this Article, the Parties shall seek to provide for:

   a) notifications, explanations and immediate consultations in the event that a recorded assistance commitment is not fulfilled; and

   b) those consultations to include consideration of resumption of assistance, measures to mitigate any consequences of such non-fulfillment, including costs associated with nuclear safety, physical protection and facility conservation, and other measures as deemed appropriate by the participants in the consultations.

10. If conclusion of the multilateral agreement referred to in paragraph 8 of this Article for assistance arrangements necessary for the disposition rate set forth in paragraph 7(a) of this Article is not completed within eighteen (18) months after entry into force of this Agreement for any reason, the Parties shall consult on whether to adjust the schedules for their respective programs, including any necessary adjustments to the milestones set forth in the Annex on Schedules and Milestones, and any other steps, or whether to terminate the Agreement in accordance with Article XIII of this Agreement.

11. Pending conclusion of the multilateral agreement referred to in paragraph 8 of this Article and conclusion of necessary arrangements with the Government of the Russian Federation for the disposition rate set forth in paragraph 7(a) of this Article, neither Party shall be obligated to construct, modify or operate facilities to dispose of disposition plutonium pursuant to this Agreement. Notwithstanding this, each Party shall proceed under this Agreement with activities in accordance with paragraph 3 of Article IV of this Agreement necessary for construction, modification or operation of disposition facilities.

12. If one or more parties to the multilateral agreement referred to in paragraph 8 of this Article decide to terminate implementation of their assistance commitments recorded in that agreement, and as a result the Government of the Russian Federation is unable to fulfill its obligations with respect to the achievement of a milestone set forth in the Annex on Schedules and Milestones or of the annual disposition rate specified in paragraphs 1 and 5 of Article IV or paragraph 3 of Article V of this Agreement, whichever is applicable, the Government of the Russian Federation shall have the right, consistent with the requirements of paragraphs 13 and 15 of this Article, to suspend those implementation activities under this Agreement that are affected by such termination.

13. If the Government of the Russian Federation intends to exercise its right pursuant to paragraph 12 of this Article, it shall notify the Government of the United States of America through diplomatic channels at least fourteen (14) days prior to any such suspension of implementation activities and identify what activities are to be suspended, and the Parties shall immediately start consultations. In the event implementation of the recorded assistance commitments referred to in paragraph 12 of this Article is not resumed within one hundred and eighty (180) days after the start of consultations, the Parties will consider whether to resume implementation of or to terminate the Agreement in accordance with Article XIII of this Agreement.

14. In the event the Government of the Russian Federation suspends any implementation activities pursuant to paragraph 12 of this Article, the Government of the United States of

America shall have the right to suspend proportionately its implementation activities under this Agreement.

15. During the consultations referred to in paragraph 13 of this Article, unless otherwise agreed by the Parties in writing, neither Party shall take any action that:

    a) could break the continuity in the other Party's knowledge of disposition plutonium or disposition facilities, that had become subject to monitoring and inspection under this Agreement, in a manner that would prevent that Party from confirming that such disposition plutonium or disposition facilities are not being used in ways inconsistent with the Agreement; or

    b) would be inconsistent with the terms and conditions for assistance that had been provided under this Agreement.

Article X

1. Under this Agreement, no United States classified information or Russian Federation state secret information shall be exchanged, except as may be agreed in writing by the Parties for purposes of exchanging information pursuant to this Agreement related to the quantities and locations of disposition plutonium and blend stock at disposition facilities.

2. The information transmitted under this Agreement or developed as a result of its implementation and considered by the United States of America as "sensitive" or by the Russian Federation as "konfidentsial'naya" must be clearly designated and marked as such.

3. "Konfidentsial'naya" or "sensitive" information shall be handled in accordance with the laws of the state of the Party receiving the information, and this information shall not be disclosed and shall not be transmitted to a third party not participating in the implementation of this Agreement without the written consent of the Party that had transmitted such information.

    a) According to the laws and regulations of the Russian Federation, such information shall be treated as "limited-distribution official information". Such information shall be protected in accordance with the laws and regulations of the Russian Federation.

    b) According to the laws and regulations of the United States of America, such information shall be treated as "foreign government information," provided in confidence. Such information shall be protected in accordance with the laws and regulations of the United States of America.

4. Information transmitted under this Agreement shall be used solely in conformance with this Agreement.

5. The Parties shall minimize the number of persons having access to information that is designated "konfidentsial'naya" or "sensitive" information in accordance with paragraph 2 of this Article.

6. The Parties shall ensure effective protection and allocation of rights to intellectual property, transferred or created under this Agreement, as set forth in this Agreement, including the Annex on Intellectual Property, which is an integral part of this Agreement.

Article XI

1. The Parties shall designate Executive Agents for implementation of this Agreement. The Executive Agent for the United States of America shall be the U.S. Department of Energy. The Executive Agent for the Russian Federation shall be the Ministry of the Russian Federation for Atomic Energy.

2. With the exception of the notification referred to in paragraph1 of Article XIII of this Agreement, notifications between the Parties that are provided for by this Agreement shall be transmitted between the Executive Agents unless otherwise specified.

3. The Executive Agents may enter into implementing agreements and arrangements as necessary and appropriate to carry out the provisions of this Agreement. When appropriate, the Executive Agents may utilize other agencies or entities to assist in the implementation of this Agreement, such as government agencies, academies, universities, science and research centers, institutes and institutions, and private sector firms.

Article XII

1. The Parties shall establish a Joint Consultative Commission for this Agreement to:

   a) consider and resolve questions regarding the interpretation or application of this Agreement;

   b) consider additional measures as may be necessary to improve the viability and effectiveness of this Agreement; and

   c) consider and resolve such other matters as the Parties may agree are within the scope of this Agreement.

2. The Joint Consultative Commission shall meet within twenty-one (21) days of a request of either Party or its Executive Agent.

3. Each Party shall designate its Co-Chairman to the Joint Consultative Commission. Each Party shall notify the other Party of its designated Co-Chairman in writing within thirty (30) days after entry into force of this Agreement. Decisions of the Joint Consultative Commission shall be made on the basis of consensus.

Article XIII

1. This Agreement shall be applied provisionally from the date of signature and shall enter into force on the date of the last written notification that the Parties have fulfilled the national procedures required for its entry into force.

2. This Agreement may only be amended by written agreement of the Parties, except that the Annex on Schedules and Milestones may be updated as specified in Section II of that Annex.

3. Except as provided in paragraph 4 of this Article, this Agreement shall terminate on the date the Parties exchange notes confirming that thirty-four (34) metric tons of disposition plutonium have been disposed by each Party in accordance with this Agreement, unless terminated earlier by written agreement of the Parties.

4. If additional quantities of weapon-grade plutonium are brought under this Agreement pursuant to paragraph 5 of Article II of this Agreement, this Agreement shall terminate on the date the Parties exchange notes confirming that thirty-four (34) metric tons of disposition plutonium and all such additional quantities of weapon-grade plutonium have been disposed in accordance with this Agreement, unless terminated earlier by written agreement of the Parties.

5. Notwithstanding termination of this Agreement in accordance with paragraph 3 or 4 of this Article:

   a) neither Party shall use plutonium, once it is received at any disposition facility, for the manufacture of nuclear weapons or any other nuclear explosive device, for research, development, design or testing related to such devices, or for any other military purpose;

   b) neither Party shall export to a third country plutonium, once it is received at any disposition facility, except by agreement in writing of the Government of the United States of America and the Government of the Russian Federation and subject to international safeguards and other applicable international agreements or arrangements, including INFCIRC/274/Rev. 1, The Convention on the Physical Protection of Nuclear Material;

   c) neither Party shall (i) use any plutonium separated from spent plutonium fuel for the manufacture of nuclear weapons or any other nuclear explosive device, for research, development, design or testing related to such devices, or for any other military purpose, or (ii) export spent plutonium fuel, immobilized forms, or any plutonium separated from spent plutonium fuel to a third country, except by agreement in writing of the Government of the United States of America and the Government of the Russian Federation and subject to international safeguards and other applicable international agreements or arrangements, including INFCIRC/274/Rev. 1, The Convention on the Physical Protection of Nuclear Material;

   d) each Party shall continue to effectively control and account for spent plutonium fuel and immobilized forms, as well as to provide effective physical protection of such material taking into account the recommendations published in the IAEA document INFCIRC/225/Rev. 4, The Physical Protection of Nuclear Material, or subsequent revisions accepted by the Parties;

   e) the obligations set forth in paragraph 3 of Article VI of this Agreement, Article X of this Agreement, paragraphs 6 and 7 of this Article, paragraphs 5, 6, and 7 of the General Assistance Section of the Annex on Assistance, and the Liability Section of the Annex on Assistance shall remain in force unless otherwise agreed in writing by the Government of the United States of America and the Government of the Russian Federation;

f) the Parties shall consult concerning implementation of existing contracts and projects between the Parties and settlement of any outstanding costs between the Parties; and

g) for any activities under this Agreement and any importation or exportation by the Government of the United States of America, its personnel, contractors and contractors' personnel of equipment, supplies, materials or services that had been required to implement this Agreement, no retroactive taxes shall be imposed in the Russian Federation.

6. At an appropriate early date, but in any event not fewer than five (5) years prior to termination of this Agreement, the Parties shall begin consultations to determine what international monitoring measures shall be applied, after termination, to spent plutonium fuel, immobilized forms, and disposition facilities that are conversion or conversion/blending facilities or fuel fabrication facilities, as well as to any reprocessing of spent plutonium fuel. In the event the Parties do not reach agreement on such monitoring measures prior to the termination of this Agreement, each Party shall:

   a) make such fuel and forms available for inspection by the other Party under established procedures, if the other Party has a question or concern regarding changes in their location or condition; and

   b) unless it can be demonstrated that such facilities have been decommissioned and can no longer be operated, make such facilities available for inspection by the other Party under established procedures, if the other Party has a question or concern regarding the use of such facilities.

7. No spent plutonium fuel shall be reprocessed by either Party after termination of this Agreement unless such reprocessing is subject to monitoring agreed by the Parties pursuant to paragraph 6 of this Article.

8. Nothing in this Agreement shall alter the rights and obligations of the Parties under the Scientific and Technical Cooperation Agreement.

DONE at ____________ and _____________, the ___ and ___ days of ___________, 2000, in duplicate in the English and Russian languages, both texts being equally authentic.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:	FOR THE GOVERNMENT OF THE RUSSIAN FEDERATION:

List of Annexes

Annex on Quantities, Forms, Locations, and Methods of Disposition
Annex on Technical Specifications
Annex on Schedules and Milestones
Annex on Monitoring and Inspections
Annex on Assistance
Annex on Intellectual Property

ANNEX
ON
QUANTITIES, FORMS, LOCATIONS, AND METHODS OF DISPOSITION

This Annex to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth each Party's declaration of disposition plutonium.

Section I -- Quantities and Methods of Disposition

For the United States of America:

Quantity (metric tons)	Form	Method of Disposition
25.00	Pits and Clean Metal	Irradiation
0.57	Oxide	Irradiation
2.70	Impure Metal	Immobilization
5.73	Oxide	Immobilization

For the Russian Federation:

Quantity (metric tons)	Form	Method of Disposition
25.00	Pits and Clean Metal	Irradiation
9.00	Oxide	Irradiation

Section II -- Forms

1. Pits and Clean Metal: plutonium in or from weapon components or weapon parts, and plutonium metal prepared for fabrication into weapon parts.

2. Impure Metal: plutonium alloyed with one or more other elements in the form of a homogeneous metal, and unalloyed plutonium metal that is not clean metal.

3. Oxide: plutonium in the form of plutonium dioxide.

Section III -- Locations

The Government of the United States of America declares that:

1) all the "pits and clean metal" it declared in Section I of this Annex will be shipped to the Pit Disassembly and Conversion Facility in the United States of America directly from Zones 4 or 12 of the Pantex Plant in Texas, Technical Area 55 at the Los Alamos National Laboratory in New Mexico (LANL TA-55), the Plutonium Finishing Plant complex at 200 West Area the Hanford Site in Washington (Hanford PFP), the Plutonium Building at Lawrence Livermore National Laboratory in California (LLNL Plutonium Building), and the F and K areas at the Savannah River Site in South Carolina (Savannah River F and K Areas);

2) all the "oxide" it declared in Section I of this Annex to be irradiated in reactors as mixed uranium-plutonium fuel will be shipped to its fuel fabrication facility in the United States of America directly from LANL TA-55, LLNL Plutonium Building, and Savannah River F and K Areas;

3) all the "impure metal" it declared in Section I of this Annex will be shipped directly to its immobilization facility in the United States of America from LANL TA-55, Savannah River F and K Areas, Hanford PFP, and LLNL Plutonium Building; and

4) all the "oxide" it declared in Section I of this Annex to be immobilized will be shipped directly to its immobilization facility in the United States of America from LANL TA-55, LLNL Plutonium Building, Savannah River F and K Areas, and Hanford PFP.

The Government of the Russian Federation declares that:

1) all the "pits and clean metal" it declared in Section I of this Annex will be shipped to the conversion/blending facility in the Russian Federation under the Agreement directly from the Fissile Material Storage Facility at Mayak being constructed under the Agreement between the Department of Defense of the United States of America and the Ministry of the Russian Federation for Atomic Energy Concerning the Provision of Material, Services, and Training Relating to the Construction of a Safe, Secure and Ecologically Sound Storage Facility for Fissile Material Derived from the Destruction of Nuclear Weapons of September 2, 1993; and

2) all the "oxide" it declared in Section I of this Annex will be shipped directly to the conversion/blending facility in the Russian Federation from the places where such oxide was stored pursuant to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors, of September 23, 1997.

ANNEX
ON
TECHNICAL SPECIFICATIONS

This Annex to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth the criteria for determining that disposition plutonium is disposed.

Section I -- Light Water Reactors

Disposition plutonium irradiated under the Agreement in light water reactors shall be considered disposed when the resulting spent plutonium fuel meets the following criteria:

1. Each spent plutonium fuel assembly contains a unique identifier that demonstrates it to be a fuel assembly produced with disposition plutonium;

2. Each spent plutonium fuel assembly is irradiated to a fuel burn-up level of no less than 20,000 megawatt days thermal per metric ton of heavy metal; and

3. The radiation level from each spent plutonium fuel assembly is such that it will become no less than 1 sievert per hour one meter from the accessible surface at the centerline of the assembly 30 years after irradiation has been completed.

Section II -- Immobilization

Disposition plutonium in immobilized forms shall be considered disposed when the system meets the following criteria:

1. Each can containing disposition plutonium immobilized in a glass or ceramic form designated to be inserted into a canister is marked with a unique identifier that allows for confirming the presence of the can as it is inserted into the canister;

2. Each canister containing cans of disposition plutonium is marked with a unique identifier that allows it to be identified during and after the immobilization process;

3. Each canister does not contain more than 30 kilograms of disposition plutonium; and

4. The radiation level from each canister is such that it will become no less than 1 sievert per hour one meter from the accessible surface at the centerline of the canister 30 years after the canister has been filled with high-level radioactive waste.

Section III -- BN-600 Reactor

Disposition plutonium irradiated under the Agreement in the BN-600 reactor shall be considered disposed when the resulting spent plutonium fuel meets the following criteria:

1. Each spent plutonium fuel assembly contains a unique identifier that demonstrates it to be a fuel assembly produced with disposition plutonium;

2. Each spent plutonium fuel assembly is irradiated to an average fuel burn-up level of no less than nine (9) percent of heavy atoms, unless the Parties agree in writing for safety reasons to a lower average level; and

3. The radiation level from each spent plutonium fuel assembly is such that it will become no less than 1 sievert per hour one meter from the accessible surface at the centerline of the assembly 30 years after irradiation has been completed.

ANNEX
ON
SCHEDULES AND MILESTONES

This Annex to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth schedules and milestones for each Party.

Section I -- Schedules and Milestones

For the program of the United States of America:

Date	Milestone
January 2002	Completion of the design of the Pit Disassembly and Conversion Facility
March 2002	Completion of the design of the mixed uranium oxide-plutonium oxide (MOX) Fuel Fabrication Facility
March 2002	Start of excavation for the Pit Disassembly and Conversion Facility
July 2003	Start of excavation for the Immobilization Facility
October 2003	Start of excavation for the MOX Fuel Fabrication Facility
June 2004	Completion of the design of the Immobilization Facility
March 2005	Completion of construction of the Pit Disassembly and Conversion Facility
March 2006	Start of industrial-scale operations of the Pit Disassembly and Conversion Facility
April 2006	Completion of construction of the MOX Fuel Fabrication Facility
December 2006	Completion of construction of the Immobilization Facility
March 2007	Start of operations of the MOX Fuel Fabrication Facility
September 2007	Start of MOX Reactor operations/Irradiation of first batch of MOX in Reactor
March 2008	Start of full-scale production-operations of Immobilization Facility

For the program of the Russian Federation:

Date	Milestone
January 2002	Completion of modification of the State-Scientific-Center Experimental-Research-Complex Research Institute of Atomic Reactors (OIK GNTs RIAR) for fabrication of VIPAC fuel for BN-600 (hybrid core)

October 2002	Completion of the test-fuel line for fabrication of initial VVER-1000 lead-test MOX assemblies (3 MOX LTAs)
January 2003	Completion of modification of the PAKET facility for fabrication of BN-600 pellet fuel (hybrid core)
January 2003	Completion of the Demonstration Conversion Facility (for weapon-grade plutonium to oxide)
July 2003	Start construction of industrial-scale Conversion Facility
July 2003	Start construction of industrial-scale MOX fuel Fabrication Facility
April 2004	Begin transition of BN-600 to a MOX hybrid core
April 2004	Fabrication of initial VVER-1000 MOX lead-test assemblies
August 2004	Completion of the design of industrial-scale Conversion Facility
October 2004	Completion of the design of industrial-scale MOX Fuel Fabrication Facility
July 2006	Completion of construction of industrial-scale Conversion Facility
July 2006	Start of operation of industrial-scale Conversion Facility
December 2007	Completion of construction of industrial-scale MOX Fuel Fabrication Facility
December 2007	Start of operation of industrial-scale MOX Fuel Fabrication Facility
October 2007	Decision on BN-600 life-extension
2008	Fabrication of an industrial batch of VVER-1000 MOX-fuel
2009	Beginning of operations of storage facility for BN-600 spent plutonium fuel

Section II -- Notification of Updates

1. Each Party shall update as necessary the information it has provided in Section I of this Annex in accordance with the following:

   a) the updating Party’s Executive Agent shall notify the Executive Agent of the other Party in writing with explanation of the reason for such an update; and

   b) the updating Party’s Executive Agent shall provide such notification in writing not later than 90 days after the associated change occurs.

Section III -- Completion Criteria

The Executive Agents will develop an agreed set of completion criteria for the milestones set forth in this Annex by not later than six (6) months after the signature of the Agreement.

ANNEX
ON
MONITORING AND INSPECTIONS

This Annex sets forth principles and provisions to govern the development of procedures for, and the implementation of, monitoring and inspection activities pursuant to Article VII of the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement.

Section I -- Definitions

For purposes of the Agreement, the following definitions shall apply:

1. "Monitoring" means a set of measures and activities, including inspections, use of special equipment, and review of documents (records and reports), that together provide data to the monitoring Party on disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, or disposition facilities.

2. "Inspection" means a monitoring activity conducted by the monitoring Party on-site at a facility in order to obtain data and make observations on disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, or disposition facilities.

Section II -- General Principles

1. *Scope*: Monitoring and inspection activities shall be conducted in accordance with the Agreement, this Annex, and procedures to be agreed by the Parties pursuant to Section V of this Annex.

2. *Purpose*: In accordance with paragraph 1 of Article VII of the Agreement, monitoring and inspection activities shall be designed and implemented to ensure that the monitoring Party has the ability independently to confirm that the terms and conditions of the Agreement with respect to disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, and disposition facilities are being met, specifically: paragraphs 1, 6 and 7 of Article II; paragraph 2 of Article III; Article VI; and paragraph 2 of Article VII of the Agreement.

3. *Systems of Control and Accounting*: The Parties shall implement national systems of control and accounting for nuclear materials to account for and keep records of disposition plutonium, blend stock, spent plutonium fuel, and immobilized forms. Operators of disposition facilities shall use this national system of control and accounting in order to prepare agreed data to be included in their reports. Such reports shall be provided to the monitoring Party according to procedures to be developed pursuant to Sections III and V of this Annex.

4. *Inspections*: The number, intensity, duration and timing of inspections, and the intensity of other monitoring activities, shall be kept to the minimum consistent with the effective

implementation of agreed monitoring activities pursuant to the Agreement and this Annex. Procedures for monitoring shall be designed so as to minimize, to the extent possible, interference with the operation of facilities, and to avoid affecting their nuclear safety or the safety of inspectors. Specific inspection procedures shall be developed pursuant to Section V of this Annex.

5. Inspectors shall be permitted access to disposition facilities sufficient for them to be able to attain the agreed goals of the inspection, using agreed procedures designed to avoid disclosure of United States classified information and Russian Federation state secret information in accordance with the provisions of paragraph1 of Article X of the Agreement. The monitored Party shall take every necessary measure, in accordance with agreed procedures, to ensure the access of the monitoring Party's inspectors to those facilities, and shall undertake to provide all necessary conditions for successful inspection implementation.

6. Each Party shall treat with due respect the inspectors of the other Party present on its territory in connection with monitoring activities under the Agreement and shall take all appropriate measures, consistent with its national law, to prevent any attack on the person, freedom and dignity of such personnel.

7. Each Party, in accordance with agreed procedures, shall facilitate the procurement of required services and use of equipment, the entry and exit of personnel of the other Party into and out of its territory, and the import into and export from its territory of materials and equipment for carrying out monitoring and inspection activities in accordance with the Agreement including this Annex.

8. *Relationship to Other Monitoring Regimes*: For disposition plutonium that comes from a facility subject to another U.S.-Russian bilateral monitoring regime, or an international monitoring regime that has been agreed by the Parties, monitoring under the Agreement shall take into account that other monitoring regime, and shall not conflict with the transfer requirements of that other monitoring regime. In developing monitoring and inspection procedures in accordance with the Agreement, the Parties should avoid duplicating the efforts of such other monitoring regimes.

9. *Pu-240/Pu-239 Ratio*: The monitoring Party shall be allowed to confirm, using an agreed method, that the Pu-240/Pu-239 ratio of the disposition plutonium is no greater than 0.10. Confirmation of this ratio shall occur after receipt but before processing of disposition plutonium at a conversion facility, or upon receipt at a fuel fabrication facility or immobilization facility, whichever occurs first for any given disposition plutonium.

10. *Protection of Information*: Measurements on plutonium, if required to protect United States classified information or Russian Federation state secret information from disclosure, shall be made by techniques using information barriers. Such measurements shall not be required, however, for any disposition plutonium in containers for which such measurements:

    a) had already been made under another agreement accepted by the monitoring Party; and

    b) are confirmed by the monitoring Party to remain valid.

11. *Blend Stock Measurements*: The monitoring Party shall have the right to confirm that the mass of any blend stock does not exceed what is allowed pursuant to paragraphs 6 and 7 of Article II of the Agreement, upon receipt of such blend stock at a disposition facility, using agreed procedures developed pursuant to Section V of this Annex. Information concerning the composition of the blend stock shall not be provided to, or obtained by, the monitoring Party.

12. *Procedures at Specific Facilities*: Each Party shall provide and update as appropriate a list of its disposition facilities as their specific locations are determined. The monitoring Party shall have the right to conduct monitoring activities, including inspections and other measures, at disposition facilities. These measures shall provide continuity of knowledge of disposition plutonium and blend stock necessary for the monitoring Party to determine whether the objectives of the Agreement are being met.

13. Pursuant to paragraph 1 of Article X of the Agreement, inspectors shall not have access to any parameters that are United States classified information or Russian Federation state secret information because of their relationship to nuclear weapon design or manufacturing.

14. *Conversion Product*: The blended or unblended plutonium-oxide at the post-processing storage location within a conversion or conversion/blending facility (hereinafter referred to as the "conversion product") shall have no characteristics that are considered classified by the United States of America or state secret by the Russian Federation.

15. The monitoring Party shall have the right to confirm the mass and relevant isotopic composition of the conversion product (even if it contains United States "sensitive" information or Russian Federation "konfidentsial'naya" information), using agreed measurement procedures, without the application of "yes/no" techniques or information barriers.

16. *Design Information*: For the purpose of developing agreed measures pursuant to Section V of this Annex, the Parties shall identify an agreed set of design information to be provided to the monitoring Party for disposition facilities. Once the set of design information is identified, that information shall be provided to the monitoring Party at an agreed time. The monitoring Party shall be allowed access to disposition facilities before operations and thereafter, as necessary to confirm design information, using agreed procedures.

17. *Unexpected Circumstances*: Procedures developed pursuant to Section V of this Annex shall include provisions, including monitoring activities as appropriate, concerning unexpected technical circumstances.

Section III -- Records and Reports

1. Based on its national system of control and accounting, each Party shall periodically submit to the other Party reports that were agreed upon in accordance with Section V of this Annex. Such reports shall at a minimum contain information on the quantity of plutonium at each disposition facility, as well as the quantities of plutonium received or shipped from that facility (including the plutonium in spent plutonium fuel, but not that in other spent fuel).

2. The Parties shall develop agreed methods of recording for disposition plutonium, blend stock, spent plutonium fuel, and immobilized forms, and the formats of reports to the monitoring Party on disposition activities.

Section IV -- General Approach to Confirm Disposition of Disposition Plutonium

1. The monitoring Party shall have the right, using agreed procedures, to confirm that spent plutonium fuel assemblies and immobilized forms meet the criteria specified in the Annex on Technical Specifications.

2. Monitoring rights on spent plutonium fuel and immobilized forms shall include procedures, designed with a view to minimize costs, that will allow confirmation that such fuel and forms remain in their declared locations.

Section V -- Development of Specific Procedures and Administrative Arrangements

1. The Parties shall seek to complete by December 2002 an agreed set of detailed measures, procedures, and administrative arrangements, consistent with the terms of the Agreement (including this Annex), for monitoring and inspections of disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, and disposition facilities. This set of detailed measures, procedures, and administrative arrangements shall be completed in writing prior to beginning construction of industrial-scale disposition facilities in the Russian Federation. The development of these measures, procedures, and administrative arrangements shall be coordinated at an early stage with, and be made compatible with, the design effort for the disposition facilities.

2. Procedures agreed pursuant to paragraph 1 of this Section shall specify, among other things, the rights and responsibilities of the facility personnel and inspectors, types of and content of reports, how measurements are to be done, and how independent conclusions are to be arrived at, including, among other things, appropriate procedures for applying containment and surveillance measures, and technical goals for monitoring, with a view to minimizing costs. These agreed procedures shall include, but not be limited to, measures to:

   a) provide assurance that at all times prior to completion of the disposition of the thirty-four (34) metric tons of disposition plutonium under the Agreement: (i) conversion product resulting from the blending of those thirty-four (34) metric tons with the allowed additional quantity of blend stock under the Agreement is the only plutonium that enters disposition facilities that are fuel fabrication facilities in the United States of America and the Russian Federation; and (ii) all plutonium (including the plutonium in spent plutonium fuel, but not that in other spent fuel) entering or leaving disposition facilities does so in accordance with the Agreement, appropriately taking into account waste, as necessary;

   b) confirm the fulfillment of the criteria specified in the Annex on Technical Specifications; and

   c) allow each Party to distinguish spent plutonium fuel from other spent fuel that may be located in the same storage area.

ANNEX
ON
ASSISTANCE

This Annex to the Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth the agreed procedures and provisions to govern assistance provided by the Government of the United States of America for the activities to be undertaken in the Russian Federation as provided for in Article IX of the Agreement.

Section I -- General Assistance Provisions

1. The steps and estimated funding levels for assistance provided by the Government of the United States of America are set forth in the attachment to this Annex. The estimated allocation in that attachment may be revised and updated as the Executive Agents may agree in writing.

2. All equipment, supplies, materials or other assistance provided under the Agreement shall be delivered to mutually-agreed points of entry, unless otherwise agreed in writing. The provider of such equipment, supplies, materials or other assistance shall notify the recipient of the planned date of arrival and point of entry in advance. The recipient shall take possession of all such equipment, supplies, materials and other assistance upon its arrival at the point of entry, unless otherwise agreed in writing.

3. Title to all equipment and facilities provided under the Agreement to, and accepted by, the Government of the Russian Federation, or entities under its jurisdiction or control, shall pass to the Government of the Russian Federation or entities under its jurisdiction or control unless agreed otherwise in writing by the Parties.

4. Equipment, supplies, materials, services, technology or other assistance provided under the Agreement shall be utilized only in accordance with the terms and purposes of the Agreement.

5. Equipment, supplies, materials, services, technology, or other assistance provided under the Agreement shall not be used for the production of nuclear weapons or any other nuclear explosive device, for research or development, design or testing related to such devices, or for any other military purpose.

6. Equipment, supplies, materials, services, technology, or other assistance provided under the Agreement, or developed with assistance provided under the Agreement, shall not be exported, re-exported, or transferred from the jurisdiction of the recipient without the written consent of the Parties.

7. Prior to the export to a third party of any equipment, supplies, materials, services, technology, or other assistance provided under the Agreement, the Parties by mutual agreement in writing shall define the conditions in accordance with which such items will be exported, re-exported, or transferred from the jurisdiction of the third party.

8. The Government of the Russian Federation notes that the Government of the United States of America intends to seek accreditation, as administrative and technical staff of the Embassy of the United States of America in Moscow, of United States Government personnel present in the territory of the Russian Federation on a regular basis for activities related to assistance provided under the Agreement, and hereby confirms that the Government of the Russian Federation will accredit such personnel. Upon entry into force of the Agreement, the Parties will consult on the overall number of United States Government assistance-related personnel envisioned for activities under the Agreement. Each Party shall treat with due respect the unaccredited personnel of the other Party present on its territory in connection with activities related to assistance under the Agreement and shall take all appropriate measures, consistent with its national law, to prevent any attack on the person, freedom and dignity of such personnel.

9. Each Party shall facilitate the movement of persons and the transfer of currencies as necessary for implementation of the Agreement.

10. Facilities in the Russian Federation that have been constructed or modified using assistance provided under the Agreement shall be used only for mutually-agreed purposes.

11. A Party, its Executive Agent, or other agents authorized to act on behalf of a Party or its Executive Agent, that awards contracts for the acquisition of articles and services, including construction, research and development, licensing, design, or other activities to implement the Agreement, shall select suppliers or contractors in accordance with the laws and regulations of that Party.

12. The Executive Agents shall establish and maintain a register of equipment, supplies, materials, services, technology and other assistance subject to the provisions of this Annex.

Section II -- Liability

1. The Parties shall continue negotiations on liability provisions to apply to all claims that may arise from activities undertaken pursuant to the Agreement and shall seek to conclude an agreement in writing containing such provisions at the earliest practicable date, and, in any event, not later than entry into force of the multilateral agreement referred to in paragraph 8 of Article IX of the Agreement.

2. Until entry into force of the agreement containing liability provisions referred to in paragraph 1 of this Section:

    a) assistance activities under the Agreement shall be limited to appropriate pre-construction design work;

    b) neither Party shall be obligated under the Agreement to construct, modify, or operate disposition facilities, including reactors; and

    c) the Russian Federation shall not utilize in any way the pre-construction design work conducted under the Agreement including for the construction, modification, or operation of disposition facilities (including reactors).

Section III -- Taxation of Assistance

1. The Government of the United States of America, its personnel, contractors and contractors' personnel shall not be liable to pay any tax or similar charge by the Russian Federation or any of its instrumentalities on activities undertaken in accordance with this Agreement. The provisions of this paragraph shall not exempt any contractor's personnel who are nationals of or permanently resident in the Russian Federation, and are present in the Russian Federation in connection with such activities, from income, social security, or any other taxes imposed by the Russian Federation, or by any instrumentalities thereof, regarding income received in connection with the implementation of programs of assistance provided by the Government of the United States of America.

2. The Government of the United States of America, its personnel, contractors, and contractors' personnel may import into, and export out of, the Russian Federation any equipment, supplies, materials or services required to implement this Agreement. Such importation and exportation shall be exempt from any license fees, restrictions, customs duties, taxes or any other charges by the Russian Federation or any of its instrumentalities, but not from the procedures called for by the export control system.

Section IV -- Audits and Examinations

1. Upon request, representatives of the Government of the United States of America shall have the right to examine the use of any equipment, supplies, materials, training or other services provided under the Agreement, if possible at sites of their location or use, and shall have the right to inspect any and all related records or documentation during the period of the Agreement and for three (3) years thereafter.

2. Appropriate arrangements in support of the conducting of audits and examinations shall be developed by the Executive Agents. The right to conduct the audits and examinations set forth in paragraph 1 of this Section shall not be contingent upon the development of these arrangements.

Section V -- Equipment Certification

1. The Executive Agent or designated agent of the Government of the Russian Federation shall examine all equipment, supplies, and other materials in each shipment received pursuant to this Agreement and within ten (10) days of receipt shall provide written confirmation to the Executive Agent of the Government of the United States of America, its designated agent or contractor of acceptance or rejection based on whether the equipment, supplies, or other materials conform to specifications mutually coordinated in advance for said equipment, supplies or other materials. Upon request, one or more representatives of the Government of the United States of America or its designated agent may be present at the examination of the equipment, supplies, materials, or other assistance being delivered. Basic certification procedures shall be agreed in writing by the Executive Agents.

Attachment to Annex on Assistance

Provision of assistance in accordance with paragraph1 of Article IX of the Agreement will begin in calendar year 2000 and will continue thereafter to support disposition of disposition plutonium of the Russian Federation, in accordance with the steps and quantities below. Development of the disposition process will continue to be funded under the Scientific and Technological Cooperation Agreement.

Purpose	Funding Level	Time Frame
Design of Industrial-scale Facilities	Up to U.S.$70 Million	2000-2003
Construction of Industrial-scale Facilities	Up to U.S.$130 Million plus future appropriations including non-U.S. sources	2003-2007
Operation of Industrial-scale Facilities	Future appropriations including non-U.S. sources	2007 and onward

ANNEX
ON
INTELLECTUAL PROPERTY

This Annex to the Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth the procedures governing the protection and allocation of rights to intellectual property transferred or created under the Agreement.

The Parties shall ensure adequate and effective protection of intellectual property created or furnished under this Agreement. The Parties agree to notify one another in a timely fashion of all intellectual property created and results of scientific and technical work obtained under this Agreement and to seek protection for such intellectual property in a timely fashion. Rights to such intellectual property shall be allocated in keeping with the provisions of this Annex.

Section I -- Definitions

1. The term “intellectual property” shall have the meaning found in Article 2 of the Convention Establishing the World Intellectual Property Organization, which was signed in Stockholm on July 14, 1967.

2. The term “participants” shall mean natural persons or legal entities participating in joint activities within the framework of implementation of the Agreement.

3. The term “background intellectual property” shall mean intellectual property created outside the Agreement and belonging to the participants, the use of which is necessary for the implementation of activities under the Agreement.

Section II -- Scope

1. This Annex is applicable to all cooperative activities undertaken pursuant to the Agreement, except as otherwise agreed by the Parties or their Executive Agents.

2. This Annex addresses the allocation of intellectual property rights and takes into consideration the interests of the Parties.

3. Each Party shall ensure that the other Party can obtain the rights to intellectual property allocated in accordance with this Annex. If necessary, each Party shall obtain those rights from its own participants through contracts, license agreements or other legal documents. This Annex does not in any other way alter or prejudice the allocation of rights between a Party and its participants.

4. Disputes concerning intellectual property arising under the Agreement shall be resolved through discussions between the participants, or, if necessary, the Parties or their Executive Agents, which may for these purposes utilize the Joint Consultative Commission. Upon mutual agreement of the Parties or participants, a dispute shall be

submitted to an arbitral tribunal for binding arbitration in accordance with the Agreement and the applicable rules of international law. Unless the Parties or their designees agree otherwise in writing, the arbitration rules of UNCITRAL shall govern.

Section III -- Allocation of Rights

1. Each Party, its Executive Agent or other authorized representative designated by a Party shall be entitled to a nonexclusive, irrevocable, royalty-free license for non-commercial purposes in all countries to translate, reproduce, and publicly distribute scientific and technical journal articles, papers, reports, and books directly resulting from cooperation under this Agreement. All publicly distributed copies of a copyrighted work prepared under this provision shall indicate the names of the authors of the work unless an author explicitly expresses the desire to remain anonymous.

2. Rights to all forms of intellectual property created under the Agreement, other than those rights set forth in paragraph 1 of this Section, shall be allocated as follows:

    a) For intellectual property created during joint research, for example, if the Parties or their participants have agreed in advance on the scope of work, each Party, its Executive Agent or other authorized representative designated by a Party shall be entitled to all rights and interests in its own country. Rights and interests in third countries shall be determined in implementing agreements, taking into consideration the following factors, as appropriate:

        1) the nature of the cooperation,

        2) the contributions of each of the Parties and its participants to the work to be performed, including background intellectual property,

        3) the intentions, capabilities, and obligations of each of the Parties and its participants to provide legal protection of intellectual property created, and

        4) the manner in which the Parties and their participants will provide for the commercialization of intellectual property created, including, where appropriate and possible, joint participation in commercialization.

    In addition, each person named as an inventor or author shall be entitled to receive rewards in accordance with the policies of each Party's participating institution.

    b) Visiting researchers not involved in joint research, for example, scientists visiting primarily in furtherance of their education, shall receive intellectual property rights under arrangements with their host institutions. In addition, each such visiting researcher shall be entitled to receive rewards in accordance with the policies of the host institution.

    c) In the event either Party believes that a particular joint research project under the Agreement will lead, or has led, to the creation or furnishing of intellectual property of a type that is not protected by the applicable laws of the United States of America or the Russian Federation, the Parties shall immediately hold consultations to determine the allocation of the rights to the said intellectual property. Such joint activities shall be suspended during the consultations unless otherwise agreed to by the Parties. If no agreement can be reached within a three-month period from the date of the request for consultations, the Parties shall cease the cooperation under the project in question.

3. Rights to background intellectual property may be transferred by the Parties and their participants through license agreements between individuals and/or legal entities. Such license agreements may reflect the following:

   a) definitions,

   b) identification of intellectual property being licensed and the scope of the license,

   c) royalty rates and other compensation,

   d) requirements for protection of business-confidential information,

   e) requirements to comply with the relevant intellectual property and export control laws of the United States of America and the Russian Federation,

   f) procedures for record keeping and reporting,

   g) procedures for dispute resolution and termination of each agreement, and

   h) other appropriate terms and conditions.

Section IV -- Business-Confidential Information

In the event that information identified in a timely fashion as business-confidential is furnished or created under the Agreement, each Party and its participants shall protect such information in accordance with applicable laws, regulations, and administrative practices. Information may be identified as "business-confidential" if a person having the information may derive an economic benefit from it or may obtain a competitive advantage over those who do not have it, if the information is not generally known or publicly available from other sources, and if the owner has not previously made the information available without imposing in a timely manner an obligation to keep it confidential. Neither Party nor its participants shall publish or transfer to third parties business-confidential information furnished or created under the Agreement without the prior written consent of the other Party or its participants.

JOINT STATEMENT
CONCERNING NON-SEPARATION OF WEAPON-GRADE PLUTONIUM
IN CONNECTION WITH
THE AGREEMENT BETWEEN
THE GOVERNMENT OF THE UNITED STATES OF AMERICA
AND
THE GOVERNMENT OF THE RUSSIAN FEDERATION
CONCERNING THE MANAGEMENT AND DISPOSITION OF PLUTONIUM
DESIGNATED AS NO LONGER REQUIRED FOR DEFENSE PURPOSES AND
RELATED COOPERATION

The Government of the United States of America and the Government of the Russian Federation, hereinafter referred to as the Parties, have already taken significant steps toward ending the production of fissile material for use in nuclear weapons. These steps include the signing of the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors (PPRA) of September 23, 1997, concerning the cessation of the generation of weapon-grade plutonium at United States and Russian plutonium production reactors.

One of the key objectives of the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, is to reduce irreversibly stockpiles of weapon-grade plutonium from each side's nuclear weapons programs. Both Parties recognize that this disposition will require significant resources. Both Parties also recognize that it would make little sense for either side to commit significant financial and other resources to dispose of such plutonium if either side were planning to continue to separate and accumulate new weapon-grade plutonium.

In this light:

- The Parties reaffirm their intentions not to produce any new weapon-grade plutonium, including by reprocessing of spent fuel or by any other technological process, for nuclear weapons or other nuclear explosive devices or for any military purposes.

- The Government of the United States of America also reaffirms its intention not to separate any new weapon-grade plutonium by any means for any other purposes.

- The Government of the Russian Federation also reaffirms its intention not to build up any stockpile of newly separated weapon-grade plutonium for civil purposes and not to produce any newly separated weapon-grade plutonium unless and until justified for civil power production purposes. In the event that spent fuel containing weapon-grade plutonium were to be reprocessed in the future, the Government of the Russian Federation will take all necessary measures to ensure that any such reprocessing and its products are as proliferation-resistant as possible. The Government of the Russian Federation also confirms its intention to ensure that separation of any plutonium through reprocessing or other technological processes will be keyed to the demand in the civil sector, so as to ensure no unnecessary build up of any civil plutonium stockpiles.

- The Parties note that, during the duration of the Agreement, the BN-600 blanket will be removed in stages to achieve its maximum reduction as quickly as possible, consistent with safety considerations, and that all fuel used in that reactor will not be reprocessed during the duration of the Agreement. After termination of the Agreement, any reprocessing of BN-600 spent fuel containing weapon-grade plutonium resulting from irradiation during the duration of the Agreement will be subject to international monitoring under agreed procedures.

- The Parties note their intention to intensify consultations concerning possible cooperation outside the Agreement on immobilization technologies, including immobilization of waste products containing weapon-grade plutonium, to develop alternatives to separation of such plutonium in the Russian Federation.

- The Parties affirm that, if any of these intentions should change in the future, the Parties will consult in advance of such change, for the purpose of reaching new understandings and agreeing on appropriate measures.

The Parties understand the term "reprocessing" to have its internationally agreed definition, that is, the "separation of irradiated nuclear material and fission products," and note that cleaning up existing separated weapon-grade plutonium to remove Am-241, minor alloying elements, or other impurities, does not constitute reprocessing or new production.

The Parties also note that this Joint Statement of intentions does not:

(1) affect the ongoing separation activities related to weapon-grade plutonium for small-scale research and development or clean-up efforts, or efforts to address urgent environmental or safety hazards, involving small numbers of kilograms; or

(2) alter or affect ongoing separation activities related to weapon-grade plutonium generated by the three plutonium production reactors still operating at Seversk and Zheleznogorsk prior to their being converted under the PPRA, provided that all such plutonium is subject to monitoring in accordance with that agreement.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:

____

________________, 2000

FOR THE GOVERNMENT OF THE RUSSIAN FEDERATION:

____

________________, 2000

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Author(s): Boertigter, S.T., Kornreich, D. E., Barkmen, W.

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Los Alamos NATIONAL LABORATORY

Summary of TA-55/PF-4 Upgrade Evaluation For Long-term Pit Manufacturing Capacity

Introduction

The National Nuclear Security Administration (NNSA) is responsible for the stewardship of the United States (U.S.) nuclear weapon stockpile. This accountability includes ensuring the production readiness of the U.S. to maintain that stockpile. The Department of Energy (DOE) has been without the capability to produce war reserve (WR) plutonium pits (the portion of a nuclear weapon that generates the fission energy to drive modern thermonuclear weapons) since the early 1990s. While the Los Alamos National Laboratory (LANL) is in the process of establishing a limited pit production capability (approximately 10 units per year) at the Technical Area 55 plutonium facility (TA-55/PF-4), this manufacturing capacity is insufficient to support the stockpile for the long term. The Departments of Energy and Defense (DoD), as well as Congress, have highlighted the lack of pit production capability as an issue of National Security interest that requires timely resolution. A new facility, known as the Modern Pit Facility (MPF), is proposed to reestablish the Nation's capability to manufacture pits. The key elements of the MPF Mission Need Statement are listed below:

1. A minimum single-shift production rate of 125 pits per year (ppy).

2. The flexibility and agility to produce two pit types simultaneously.

3. The ability to support all pit types in the enduring stockpile.

4. The capability to meet all future pit manufacturing requirements in an environmentally compliant manner.

A process, compliant with the requirements of the National Environmental Policy Act (NEPA), is being followed to make several key decisions related to the MPF. Two of these decisions are whether to build a new pit manufacturing facility and if the first decision is affirmative, where to site it. During this decision process, all reasonable alternatives need to be evaluated. One potential alternative for increasing the nation's pit manufacturing capability is to upgrade the TA-55/PF-4 at LANL to maximize its production capacity in a manner that is compatible with all of this facility's required missions.

A balanced, multi-organizational, multi-disciplinary team was formed in August 2002 to perform a six-month study on whether or not the upgrade of TA-55/PF-4 should be evaluated in the MPF environmental impact statement (MPF-EIS) as a reasonable alternative for meeting the Nation's long-term pit production requirements. This team examined the potential production rates that might be achieved with several upgrade options, estimated the implementation costs, and addressed the advantages and disadvantages of each approach. The outcome of this study was a technical assessment to support a decision on the "reasonableness" of the alternative of relying on an upgraded

TA-55/PF-4 to maintain the security of the nation's nuclear weapon stockpile. The team members included personnel from Kansas City Plant (KCP), LANL, Lawrence Livermore National Laboratory (LLNL), Savannah River Site (SRS), Sandia National Laboratories (SNL), Y-12 National Security Complex (Y-12), and NNSA.

Background

The study team defined three different options, described below, as a means of bounding the assessment. This report covers the underlying assumptions associated with all of the options, their nominal production capacity estimates, estimated implementation costs, and a general discussion of their advantages and disadvantages. It is readily apparent that with the upgrade of an existing facility some reduction in production capacity and agility, as well as infrastructure lifetime, will occur relative to a newly constructed, full-scale Modern Pit Facility. These impacts are discussed for each of the upgrade options.

A TA-55/PF-4 transition approach was developed for each option that incorporated an incremental series of small facility modifications that would be implemented over a period of years. This approach avoided imposing a disruptive, short-term major retrofit operation on the TA-55/PF-4 facility and personnel, and reduced the risk of causing serious disruptions to LANL missions, including the interim production of W88 pits. In addition, the ramping up of the production capability also facilitates the timely incorporation of new equipment and processes as they are demonstrated to be suitable for use in manufacturing plutonium components.

A preliminary analysis was made of the plutonium-related supporting infrastructure that could fit within the available floorspace. Infrastructure requirements, such as waste and residue processing, analytical chemistry resources, and materials characterization operations, were evaluated and addressed to identify differences between the various production options.

Differences between upgrade options and a new baseline facility are discussed with respect to difficult-to-define metrics such as agility. The pit production flowsheet, operation times, expected efficiencies, etc. used in this study are the same as have been used in MPF modeling activities. Additional supporting information was obtained by interviewing nuclear weapons complex (NWC) personnel with experience in special nuclear material (SNM) production operations and facility upgrade projects, as well as by reviewing previous assessments of site reconfiguration options. Manufacturing requirements for non-plutonium components necessary to support pit production, such as metal shell fabrication and mold production operations, were not addressed in this study.

The upgrading of the TA-55/PF-4 facility, as an alternative to the construction of the MPF, implies major strategic tradeoffs. These considerations include issues such as the inherent complications associated with the extended use of an older facility, the possibility of an earlier start-up date of an upgraded TA-55/PF-4 relative to the proposed MPF schedule, and stockpile refurbishment implications associated with a lower production rate than is achievable with the proposed MPF. This report does not directly address these strategic issues, but instead focuses on the reasonable maximum production rate that could be achieved with different TA-55/PF-4 upgrade options.

Objective

The objective of this study was to provide a credible assessment of the costs, issues, impacts, and environmental considerations related to achieving a maximum reasonable pit manufacturing capability at the existing TA-55/PF-4 facility. The specific elements involved in the study are as follows:

1. Provide objective information on upgrade options for LANL plutonium facilities in TA-55 to support an NNSA decision on whether long-term use of an upgraded TA-55/PF-4 is a reasonable alternative to be considered in the MPF NEPA process.

2. If upgrading TA-55/PF-4 is determined not to be a reasonable alternative for detailed evaluation in the MPF NEPA process, document the data used for this determination.

3. If upgrading TA-55/PF-4 is determined to be a reasonable alternative for detailed evaluation in the MPF NEPA process, provide bounding data on the upgrade to support preparation of the MPF EIS.

Study Methodology

The study evaluated several different upgrade options to estimate the maximum number of pits that could be produced within TA-55/PF-4. The manufacturing options range from using only existing floor space available in TA-55/PF-4 for pit production, to shifting non-weapons missions in TA-55/PF-4 to other facilities, and finally, to adding floor space to TA-55/PF-4. The following assumptions were used during the evaluation of each upgrade option.

Assumptions

1. The TA-55/PF-4 manufacturing activities will continue during the upgrade; the facility will not halt pit production operations.

2. All required stockpile certification activities will be preserved.

3. The facility will continue to be operated in compliance with all applicable laws, regulations, DOE Orders, Laboratory requirements and permits, and within the authorization basis.

4. The requisite facility upgrade costs already planned to support existing production commitments at TA-55/PF-4 are presumed to occur as

scheduled. These expenses are not included as a portion of the upgrade costs.

5. Worker radiation exposure guidelines presently in use at TA-55/PF-4 will continue. (The present guideline is a maximum exposure of 2 Rem/yr.)

6. The estimated start date for operations in the upgraded portion of the facility will be as soon as is reasonable, and will be included in the discussion for each of the options.

7. Non-plutonium component fabrication will be supported by other NNSA suppliers and will not be a differentiating factor in the TA-55/PF-4 upgrade options.

8. An adequate supply of non-plutonium parts will be available to support the pit manufacturing operations.

9. Estimates of the "reasonable maximum production rate" will be based upon the production of a single pit type, under nominal 1-shift operating conditions.

10. Sufficient analytical chemistry and materials characterization capability will be available to support activities in the LANL Technical Area-55 complex, and that adequate space will be provided to accommodate this capability.

11. The upgraded facility will not necessarily support production of all weapons systems in the enduring stockpile. Specifically, the B-83 will not be supported in some options.

12. No provision is made to allocate space in TA-55/PF-4 for the present LLNL plutonium activities. This assumption implicitly means that the LLNL Superblock facility would be required to remain open until LLNL no longer requires a plutonium facility capability to support its national security projects.

Table 1 provides a brief summary of the three upgrade cases that were developed for this study. These options incorporate a range of potential scenarios for implementation, schedules, and funding profiles. Option 1 is an upgraded facility that takes advantage of optimized operations and equipment but only produces a minimal impact to the current range of TA-55/PF-4 missions. This option includes the necessary activities required to support all weapons systems within the enduring stockpile except for the B-83. It performs the appropriate equipment and facility upgrades without changing the present TA-55/PF-4 footprint or worker radiation exposure guidelines. Option 2 is based on the same set of conditions except that it allows a limited impact on the currently planned TA-55/PF-4 missions. Specifically, some existing non-weapons missions may be moved elsewhere to provide about 3,000 square feet of additional floor space for pit manufacturing activities. Option 3 describes a case that produces a more significant impact on TA-55/PF-4 beyond what was considered in option 2. This case expands the option 2 criteria to include the construction of a new PF-4 wing and the incorporation of B-83 pit manufacturing activities.

Table 1: Summary of Upgrade Options

Option	Footprint Requirements	Mission Impacts	Weapons Systems
1	No New Floor space	Minimum impact: All existing missions are protected.	Enduring Stockpile less B-83
2	No New Floor space	Limited impact: Stockpile certification mission protected, other missions are shifted, eliminated or reduced.	Enduring Stockpile less B-83
3	Add ~12,000 sq. ft. to TA-55/PF-4	Significant impact: Stockpile certification mission protected, other missions are shifted, eliminated or reduced	Enduring Stockpile

A significant level of detail information on each option was developed and evaluated by the study team. For example, facility layouts, equipment lists, and transition approaches for implementation were developed to establish costs, impacts, projected pit manufacturing capacity, and advantages/disadvantages for each option. Computer models were used to estimate production capacities for various TA-55/PF-4 equipment layouts. Since detailed layout and configuration information on an operating nuclear facility (TA-55/PF-4) is classified as UCNI (unclassified controlled nuclear information) or higher, only summary information of study results is contained in this unclassified document.

Study Results

Table 2 provides summary results associated with an analysis of each option. Option 1 is estimated to be capable of a nominal production capacity of 50 pits per year. As such it falls within the production capacity bounds of the "no action" alternative being evaluated in the MPF EIS and previously evaluated in the Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS). Option 2 makes use of extra space in PF-4 through non-weapon mission consolidation. With an estimated nominal production capacity of 80 pits per year, it does not meet the minimum pit production capacity (125 ppy) needed for long-term support of a stockpile consistent with requirements of the Nuclear Posture Review. While Option 3 is estimated to meet the minimum capacity target, it has a high execution risk.

Table 3: Top-Level Results of Analysis of Upgrade Options

Option	Nominal Single-shift Production Rate (ppy)	Start Date	Implementation Cost (M$)	Agility	Risk	Process Development (PD)
1	~50	2014	~ 500	Limited	Low	Limited, co-located PD Space
2	~80	2016	~700	Improved	Low	Improved, w/ some dedicated PD Space
3	~150	2020	1200-1600	Good	High	Dedicated PD Space, two pit-type operation

The transition plan for increasing the TA-55/PF-4 pit production capability for each of the three options is based on a strategy of doing a steady upgrade activity over an extended period of time. This minimizes the impact on the facility and enables the existing pit manufacturing operations to continue without serious disruption. The actions required to achieve success with Options 1 and 2 are believed to be manageable and therefore relatively low risk. However, the cost required to achieve Option 2 is higher that the cost of Option 1.

Options 2 and 3 offer the advantages of providing a measured approach to increased capacity. Option 2 has the advantage of being less costly than either Option 3 or a new MPF and being on-line sooner (around 2016). Option 3 has the advantage of providing a production capacity that is equivalent to a small MPF. Option 3 also entails a very significant challenge due to the possibility of an unforeseen event during the construction of new floor space that could disrupt both the upgrade and on-going TA-55/PF-4 manufacturing and certification activities. While Option 3 approaches the cost of a small, new MPF, it is judged to entail a high execution risk without the benefits of a fully newly designed and constructed facility.

The following conclusions are applicable to all of the upgrade options:

1. The TA-55/PF-4 facility will be approximately 40 years old when the planned upgrade capacity is achieved. Although significant facility upgrades are planned for, meeting future nuclear facility safety and operating requirements over an additional 50 years is uncertain without significant and currently unspecified, long-term financial commitments.

2. The TA-55/PF-4 facility was designed for plutonium research and development. For example, pit manufacturing equipment is not on grade in TA-55/PF-4 as would be preferred for a production plant. The additional floor space required for

an increased production mission will reduce the ability of the facility to support potential future plutonium research and stockpile support missions as well as the development of pit manufacturing technology.

3. The physical constraints of the existing facility limit the upgrade options, increase the cost of needed improvements (material handling, storage, ventilation, shielding, and power) and inhibit the introduction of improved manufacturing technologies. These constraints also reduce the opportunities for inclusion of new facility design approaches that can enhance production efficiency, reduce worker radiation exposures, and minimize safety and security risks.

4. Major modifications to an operational nuclear facility increase the risk of significant safety, contamination, or safeguards and security events during the transition period. While manageable, this increased risk is not realized with a new MPF.

5. The analyses for each upgrade option assumed external support for Analytical Chemistry operations (CMR or CMR-R) and the continued operation of existing facilities (Superblock).

Summary

Option 1 provides a nominal 50 pits per year production rate with relatively minimal impact to the current missions in TA-55/PF-4. However, this provides no greater pit manufacturing capacity than the “no action” alternative in the MPF EIS.

Option 2, provides a nominal manufacturing capacity of 80 pits per year. However, this option does not have the potential to reach the minimum production capacity (125 pits per year) or agility required by the current mission need for a long-term pit manufacturing facility. This option may be considered a reasonable EIS alternative to a new MPF since it could support the stockpile should substantial reductions in pit production requirements arise.

Option 3 requires construction of additional floor space in TA-55/PF-4 and has the hypothetical potential to achieve a capacity of approximately 150 pits per year. However, there is a high risk that Option 3 will not meet capacity, cost, or schedule projections. There is uncertainty that significant construction additions might affect the assumptions and regulatory framework for the facility that were originally established at the time of initial construction. In addition, the cost of Option 3 approaches estimates for a new facility that has much greater performance potential and would not be nearly 40 years old at the start of long-term pit production.

As a result of consideration of the summary information developed by the multi-disciplinary team, the NNSA Pit Project Office selected Option 2 as a reasonable alternative to be considered in the MPF-EIS. Option 1 was considered as bounded by the

No Action alternative. Option 3 was not considered reasonable. Subsequent to selection of Option 2 as a reasonable alternative to be considered, study team contributors assembled data on this TA-55/PF-4 upgrade option for inclusion in the MPF-EIS.

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DRAFT

Plutonium Aging: Implications for Pit Lifetimes

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Executive Summary

Planning for future refurbishment and manufacturing needs in the US nuclear weapons complex critically depends on credible estimates for component lifetimes. One of the key variables in planning both the size and schedule for the proposed Modern Pit Facility (MPF) is the estimated lifetime for stockpile pits, defined as the age at which a pit can no longer be certified to meet the military characteristics. In this report, we will describe the status of our understanding of pit aging, provide our current assessment of pit lifetimes, and describe in some detail the methodology we are using to improve this assessment over the next few years. At a high level, our lifetime assessment methodology is based on an evaluation of all potential aging mechanisms. The test matrix is a series of plutonium alloys ranging in age from newly processed reference alloys to old Pu taken from approximately 40 year old retired pits. Extensive experimental data obtained from these materials over the last three years, derived from microstructural characterization and property measurements, are applied to evaluate any age-related changes. Then, age-dependent, predictive models are developed based on experimental data. The predicted changes in properties are then inserted into design sensitivity calculations in order to quantify the effect of that specific property change on the performance and margin of a specific weapon system.

To date, only minor age induced changes have been observed and there is no direct evidence that these affect pit performance, reliability, and safety. The response of each system to potential changes is specific to each particular design. The current estimate of the minimum age for replacement of pits is between 45 and 60 years. This is based on observations of pit and plutonium aging taken from pits up to 42 years old and conservative extrapolation of this data combined with system-specific design sensitivity analysis. Additional data and analysis coupled with further design sensitivity studies are needed to refine our estimates of minimum lifetimes for each system. It is possible these studies may show that certain systems exhibit lifetimes shorter than the stated 45 years or longer than 60. In the most conservative case that lifetimes are found to be less than 45 years of age, mitigation methods currently exist to extend these lifetimes to a 45-year minimum. At the end of FY03 the Enhanced Surveillance Campaign has a key milestone to provide a pit lifetime assessment based on old pit data. In FY06, we will deliver a pit lifetime estimate based on old pit data and the accelerated aging program. Further experiments, modeling, and design sensitivity calculations on different weapon systems are required to gain greater confidence and reduce uncertainties in our lifetime estimates.

Background

Pits for nuclear weapons have been manufactured by the United States for nearly 60 years. Systematic aging studies on pits were initiated only a few years ago after the loss of the Rocky Flats manufacturing capability. During the past 60 years, designs, materials, and processes have changed dramatically. Throughout this history, refinements have been introduced such that pits of modern design are more robust, safer, and suited for longer storage times. Modern pits consist of hollow, metallic shells containing fissile material at their core. The outer, non-nuclear materials used in pits are selected for properties such as mechanical robustness and integrity as well as corrosion resistance. In practice, these materials remain remarkably pristine over decades. Further, modern designs rely on the boost process – the presence of deuterium/tritium mixtures into the interior – as an essential element of weapon function. Hence, the integrity of pits as gas-pressure vessels is another important element of weapon function. In this respect as well, the surveillance program has proven that pits are demonstrably robust over decades. Given this positive history with the non-nuclear materials in pits, most concerns with pit aging focus on the behavior and possible degradation of the plutonium.

Evaluation of the Aging Process

The approach used to address the aging of pits starts with an identification of the key plutonium properties required to ensure safe and reliable weapon function. These properties (such as density) are selected by knowledgeable design physicists who will ultimately use them in computer simulations as part of the certification process of a given weapon. This process is quite complicated because for years designers relied largely on testing the devices at the Nevada Test Site (NTS) to assess performance. Although a substantial amount of work has been done to relate performance to specific materials properties, our understanding is incomplete. We are in the process of developing a better fundamental understanding as to how key properties influence weapons performance using advanced tools such as improved codes. Once these properties have been identified, diagnostic tools are developed to measure them with sufficient precision as determined by the weapon designer. An important aspect of the aging program is the execution of experiments to measure baseline properties of new (zero-aged) material.[1]

Next, materials scientists and chemists identify the aging mechanisms that could potentially alter these properties over time. The three most important potential aging effects in plutonium are the radioactive decay of the various plutonium isotopes (and the impact of this decay on the chemistry, structure, and properties of the material), the thermodynamic phase stability of the plutonium alloy, and the corrosion of the plutonium during both storage and function. In many cases, these aging effects accumulate slowly over decades, and not necessarily in a linear fashion. Only when key properties have sufficiently changed would we anticipate a measurable impact on weapon safety or performance. Through the process of experiments, model development of the age-related changes, and design sensitivity studies, the weapon designers attempt to specify the limits of acceptable change for each of these properties by evaluation of the margins associated with each system. By combining these limits with the measured or predicted rates of change due to aging effects, we will derive estimates for pit lifetimes.

Each of the three, principal aging mechanisms identified above is under intensive examination within the National Nuclear Security Administration's (NNSA's) Enhanced Surveillance Campaign. This program has four key elements/objectives: 1) measurement of actual properties and trends from the newest to the oldest materials available from the stockpile; 2) acceleration of the aging where possible and subsequent measurement of material properties; 3) modeling of aging effects for insertion into design sensitivity analyses; and 4) the development of new diagnostics to identify the signatures of aging as early as possible in order to provide lead time for refurbishment. In parallel, the Primary Certification Campaign in concert with ASC are developing the computational tools required to address design sensitivity, acquiring the test data (e.g., sub-crits) to quantify key parameters, and the expertise to complete the design sensitivity assessment.

In the following sections, we will describe our current understanding of the three principal aging mechanisms: radiation damage and the application of the accelerated aging methodology, phase stability, and corrosion. Then we will describe our efforts to reduce uncertainties and our current lifetime assessment.

Damage Mechanisms and Applicability to Evaluation of Old Pits

The oldest plutonium made in the United States and available for analysis is approximately 40 years of age. This plutonium was manufactured by processes slightly different from the materials in the enduring stockpile. As a result, a direct comparison of this oldest plutonium to modern alloys may invoke uncertainty, but has provided substantial insight to the aging behavior. Extensive, but incomplete evaluations of this material over the past three years have shown only modest changes in key properties. Nonetheless, these small changes are invaluable in helping to calibrate and refine our aging models. Our experience with this oldest plutonium has been crucial in another respect: we have yet to observe the onset of void-swelling, one of the potentially most troublesome manifestations of self-irradiation damage.

A fundamental aspect in the accumulation of radiation damage in materials is the existence of a threshold beyond which further damage results in rapid swelling and density decrease. Experience from all materials in reactor environments of similar crystal structure to the plutonium alloys in the stockpile shows that the damage results initially in little change in density, but after an "incubation period", void swelling begins. This void swelling can result in volumetric increases of about 1% per decade. The length of this incubation is unknown for weapon grade plutonium and presently cannot be predicted.

The principal decay mechanism for most plutonium isotopes is alpha-particle decay. The parent atom spontaneously decays into a doubly charged helium nucleus (i.e., alpha particle) and a uranium atom. Both of these particles are highly energetic. This initial decay event is rapid and results in considerable, local disruption of the crystalline lattice. Based on theoretical considerations, this single decay energizes roughly 20,000 other atoms and displaces approximately 2400 atoms from their lattice sites. Within the first 200 nanoseconds, about 90% of these displaced atoms return to a normal lattice position. The remaining 10% of these atoms are retained in the lattice, where an atom now sits between regular positions on the lattice (known as an interstitial) and leaving the regular lattice positions empty (known as a vacancy).[2] The ultimate disposition of these more permanent defects is the principal concern in our evaluation. This accumulation of damage is significant within the time frames of interest: on average, each atom of plutonium has been displaced once every 10 years.

We have developed and deployed a number of advanced diagnostics to obtain data of early evidence of age-related changes. One of these, positron annihilation spectroscopy has recently provided data that indicates the newly formed helium atom immediately fills an unfilled vacancy. These helium filled vacancies have the potential to migrate in the lattice, eventually coalescing as small helium bubbles. This may result in a modest swelling of the material as well as changes in the mechanical properties of the plutonium. These changes can now be estimated with computer simulations supplied with age-dependent experimental data provided by another newly developed diagnostic technique, near atomic resolution transmission electron microscopy. It is found that the helium-induced changes are very small, and if they continue to increase at the predicted rate, will not affect weapons performance for pits in excess of 60 years of age. However, the vacancies also have the potential to migrate and accumulate into voids, the phenomenon of void swelling discussed above. These mechanisms are not necessarily independent: helium likely stabilizes the voids and assists in the accumulation of a critical number of these defects, which defines the incubation period for void swelling. Modeling of these processes requires detailed knowledge of the structure of the lattice and the energy required to nucleate and move these various defects within the crystal structure. These energies are derived from knowledge of the electronic structure of both individual plutonium atoms and the metallic bonds that form between them. The great complexity of interatomic bonding in plutonium has made this a particularly difficult problem to address. Although void swelling models do indeed exist for reactor materials, our best models for plutonium are still incomplete as they lack crucial materials parameters, which cannot easily be measured or computed from fundamental theories for plutonium. Although progress is being made, ultimately, experimental data will be necessary to establish confidence in these models and to reduce the uncertainty in their estimates.

A significant number of macroscopic measurements (such as density), microstructural measurements (optical microscopy, scanning electron microscopy, electron microprobe, transmission electron microscopy, positron annihilation spectroscopy, extended x-ray absorption fine structure, and resonant ultrasound spectroscopy), and dynamic property measurements have shown rather small or nonexistent changes over a period of time of 30 to 40 years. However, additional measurements coupled to model development and design sensitivity calculations are essential to extend these data to longer time frames and to reduce the uncertainty in margin. This estimation requires considerable expertise in the modeling of aging effects in solid-state materials, particularly in the discipline of radiation damage modeling. It is largely the uncertainties in these models that drive uncertainties in the minimum estimates for pit lifetimes.

Accelerated Aging Methodology

The need for fundamental aging data helps to drive the second objective of the Enhanced Surveillance Campaign's technical element on pits: the accelerated aging of plutonium. The process of alpha decay within plutonium can be accelerated by the addition of isotopes with shorter half-lives. An alloy of normal weapon-grade plutonium mixed with 7.5% of the Pu-238 isotope will accumulate radiation damage at a rate 16 times faster than weapon-grade material alone. This is a useful tool to evaluate extended-aged plutonium (up to 60-years equivalent and possibly beyond) within a few years. Critically, acceleration of the input of radiation damage must be matched by acceleration of the subsequent annealing and diffusion of that damage. We accomplish this subsequent acceleration by raising the temperature at which the samples are stored. These processes are thermal in nature, and the activation energy (a term which describes the energy required to activate a process) is different for each specific mechanism. Unfortunately, there is no single temperature at which the thermal diffusion of this damage will be equivalently and perfectly matched to the initial acceleration of the damage input. As a result, the accelerated aging experiments are carried out at three different temperatures.

Thus, the accelerated aging method is only approximate and not a perfect match to the actual aging of materials in the stockpile. Hence, we focus a large portion of the accelerated aging work on comparing the accelerated-aged material with actual-aged plutonium in an effort to calibrate the technique and build confidence that our estimates (for things like storage temperature) are accurate. Nonetheless, findings from the accelerated aging program are essential in order to gather experimental data for key mechanisms such as void swelling and its associated incubation period. Even if the process isn't perfectly replicated, our models are sufficiently sophisticated to use data from the accelerated aging program to refine estimates of the incubation period and rate of void swelling for weapons-grade material.

Thermodynamic Stability of Plutonium Alloys

A secondary concern is the thermodynamic phase stability of the δ-Pu alloy. The δ-phase in unalloyed plutonium is stable between about 310°C and 415°C but can be "stabilized" to room temperature by the addition of small quantities of alloying agents such as aluminum or gallium. The δ-phase alloy is a ductile, copper-like material that is easily fabricated and is thus preferred for weapon use. Plutonium/gallium alloys have been widely studied since the earliest days of the Manhattan Project and have shown that the δ-phase plutonium alloy is metastable, similar to steels in that it will not transform to thermodynamically stable phases in the time frame of thousands of years.[3] However, upon cooling to very low temperatures, the δ-plutonium will partially transform to α-plutonium, a phase that is 20% more dense than the δ-Pu. There has been no evidence of this phase transformation occurring in weapon material, but the severity of the transformation warrants detailed investigation.

A third advanced diagnostic technique has recently been applied to probe the plutonium alloys for early evidence of age-related changes. X-ray absorption spectroscopy is a technique that is ideally suited for determination of the local atomic environment of the major atoms (Pu) and the alloying atoms (Ga). In newly prepared δ-Pu alloys for example, x-ray absorption measurements reveal evidence for a second arrangement of atoms, or a minor amount of a second crystalline structure where there is a deficiency of Ga atoms. This second phase material disappears rapidly with age, and this discovery prompted Jeanloz to observe that the crystallinity of δ-plutonium actually increases with age.[4] More detailed study, using high resolution x-ray absorption and x-ray diffraction reveal that the main δ-phase retains good long-range order for ages exceeding 40 years, but that asymmetry in certain diffraction peaks is also growing in with age, presumably due to accumulated irradiation damage.

The influence of the radiation-damage processes (discussed previously) on phase stability is still unknown and therefore continues to represent an uncertainty in our evaluation of plutonium aging.

Corrosion of Plutonium Alloys

Finally, corrosion of plutonium is potentially the most catastrophic of all aging effects.[5] Fortunately, corrosion is both limited by the availability of corrosive agents and relatively easily studied. Whereas plutonium will readily oxidize given sufficient exposure to air or other oxidizing environments, it is hydrogen-catalyzed corrosion that is of greatest concern. Most importantly from a pit aging perspective is the maintenance of well-sealed pits and the exclusion of foreign contaminants during pit production. The employment and insurance of robust cleaning methods during the final stages of pit manufacture are essential. Experience from stockpile surveillance programs reflects this point: pits have remained remarkably pristine and free of corrosion, especially since the adoption of modern cleaning and sealing methods.

Reducing the Uncertainties

The current program is aimed at quantifying the margins and uncertainties and improving our fundamental understanding in order to increase our confidence in the lifetime assessment. The methodology for this is based on design sensitivity analyses. Extensive experiments are conducted on new and aged material. Age-dependent models are then developed based on the experimental data, science-based computational methods and models, and conservative assumptions. These models are then inserted into the design codes to calculate the change in performance based on the predicted change in properties. The sensitivity calculations to date have indicated no performance impacts of aging under the most pessimistic assumptions. However, it must be noted that these calculations have been conducted on only one system and are not comprehensive. We expect there to be system-by-system variations in sensitivity to aging parameters as a function of design considerations.

To provide crucial data for the design sensitivity analysis and aid in focusing our efforts, extensive measurements of stockpile-aged plutonium are continuing. The assessment presented here will be thoroughly documented and reviewed (by internal and external reviewers), and lifetimes will be updated with data from old pit examinations, at the end of FY03. A series of additional experiments and measurements will occur between now and 2006. These include the conduct of various dynamic experiments (gas guns, laser shock experiments, Kolsky bar measurements, U1a experiments, etc.) to supplement our existing database as well as the careful, in-situ examination of the accelerated aged alloys (via dilatometry, resonant ultrasound spectroscopy, electron microprobe analysis, transmission electron microscopy, positron annihilation spectroscopy, and other techniques). All of this data serve the common goal of trending changes in key properties and understanding the evolution of micro-scale processes (ingrowth of decay product, buildup of radiation damage) that affect macro-properties of the material (density, mechanical properties, etc.).

Assessment of the Minimum Pit Lifetime

On the basis of careful evaluation of the effects described above through extensive characterization of old pits, modeling, and preliminary design sensitivity calculations (as well as a few other, less-prominent concerns), an initial assessment of minimum pit lifetimes has been derived. Evaluation of the oldest samples of plutonium metal, both metal of oldest absolute age (40 years) as well as the oldest samples most directly comparable to the enduring stockpile (25 years) have shown predictably stable behavior. The many properties that have been measured to date, such as density and mechanical properties have shown only small changes and detailed microstructural studies have been correlated to these changes in properties. The response of each system to potential changes is specific to each particular design. Based on this assessment, current estimates of the minimum age for replacement of pits is between 45 and 60 years. Additional data and analysis coupled with further design sensitivity studies are needed to refine our estimates of minimum lifetimes for each system. It is possible these studies may show that certain systems exhibit lifetimes shorter than the stated 45 years or longer than 60. In the most conservative case that lifetimes are found to be less than 45 years of age, mitigation methods currently exist to extend these lifetimes to a 45-year minimum.

The principal uncertainty in this assessment relates to the incubation periods inherent in radiation damage effects. Certain key variables in these models (such as the energy of defects and the nature of plutonium bonds) are still uncertain enough that future estimates will require benchmarking against more extensively aged samples and data. Additional uncertainty arises from the intrinsic scatter in much of the experimental data (necessitating a statistically-based analysis of much of this information) as well as uncertainties on the influence of certain changes on weapon performance. In our design sensitivity studies, we mitigate some of these uncertainties by applying pessimistic assumptions to our models. Thus, our bounding calculations are a valid tool for assessments of this type. In some specific circumstances, pit performance may be found to be extremely sensitive to slight changes in certain properties, more sensitive than current diagnostics can reliably detect. In this case, careful review of data combined with modeling can provide an estimate of change which is useful to designers in establishing acceptable limits. Continuing research is necessary and will strengthen the linkage between the plutonium microstructure and changes resulting from aging, key properties, and weapons performance as determined by prior nuclear tests.

Pit Aging Milestones for the Enhanced Surveillance Campaign

NNSA, through the Enhanced Surveillance Campaign, has a formal program to acquire this data and assess it on a time scale relevant to upcoming decisions such as the Modern Pit Facility. Several key milestones occur from now until 2006. At the end of FY03, we will provide a pit lifetime assessment based on old pit data. For the accelerated aging component of this assessment, we have successfully completed the milestone to produce the accelerated aging alloys at both LANL and LLNL. This material will be validated at both zero-age and against the oldest stockpile samples in the next two years. The comparison of baseline properties of this material to zero-age control samples will be substantially completed as of early 2003. By early 2006, these samples will have reached an equivalent age of 60 years, and measurements of their properties (and comparison to aging models) form a key milestone in our estimate of pit lifetimes.

Summary

We have made substantial progress in the past few years in our fundamental understanding of some of the age-related changes in plutonium. The theoretical, modeling, and experimental components are now in place to make significant progress over the next few years in order to quantify the margins and uncertainties.
We are encouraged that measurements to date have not shown any significant degradation of pits over approximately 40 years. The changes observed to date have been quite small, giving both LANL and LLNL investigators reasonable confidence in the 45 year minimum lifetime estimate based on the data collected to date, though further design sensitivity studies may show a shorter lifetime than 45 years for some systems and longer than 60 years for others. In the case that pit lifetimes are found to be less than 45 years using highly conservative assumptions, mitigation methods are available to extend these

systems back to a 45-year minimum life. Further experiments, modeling, and design sensitivity calculations on different weapon systems are required to gain greater confidence and reduce uncertainties in these estimates.

(For further information on the detailed aging processes in plutonium and the unique nature of this material in general, see "Challenges in Plutonium Science", volume 26 of *Los Alamos Science*, N. Cooper, ed (2000), "Plutonium Aging: from Mystery to Enigma", S.S. Hecker and J.C. Martz, proceedings of the Oxford Conference on Ageing Studies and Lifetime Extension of Materials (1999), or *MRS Bulletin*, "Challenges in Plutonium and Actinide Materials Science," L.J. Terminello, ed Volume 26, No. 9, September, 2001.

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[1] An example of these important measurements includes the series of subcritical tests at the U1a facility at the Nevada Test Site. These measurements help to describe the equation-of-state and other dynamic properties of plutonium.

[2] An interstitial/vacancy pair is known collectively as a "Frenkel pair". Calculations show that each Pu decay results in the generation of roughly 2200 Frenkel pairs – 2000 from the uranium recoil and 200 from the alpha particle itself. A more extensive account of radiation damage in plutonium is given by W.G. Wolfer, *Los Alamos Science* 26, Vol. 1, p. 274.

[3] S.S. Hecker and L.F. Timofeeva, *Los Alamos Science*, 26, Vol 1., p. 244.

[4] R. Jeanloz, "Science-Based Stockpile Stewardship", *Physics Today*, December 2000.

[5] J.M.Hashcke and J.C.Martz, "Plutonium Storage", in the Encyclopedia of Environmental Analysis and Remediation, John Wiley and Sons, 1999.

APPENDIX H

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE *SUPPLEMENT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT ON STOCKPILE STEWARDSHIP AND MANAGEMENT FOR A MODERN PIT FACILITY*

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 8026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)." 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal).

(a) ✓ Offeror and any proposed subcontractor have no financial or other interest in the outcome of the project.

(b) _____ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

1.

2.

3.

Certified by:

Thomas Magette [signature]

Signature

Thomas E. Magette, Vice President

Printed Name and Title

Tetra Tech, Inc.

Company

5.15.03

Date